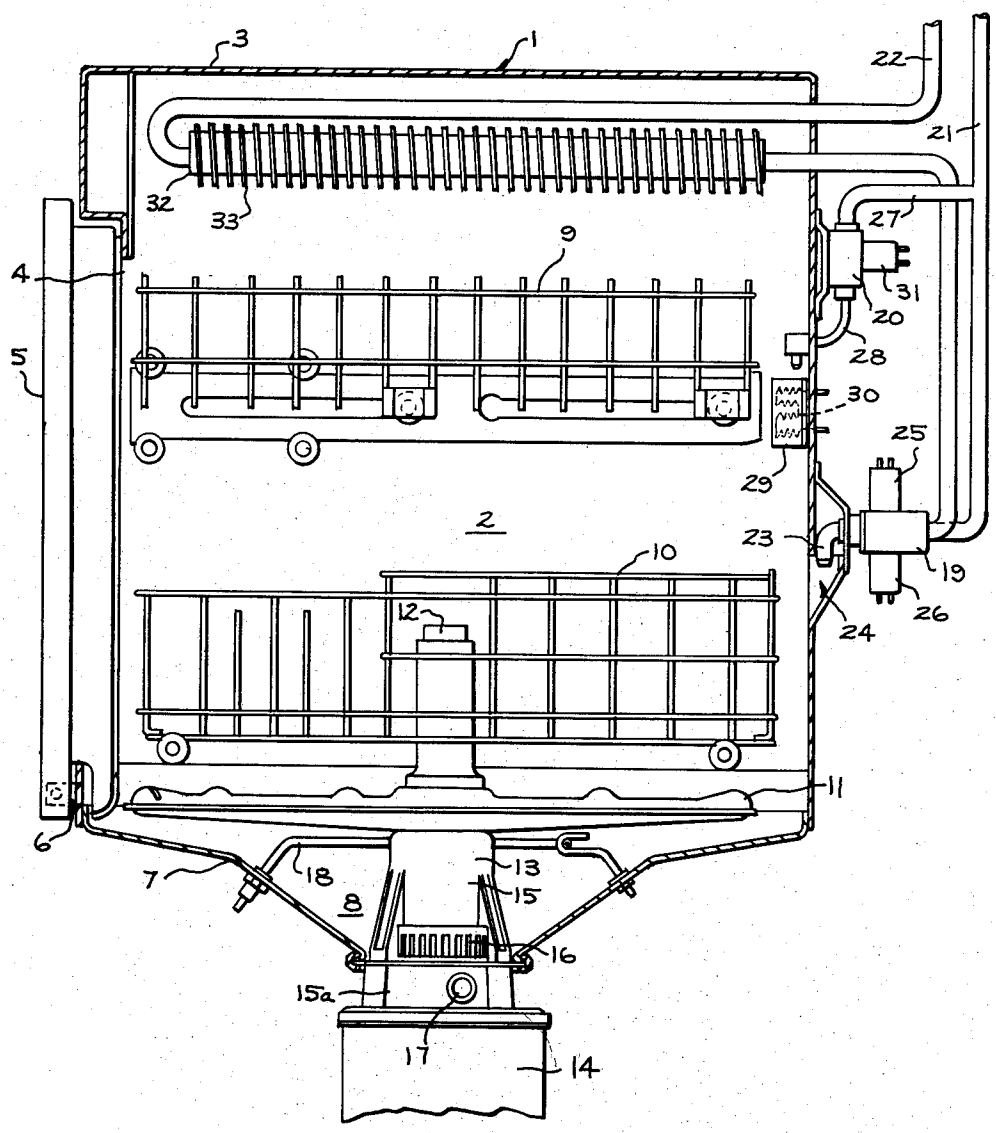
June 1, 1965 H. STERN 3,186,418

APPARATUS FOR MINIMIZING SPOTS ON ARTICLES WASHED IN AUTOMATIC DISHWASHERS

Filed Oct. 14, 1963 2 Sheets-Sheet 1

FIG. 1



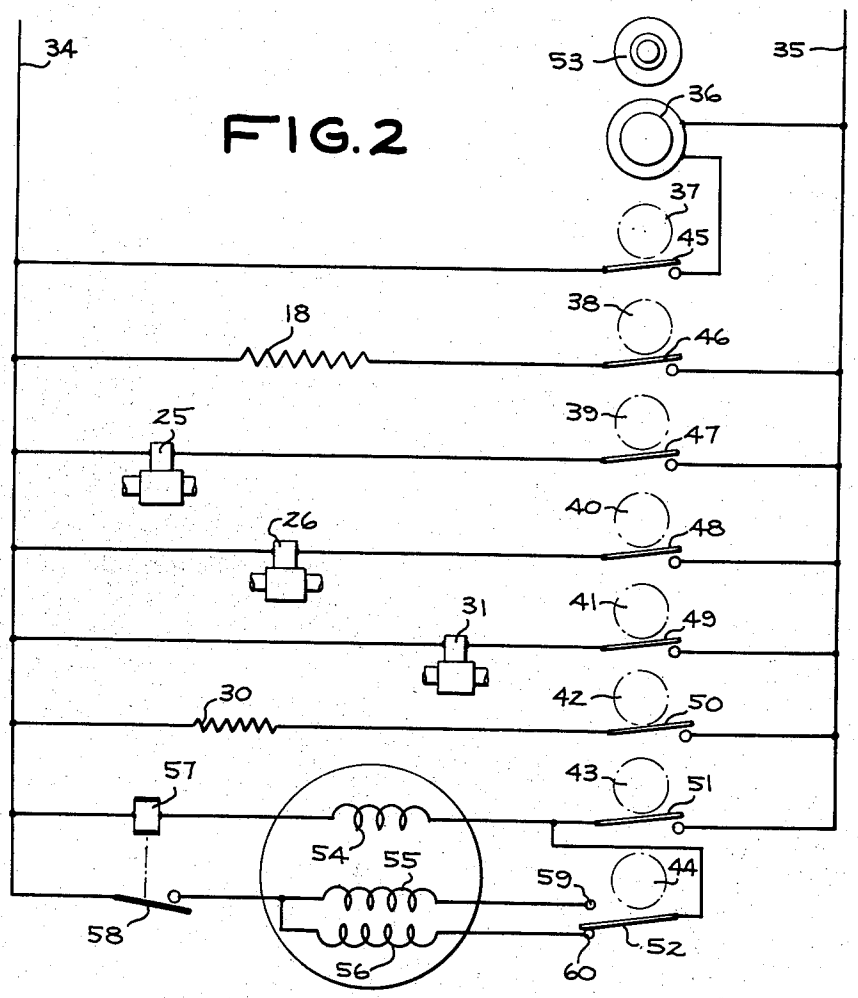
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FIG. 2



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3,186,418

APPARATUS FOR MINIMIZING SPOTS ON ARTICLES WASHED IN AUTOMATIC DISHWASHERS

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This invention relates to apparatus for washing dishes and, more particularly, to an improved apparatus for washing dishes which minimize the formation of mineral deposits on the surface of the articles washed.

Dishwashing machines have met with considerable success in recent years; however, when used in areas in which the water supply constitutes what is commonly known as hard water, they have resulted in a spotting effect on the articles cleaned, caused by the deposit of minerals on the surface of the articles as the articles are dried at the end of the washing operation. It is possible to alleviate the problem by incorporating water softening mechanism in the water supply lines to the dishwashing machine; however, the water softening mechanisms and the chemicals used therein are rather expensive and, therefore, add substantially to the cost of operation of the dishwasher. Some dishwashers have been developed which attempt to solve the problem by collecting a portion of the final rinse water and vaporizing it in order to dilute the water coating the articles which have been washed and thereby reduce the amount of mineral spotting. These have not been completely successful in that they have not been able to condense enough water vapor on the surface of the articles washed to do a satisfactory job of diluting the mineral bearing water.

Therefore, an object of this invention is to provide apparatus for minimizing mineral spots on dishes or the like washed in automatic dishwashers.

Further objects and advantages of this invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In carrying out my invention, in one embodiment thereof, the dishes or other articles to be washed are placed in supporting racks in the dishwasher. The dishes are first subjected to a normal dishwashing operation which might include a pre-rinse step, a washing step, and a rinsing step, the fluid used in each step being drained from the machine at the conclusion of that step. In normal operation, washing machines utilize hot water for all of these steps in order to insure proper cleaning and rinsing of the dishes. With this invention the last hot rinse is followed by spraying cold tap water over the dishes in order to cool them. Then water is introduced into the machine and heated to form water vapor which is free of minerals and the water vapor flows around and condenses on the articles. Since the articles have been cooled, a substantial amount of vapor condenses on them. A condenser is positioned above the supporting rack and water vapor condenses on it and then drips off of the condenser onto the top of the articles to aid in the diluting of the water which remained on the dishes at the end of the cold rinse. Finally the dishes are dried by the application of heat; however, since the mineral bearing water which coated the dishes at the end of the cold rinse has been greatly diluted, the drying of the dishes and its attendant evaporation of the water thereon will not cause mineral spotting of the dishes.

It will be understood that the word "dilute" is used in a broad sense and includes both washing mineral-bearing water from the surface of the articles by the condensed water vapor and commingling mineral-bearing water with

pure condensed water vapor. The combination of these two actions reduces the mineral content of the water on the articles to a level such that no spots will be formed when the water evaporates. This water is not necessarily completely free of minerals; however, the mineral content is so low that when articles coated with it are dried the mineral deposit is isolated invisible particles rather than in concentrations giving rise to unsightly spots.

For a better understanding of this invention, reference may be had to the accompanying drawings in which:

FIGURE 1 is a schematic side elevational view of a dishwashing machine, the view being partially in section to illustrate details; and

FIGURE 2 is a schematic electrical diagram showing the control system for the dishwasher of FIGURE 1.

Referring now to FIGURE 1, there is shown an automatic dishwasher **1** having a dishwashing compartment **2** formed by a tub **3** with a front opening **4** adapted to be closed by a cover **5** which is mounted at the bottom of the opening by hinge assembly **6**. The bottom of tub **3** has a downwardly sloped portion **7** forming a sump **8** at the center thereof. An outer appearance cabinet may be provided; however, it has been omitted for purposes of illustration.

Within the compartment **2** there is provided a number of dish-supporting members, such as an upper rack **9** and a lower rack **10**, to support dishes and other eating or cooking utensils. Dishwasher **1** incorporates suitable washing means which, in this case, are embodied in a rotatable water-ejecting member **11** positioned below rack **10** together with a telescoping member **12** positioned at the center of member **11**. Under water pressure, member **12** rises somewhat and is provided with apertures in its top so as to eject water with substantial force against dishes in the upper rack **9**. At the same time, member **11** rotates under the force of the water and ejects that water against the dishes in both racks.

Water-ejecting member **11** and telescoping member **12** form a part of an assembly **13** which further includes a motor **14**. Motor **14** operates pumping assemblies **15** and **15***a* which receive water through an inlet **16** at the very bottom of sump **8**. The motor is of the type which, when rotated in one direction, causes pumping assembly **15** to force liquid up through members **11** and **12**, and when reversed causes pumping assembly **15***a* to discharge the liquid to a drain (not shown) through outlet **17**.

In addition, for drying the dishes after they have been cleansed, a suitable electrical heating element **18** is provided in the conventional manner. Heating element **18** as well as motor **14** and a water inlet valve **19** will normally be under control of a sequence control assembly (not shown in FIGURE 1).

Water is provided to the dishwasher **1** by means of a hot water conduit **21** and a cold water conduit **22**, both of which are connected to valve **19**. Valve **19** is provided with an outlet conduit **23** which extends into a recess **24** in tub **3**. Therefore, water which passes through valve **19** flows into tub **3** and passes downwardly into the sump **8** from which pumping assembly **15** may pump it through water-ejecting member **11** and telescoping member **12** in order to wash and rinse articles placed in racks **9** and **10**.

Valve **19** is of the three-way type and is controlled by solenoids **25** and **26**. When solenoid **25** is activated, valve **19** will pass cold water whereas when solenoid **26** is activated, valve **19** will pass hot water. If both solenoids **25** and **26** are activated a mixture of hot and cold water will be provided to the dishwasher and if both solenoids **25** and **26** are deactivated valve **19** will be completely closed and no water will pass therethrough into tub **3**. Hot water conduit **21** is provided with a branch conduit **27** which communicates with valve **20**. The other side of

valve 20 is connected to an outlet conduit 28 which extends into tub 3 and directs water passing through valve 20 into a vaporizer 29. Vaporizer 29 includes an electric heating element 30 which functions to vaporize water introduced into vaporizer 29. Valve 20 is controlled by solenoid 31 so that when solenoid 31 is activated, water from conduit 21 will pass through conduit 27, valve 20 and outlet conduit 28 into vaporizer 29 where it will be heated by electric heating element 30 to form water vapor. When solenoid 31 is deactivated no water will be supplied to vaporizer 29.

Referring now to FIGURE 2, there is shown a control circuit including one embodiment of this invention. It will be understood that, besides the components specifically shown, other electrically-controlled components of the machine, such as suitable indicating lights and detergents and rinse agent dispensers will often be controlled electrically. These other components have been omitted from FIGURE 2 in order to show clearly this invention without additional confusing details which do not form a part thereof.

The circuit is energized through a pair of supply conductors 34 and 35 which are connected across a suitable source of power (not shown), such as the conventional 110-volt, 60-cycle source generally available. Connected across conductors 34 and 35 is a timer motor 36. As shown schematically in FIGURE 2, timer motor 36 forms part of a sequence control assembly including a plurality of cams 37, 38, 39, 40, 41, 42, 43 and 44 in controlling relationship to switches 45, 46, 47, 48, 49, 50, 51, and 52 respectively. In addition, the assembly will normally include a manual control member 53 for beginning or interrupting the operation of the control assembly. Switch 45 is in series with timer motor 36 across the conductors 34 and 35 so as to energize timer motor 36 when switch 45 is closed and de-energize timer motor 36 when switch 45 is opened. Similarly, heating element 18 is connected across conductors 34 and 35 in series with switch 46; solenoid 25 is connected in series with switch 47; solenoid 26 is connected in series with switch 48; solenoid 31 is connected in series with switch 49, and heating element 30 is connected in series with switch 50.

Motor 14 includes a main winding 54 and a pair of start windings 55 and 56. When main winding 54 and start winding 55 are energized at the same time, motor 14 starts to rotate in the direction appropriate to cause operation of the water-ejecting member 11. When main winding 54 and start winding 56 are energized at the same time motor 14 starts to rotate in the direction to operate pumping assembly 15*a* to drain liquid out of tub 3 through inlet 16 and outlet 17. In the conventional manner, a start relay 57 may be provided in series with winding 54 in controlling relationship to a contact 58 which is in series with both windings 55 and 56. At a relatively high current level, such as that which flows through relay 57 when the motor is not rotating, relay 57 closes switch 58. As motor 14 comes up to speed, the level of energization drops substantially; as a result, relay 57 allows switch 58 to move to its normally open position to insure deenergization of whichever of windings 55 and 56 are energized. Thus, motor 14 may be caused to start in either direction of rotation, and will then continue to run on winding 54 alone after it has come up to speed.

The direction of rotation is determined by switch 52 which is movable into engagement with either of two contacts 59 and 60 to provide for selection of start windings 55 or 56 respectively. Both the start windings, through switch 52, and main winding 54 are connected through switch 51 so that the entire motor energizing circuit is connected across lines 34 and 35 and is controlled by switch 51.

A conventional sequence of operations of a dishwashing machine includes a first rinse which is actually introduction of water and a brief washing operation; that may either be with or without detergent, and is followed by a draining of that water. A second similar rinse and drain

are then provided, followed by a wash step which is simply a provision of the washing operation for a longer period of time with a suitable detergent being injected. This wash step is then followed by a drain and then two rinses and drains follow, after which a drying operation may be provided. The two rinses which follow the wash step result from cam 40 closing switch 49 to energize solenoid 26 thereby introducing a quantity of hot water into tub 3 followed by cams 43 and 44 closing switches 51 and 52 to energize coils 54 and 55 in order to operate water-ejecting members 11 and 12. Each rinse is followed by a drain step in which cams 43 and 44 control switches 51 and 52 to energize coils 54 and 56 to drive motor 14 in a reverse direction for actuating pumping assembly 15*a*.

In order to prevent mineral spotting of the dishes this invention provides for an alteration of the usual sequence of operation. The second of the rinse and drain steps after the wash step are followed by cam 39 closing switch 47 to activate solenoid 25, thereby introducing an amount of cold water into tub 3. Then cams 43 and 44 function to energize coils 54 and 55 to operate water-ejecting members 11 and 12 so as to submit the articles in racks 9 and 10 to a cold final rinse. Cams 43 and 44 then function to reverse the direction of rotation of motor 14, thereby halting the action of water-ejecting members 11 and 12 and draining the cold water from tub 3 by means of pumping assembly 15.

Following the draining of the cold water, cam 41 closes switch 49 and cam 42 closes switch 50. This combined operation admits hot water through valve 20 and outlet conduit 28 to the interior of tub 3 and into vaporizer 29 where heating element 30 heats the water further to form water vapor which flows around the articles contained in the racks 9 and 10. The water vapor condenses upon the surface of the articles and, since the articles have just been cooled to a relatively low temperature by the cold rinse, a substantial amount of vapor condenses on the surface of the articles. The condensation of water vapor on the articles dilutes the residue of the water which was left on the surface of the articles after the cold rinse. This dilution results from a two-fold action in that sufficient water vapor condenses on the articles to cause part of the water on the articles to be washed off and fall to the bottom of the tub 3 and the water which remains on the articles is a commingling of water from the cold rinse and condensed water vapor, thereby minimizing spotting of the articles.

Many articles such as glasses and bowls are placed in dishwashing machines in an inverted orientation, which results in small recesses being positioned on the top of the articles when in the dishwasher. Pools of water tend to collect in these recesses during the rinsing process, which makes it very difficult for sufficient water vapor to condense in these area to dilute the rinse water sufficiently to prevent mineral spotting of this portion of the articles when they are subjected to heat to be dried. Additionally, some dishes have a low heat capacity either because they are of a very thin construction or because they are made of a plastic material and only small amounts of vapor will condense on them. These problems are solved by extending cold water conduit 22 into tub 3 and forming it into a condenser 32 provided with fins 33. During the cold rinse, cold water flows through condenser 32 bringing it to a relatively low temperature. Therefore, during the vaporization step a large amount of water vapor condenses on the condenser 32 and the fins 33. In fact, sufficient vapor so condenses that a substantial portion of it falls from the surface of the condenser 32 and fins 33 and drops onto the articles in racks 9 and 10. This additional condensate is sufficient to dilute the water in the recesses on top of some articles and dilute the water cooling the low heat capacity articles to such a point that upon drying of the articles mineral spotting is essentially precluded. Also, the condenser could be formed as a closed container filled with a high specific heat liquid. The container would be cooled during the cold

rinse by contact with part of the water sprayed on the dishes being cooled.

If desired, the vaporizer 29 and heating element 30 may be eliminated by utilizing heating element 18 to vaporize a portion of the water collected in the sump 8 after the cold rinse step. This could be accomplished by configurating cam 38 to close switch 46 after completion of the cold rinse step. Since heating element 18 will be operating in a much larger quantity of water, only a small percentage of the water will evaporate but this will still provide a sufficiently large quantity of water vapor in compartment 2. Since only a small percentage of the water present evaporates, local temperatures at the heat transfer surface of heating element 18 are kept low, thus minimizing encrustation of minerals on the element 18.

While in accordance with the patent statutes I have described that which at present is considered to be the preferred embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and I, therefore, intend in the appended claims to cover all such changes and modifications as are within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A dishwashing machine comprising:

(a) a compartment,

(b) support means for articles to be washed within said compartment,

(c) water pumping and ejecting means disposed in a lower portion of said compartment to effect washing and rinsing of the articles and removal of wash and rinse water from said compartment,

(d) heating means disposed within a lower portion of said compartment to facilitate drying of the articles upon completion of washing and rinsing,

(e) a timer having a plurality of electrical switching contacts for controlling the washing sequence,

(f) hot and cold water conduits for connection to hot and cold water supplies respectively,

(g) a first electrically-operable valve having hot and cold water inlets connected to said conduits and an outlet within said compartment,

(h) a first set of switching contacts in said timer controlling said valve so that cold water only enters said compartment subsequent to the washing and rinsing sequence,

(i) a second set of switching contacts in said timer energizing said pumping and ejecting means to spray the cold water on the articles and to drain the cold water from said compartment,

(j) a vaporizer disposed in an upper portion of said compartment,

(k) a second electrically-operable valve to supply water to said vaporizer,

(l) a third set of contacts in said timer energizing said second valve to admit water to said vaporizer, and

(m) a fourth set of switching contacts in said timer energizing said vaporizer when water is admitted thereto to form a mineral-free water vapor which flows about the articles and condenses thereon to dilute any residue of water remaining on the articles to minimize spotting.

2. A dishwashing machine as defined in claim 1 wherein a condenser is disposed above said support means to condense a portion of the water vapor thereon so that the condensate falls therefrom onto the articles to further dilute any residue of water remaining thereon.

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