Nov. 24, 1959 J. D. WARHUS 2,914,217

DOMESTIC APPLIANCE

Filed Aug. 31, 1956 2 Sheets-Sheet 1

FIG. 1

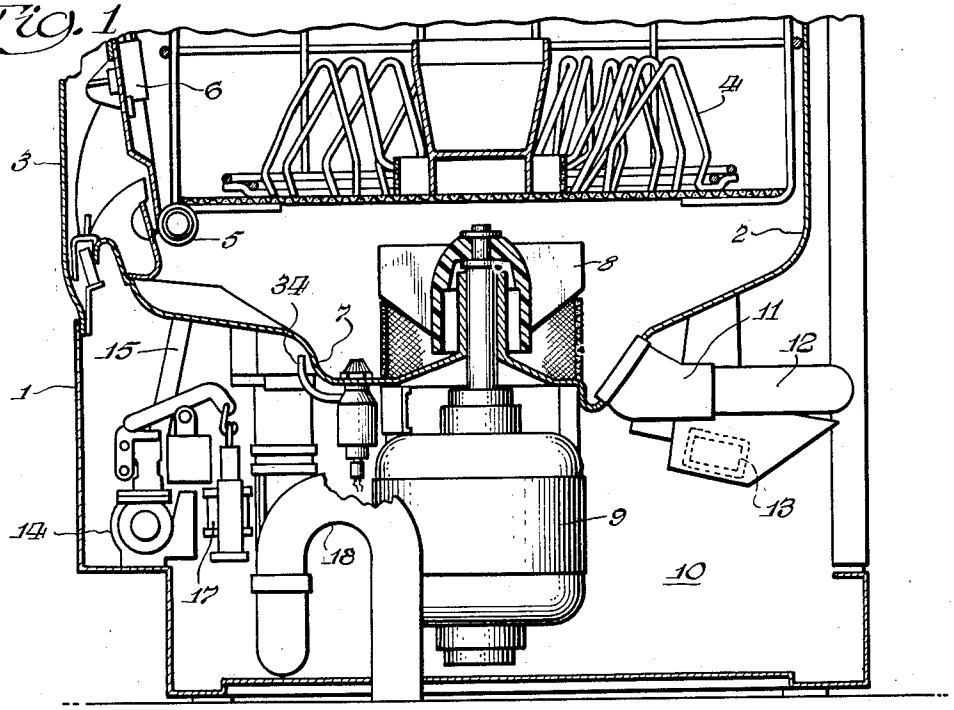
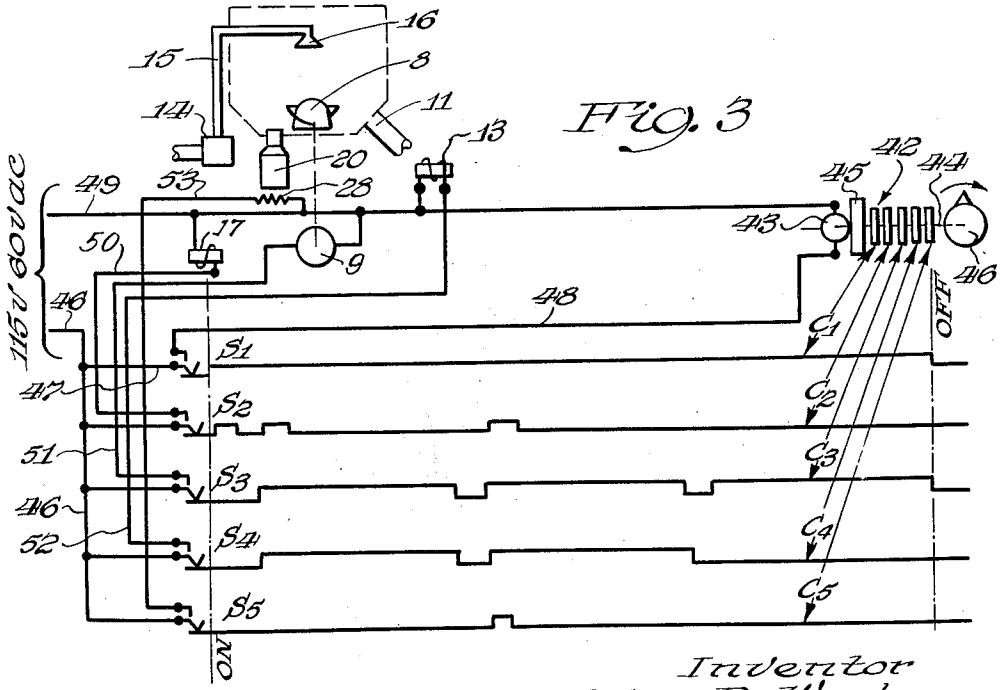


FIG. 3



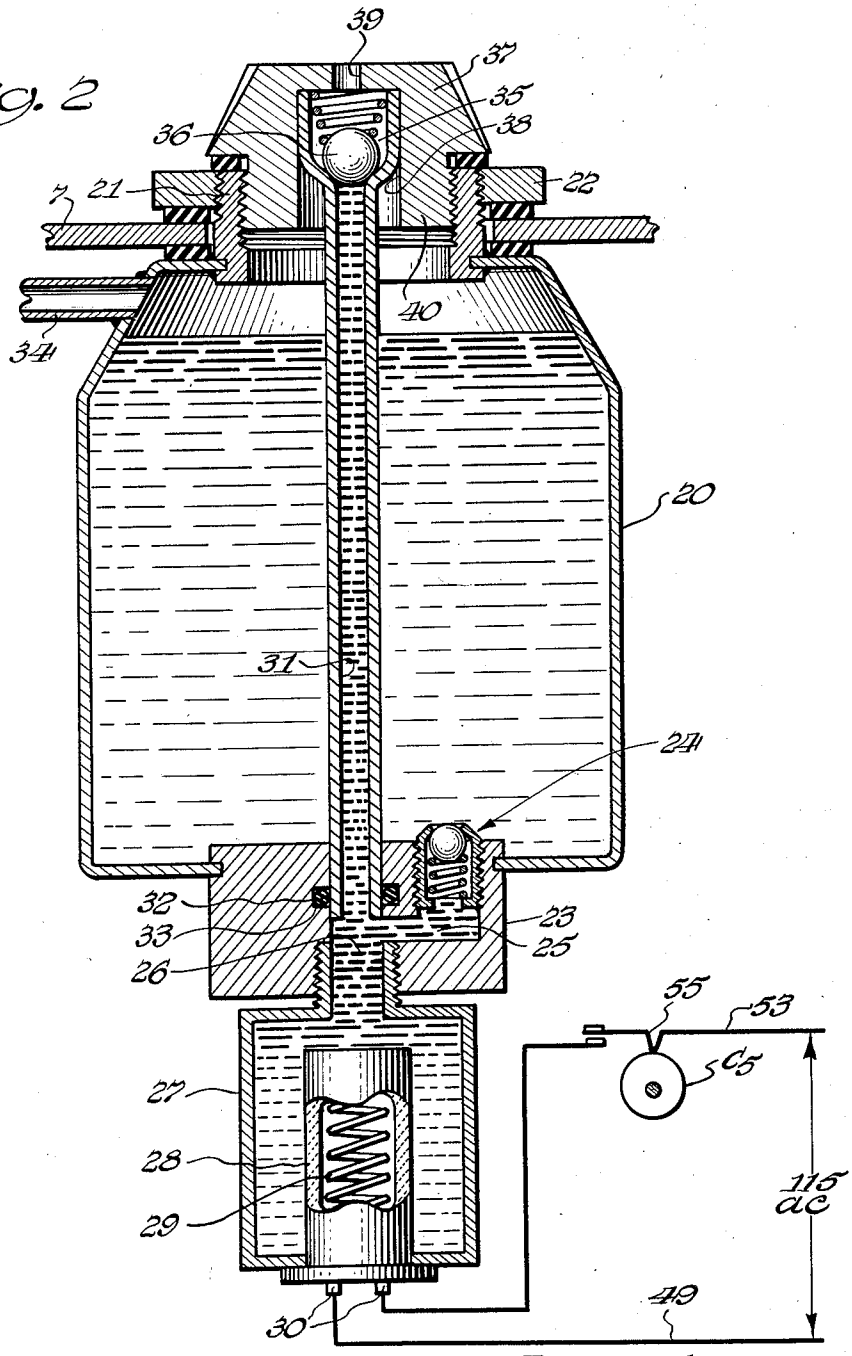
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FIG. 2



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2,914,217

DOMESTIC APPLIANCE

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4 Claims. (Cl. 222—76)

This invention relates to domestic appliances such as dishwashers or clothes washers and in particular to means for automatically introducing a liquid-conditioning material into the washing or rinsing tub thereof.

It has been found that the introduction of a liquid-conditioning agent such as a wetting agent into the tub of a washing machine has definitely advantageous effects. In clothes washing machines in which the clothes are soaked for a suitable interval prior to the washing operation, a small amount of wetting agent in the water increases the penetration of the clothes by the water and better conditions them for the ensuing operations. When added to the rinse water, it facilitates the separation of the water from the clothes particularly during the centrifuging operation now so common in automatic washing machines. In automatic dishwashers in which the drying of the dishes is accomplished by drainage and evaporation of the dishes while they remain in the tub, the addition of a wetting agent to the final rinse water greatly improves the drainage.

It is therefore an object of the present invention to provide a simple and effective device for automatically introducing a quantity of a liquid-conditioning material such as a wetting agent into a body of water.

It is another object of the invention to provide a liquid-conditioner injector which has a minimum of moving parts, is inexpensive to manufacture and operate, and will function with a high degree of reliability throughout a long operating life.

In a presently preferred form of the invention, the liquid-conditioner injector comprises a tube of small volumetric capacity in open communication with an expansion chamber of much greater capacity. Said chamber is arranged to be heated by an external source. A discharge end of the tube communicates with the tub or vat. A chamber or reservoir of the conditioning material communicates with the expansion chamber. Suitable check-valve means are provided to permit the discharge of the material from the tube as the result of the expansion of the material therein, and the replenishment of the tube as the content thereof contracts following de-energization of the heating medium. The heating element is activated and de-activated by a time-cycle switch associated with the program controller for the washing apparatus.

Other features and advantages of the invention will best be understood by the following detailed description of a presently preferred embodiment read in connection with the accompanying drawings in which:

Figure 1 is a fragmentary sectional elevation of a dishwasher embodying the present invention;

Figure 2 is a sectional elevation of a liquid-conditioner injector embodying the invention; and

Figure 3 is a schematic wiring diagram showing means for automatically controlling the dishwasher and the liquid-conditioner injector.

Figure 1 illustrates a typical domestic dishwasher with

which the present invention may advantageously be used. Said dishwasher includes an outer casing **1** within which is supported the tub or vat **2**, within which the dishes are washed, rinsed and dried. The front opening door **3** is bottom-hinged for operation between the illustrated closed position and a substantially horizontal open position. A rack **4** having means for accommodating the dishes and other articles (not shown) is slidably supported within the vat and when the door is open may be drawn outwardly on the door, being guided thereon by suitable rollers such as the roller **5**. A detergent-receiving cup **6** on the door is arranged to receive granulated detergent when the door is open and to expose the detergent to water action during the operation of the dishwasher, whereby a suitable detergent solution is formed. A sump **7** houses an impeller **8** driven by a motor **9** mounted in a machinery compartment **10**. A drain valve system **11** includes a flexible hose **12** arranged to be moved by a solenoid mechanism **13** between the illustrated drainage position and a non-draining position (not shown) in which the hose is elevated above the normal level of liquid in the sump **7**. The hose communicates with a trap **18** connected to the plumbing wasteline (not shown) of the building. Such a drain valve system is shown in Stoddard U.S. Patent 2,652,854 granted September 22, 1953, entitled "Drain Control Mechanism for Washing Apparatus." When the solenoid is de-energized, the drainage system assumes a draining position.

A water valve **14** receives water from a suitable source (not shown) of heated water and discharges it through a conduit **15** for entry into the vat by way of a suitable fitting **16** (shown schematically in Figure 3). The valve is normally closed and arranged to be operated to open position by a solenoid **17**.

As later explained, the dishwasher is arranged for automatic progression through a series of operations including pre-rinse, wash, rinse and dry. In practice, the cycle may include more than one washing operation and more than one rinsing operation as is well known in the art; the exact cycle forms no part of the invention and hence has been abbreviated in the present description.

The objective of the invention as applied to a dishwasher is to introduce a liquid-conditioner such as a wetting agent into the vat at an appropriate time during the final rinse so as to reduce the surface tension of the rinsing water and cause it to drain more completely from the dishes. A wetting agent known in the art as a "pluronic" and sold commercially under the trade-name "Rinse-Dry" is well suited for the purpose. It is a non-viscous liquid which may be safely used in connection with aluminum and stainless steel metals and it has a relatively high coefficient of expansion.

A presently preferred apparatus for effecting the introduction of the wetting agent is shown in Figure 2. The device comprises a reservoir **20** having a threaded collar **21** extending through an opening in the bottom wall of the sump **7** and secured thereto by the nut **22** and illustrated gaskets. The base of the reservoir is provided with a connector block **23** having an inlet valve **24** communicating directly with the interior of the reservoir and comprising a ball check valve permitting flow from, but not into, the reservoir. The valve chamber terminates a passage **25** communicating with a chamber **26** centrally of the block **23**. The bottom wall of said block is tapped to receive the male-threaded end of the expansion chamber **27**, which may be formed of aluminum. Disposed within said chamber is a heating cartridge **28** containing an electrical resistance element **29**, and having suitable external terminals **30**. Preferably coaxial with the chamber **26**, the block **23** has a reduced diameter bore to removably receive the

end of the discharge tube 31, said tube being sealed relative to the block by means such as the O-ring 32, housed within the annular groove 33. It will thus be seen that the open end of tube 31, the passage 25 and the expansion chamber 27 are in open communication with each other. A suitable vent tube 34 maintains atmospheric pressure within the reservoir.

The upper end of the tube 31 is suitably arranged to provide a valve chamber 35 containing a spring biased ball valve 36 arranged to permit discharge from the tube but not return flow thereinto. The valve chamber is suitably secured within the cap 37, which is formed with an accommodating passage 38 terminating in a reduced diameter orifice 39 through which the wetting agent in the tube 31 enters the sump 7 of the dishwasher vat. The cap has a threaded portion 40 which is screwed into the collar 21. The tube 31 and the cap 37 are a unit and may be removed from the reservoir 20 by unscrewing the cap, which may be grooved or knurled to facilitate this operation. The illustrated location of the reservoir and filling cap is intended only as typifying a location which is readily accessible upon opening the door 3.

When the apparatus is to be placed in service, the cap 37 and associated tube 31 are removed from the reservoir, it being understood that the O-ring seal 32 readily permits such removal. The reservoir 20 is then filled nearly to the brim of the collar 21. The liquid fills the expansion chamber 27 and the various passages in the connection block 23. When the tube 31 is returned to the reservoir and the cap 37 tightened, the liquid will rise within the tube to the extent permitted by the entrapped air. However, the inside diameter of the tube is small and its length only about six inches. The volumetric capacity of the tube is substantially less than that of the chamber 27. The first heating of the contents of the chamber 27 and the expansion of said contents will immediately purge the tube of the small amount of air, and the liquid will issue from the tube. The tube from this time on remains primed until the reservoir 20 is empty.

In Figure 3 I have illustrated somewhat schematically a control circuit for conducting the dishwashing apparatus through a series of operations concluding with a final rinsing operation. The program switch 42 may be of any well known type such as that disclosed in Illian U.S. Patent 2,619,557 granted November 25, 1952, for "Program Selector Switch." Such a switch comprises a synchronous motor 43 driving a cam shaft 44 through a gear reduction and slip clutch mechanism 45. At the other end of the cam shaft, placed at a location externally of the dishwasher where it will be readily available to the user, is a control or setting knob 46. The cam shaft contains a plurality of disc cams C1 to C5 inclusive. When the control knob 46 is rotated through about 10° from an off position to an on position, the motor 43 is energized, whereupon the operation proceeds for a predetermined period—for example 30 minutes—until the cam controlling the motor operation returns to the off position and terminates the operation.

The several cams are associated with single pole switches which operate between closed and open position according to the contour of the cam, as is well understood. The rotation of knob 46 to the on position causes cam C1 to close switch S1, thereby completing the circuit to the timer motor 43 by way of conductors 46, 47, 48 and 49. About ten seconds thereafter, cam C2 closes switch S2 which thereupon completes the circuit through the water inlet solenoid 17 by way of conductors 46, 50 solenoid 17 and conductor 49. It will be noted that cam C3 has not yet closed switch S3 controlling the impeller motor 9, nor has cam C4 closed switch S4 which controls the drainage solenoid 13. The impeller 8 is not running and the drainage system 11 is in its normal drain position during the preliminary introduction of water through the fitting 16. The purpose of this preliminary introduction is to purge the pipelines of cold water and to rinse off and evacuate the gross soil which may be present on the dishes. This prerinsing operation continues for about 45 seconds, whereupon cam C2 opens switch S2 and maintains it in open position for a sufficient time to permit the complete drainage of water from the dishwasher vat. Shortly before the next introduction of water, cam C3 closes switch S3, whereupon the motor 9 is energized by way of conductors 46, 51 and 49. Simultaneously therewith cam C4 closes switch S4, whereupon the solenoid 13 is energized by way of conductors 46, 52 and 49. Thus the impeller 8 has begun rotation and the drainage control system 11 operated to a non-draining position. When cam C2 then closes switch S2, the heated water introduced into the vat by way of valve 14 and fitting 16 remains in the vat and is caught up by the impeller blades and circulated forcefully throughout the vat and the contents thereof. During this operation, the water streams enter the detergent cup 6 and evacuate the detergent therefrom. The immediate mixture of the detergent and the water provides a detergent solution to effect the washing operation. Cam C2 maintains switch S2 in closed position for a sufficient time to insure that the proper amount of water is added to the dishwasher vat. In the usual domestic dishwasher, about 12 pints of water are thus introduced. At the end of the washing period which may comprise about five minutes, cam C3 opens switch S3 to de-energize the drive motor 9, and cam C4 opens switch S4 to de-energize valve solenoid 13. The drain valve system resumes its inital draining position. At the end of a time calculated to provide complete drainage, switches S3 and S4 are again closed to energize their respective components and switch S2 is also closed to effect the introduction of rinsing water into the vat. The time of operation of the inlet valve solenoid 14 is again calculated to introduce about 12 pints of water into the vat, whereupon the water valve closes and remains closed for the remainder of the timer operation. The rinsing operation continues for about five minutes during which the motor 9 is continuously operated and the drain valve solenoid 13 energized to provide for a power rinsing operation in which none of the rinse water is permitted to escape from the dishwasher vat. At the end of the rinsing operation cam C3 again opens switch S3 and cam C4 opens switch S4, whereupon the motor 9 stops and the drainage system restores to its draining position. The motor 9 is de-energized for a period sufficient to insure complete drainage from the vat, and then is again energized for the purpose of circulating air throughout the vat to facilitate the drying of the dishes therein.

Substantially simultaneously with the closing of switch S2 to admit the rinsing water in to the vat, cam C5 closes switch S5 to energize the heating element 28 through the circuit including conductors 46, 53 and 49. The heating circuit remains energized for about 45 seconds during which time its heat energy is transmitted to the liquid wetting agent contained in the chamber 27. Chamber 27 is a rigid structure, and the heating element 28 has a thermal output sufficient to raise the temperature of the wetting agent rapidly to about 200° F. The rapid expansion of the wetting agent accompanying the rise in temperature thereof effects the flow of the wetting agent past the valve 36 for discharge through orifice 39 into the tub. Only a very small amount of wetting agent is required for mixture with the rinsing water. With the termination of the energy source to the heating element 29, the material in the chamber 27 cools and contracts. As it does so, it of course recedes within the tube 31 only slightly because of the immediate seating of the ball valve 36. However, the contraction of the liquid creates a negative pressure condition within the liquid system which causes flow of liquid from the reservoir through valve 24 and into the various passages as above noted.

A definite advantage of the expansion method of introducing the wetting agent into the dishwasher vat is its substantially complete freedom from moving parts and the ease with which the apparatus may be maintained in service. The expansion of the liquid in the chamber 27 is practically unaffected by ambient temperature conditions for the reason that at the time cam C5 closes switch S5 the compartment 10 will have attained a substantially stabilized temperature by reason of the heat loss from the vat during the immediately preceding operation.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the scope of the invention.

I claim:

1. Apparatus for discharging a quantity of liquid material into a tub, comprising a chamber for containing said material, means for mounting said chamber on a wall of said tub, said mounting means including a cap having an orifice communicating with said tub a discharge tube of less volumetric capacity than said chamber communicating between said chamber and said cap, means within said cap for permitting flow of liquid only from said discharge tube into said tub, means for thermally expanding the liquid in said chamber, whereby the expansion of said liquid will effect flow of liquid from said discharge tube into said cap for discharge therefrom into said tub, and means for adding liquid to said chamber to replenish the same.

2. Apparatus for discharging a quantity of liquid material into a tub, comprising a reservoir for said material, means for mounting said reservoir in proximity to said tub, said mounting means providing a fill opening for said reservoir, a cap on said mounting means, said cap having an interior chamber and a passage communicating therewith through which liquid may be ejected into said tub, an expansion chamber, passage means communicating between said reservoir and said expansion chamber, valve means permitting flow of said liquid only from said reservoir into said expansion chamber, a discharge tube communicating between said expansion chamber and the chamber in said cap, means for maintaining said discharge tube substantially full of said liquid, valve means for permitting flow of said liquid only from said discharge tube into said chamber, and means for thermally expanding the liquid in said expansion chamber, whereby the expansion of said liquid will effect flow from said discharge tube into said chamber and thence through said passage into said tub.

3. For use in a washing machine having a tub to contain articles to be washed, and water inlet means for said tub; apparatus for introducing a quantity of a liquid water-conditioning material into said tub, comprising a reservoir for a releatively large quantity of said material, a connection block forming a closure for said reservoir, a relatively non-expansible chamber secured to said connection block, a discharge tube of substantially smaller volumetric capacity than said chamber extending through said reservoir into removable association with said connection block, means including a fill cap for mounting said reservoir on a wall of said tub, said fill cap having a passage communicating with said tub, means for securing and discharge tube within said cap in communication with said passage, said block having passages affording intercommunication between said reservoir, said tube, and said chamber, a check valve in said block in communication with the passages therein and into said reservoir to permit only flow from said reservoir into said passages, a check valve at the discharge end of said tube within said fill cap to permit only flow from said cap into said tub, electrical heating means disposed in said chamber to heat the contents thereof to effect the expansion of said water-conditioning material for discharge thereof through said tube into said tub, and means for energizing said heating element for substantially predetermined time intervals.

4. Apparatus for discharging a quantity of liquid material into a tub, comprising a reservoir for said material, means for mounting said reservoir in relatively close proximity to said tub, an expansion chamber communicating with said reservoir, passage means communicating between said reservoir and said expansion chamber, valve means permitting flow of said liquid only from said reservoir into said expansion chamber, a discharge tube of less volumetric capacity than said expansion chamber extending through said reservoir and communicating between said expansion chamber and said tub, means for permitting flow of liquid only from said discharge tube into said tub, heating means disposed in heat exchange relation with the liquid material in said chamber, and means for energizing said heating means for a predetermined interval to effect expansion of said liquid material to enforce flow thereof from said chamber into said discharge tube, whereupon an equivalent volume of said liquid material will pass from said discharge tube into said tub.

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