This invention relates to a washing machine having a water level control, and more particularly to a washing machine wherein the correct amount of fluid is selected for the requirements of a given load of clothes, automatically and with no pre-selection by an operator.

Although there has been a long standing need for automatic water level control in a washing machine, both from the standpoint of saving water and for the purpose of providing an effective washing action, all efforts to provide same have heretofore been unsuccessful. The present invention provides a solution to this problem which includes means for introducing an amount of water into the tub which is determined in accordance with the actual requirements of a specific load of clothes, without any need for estimating or pre-selection on the part of the operator.

It has been determined that any given load of clothes will absorb water in proportion to its mass, i.e., its absorbency, weight and volume. Consequently, if a given amount of water is introduced into a washing machine, the amount not absorbed or retained by the clothing in the machine is inversely proportional to the mass of the clothing. This invention employs such proportionate relationship to produce a signal for presetting a water level switch whereby the machine may be filled only to the level necessary for a given load, so as to afford desired economies in operation.

Accordingly, spray means are utilized to introduce a predetermined amount of water into a spinning load of clothes, and a water pickup area is built into the tub at either the bottom or outside of the tub. There are several methods of metering this predetermined amount of water into the load, but they do not form a part of this invention. In a preferred form of the invention, a collector rib is formed in the tub and a pressure-sensitive device is attached to the water pickup area in communication with the collector rib, whereby to preset the contacts of the water level switch.

The invention contemplates the use of a manometer as the pressure-sensitive device, with valve means for introducing water collected by the spraying operation into an air trap of the manometer, the valve being shut off after the spraying operation so that as the tub is filled, preferably through a separate fill conduit, water will be collected above the shut off valve with the result that as the water level rises in the tub it will increase the air pressure in the manometer which will actuate a pressure-sensitive switch at a predetermined level of pressure to terminate filling of the tub at a level inversely related to the amount of sample spray fluid collected in the air trap during the preliminary spin operation of the dry load when the load size sampling fluid is introduced to the load.

It is, therefore, an object of the present invention to provide a method for determining the water level required for effective washing of a specific load of clothes or the like, and for transposing that determination for controlling means to produce that level.

Another object of the invention is to provide a device as described which reduces vibration and wear in the machine by assuring that the load is immersed in a sufficient amount of water.

Another object of the invention is to provide a device as described wherein water and detergent savings are effected by the elimination of over-filling of the tub relative to the requirements of a specific mass of clothes.

Another object of the invention is to provide a device as described which is entirely self-operating and automatic.

Another object of the invention is to provide a washing machine which controls the amount of water introduced into the tub precisely in accordance with the requirements for a specific wash load.

Other objects and advantages of the invention will become apparent as the description proceeds in accordance with the drawings in which:

On the drawings—

FIGURE 1 is a vertical sectional view, partly broken away, of a washing machine according to the present invention;

FIGURE 2 is a top plan view of the structure shown in FIGURE 1; and

FIGURE 3 is a schematic showing of a circuit for use in the washing machine of the invention.

As shown on the drawings:

As seen in FIGURE 1, a washing machine 10 according to the invention includes a tub 12 in which is mounted a foraminous basket 14 supported for rotation on a drive shaft 16 which is adapted to be driven through gear means 18 energized by a motor 19 as shown schematically in FIGURE 3. An agitator 22 is mounted on the shaft structure 16 to be driven selectively in accordance with a presettable sequential control as understood by those skilled in the art.

In accordance with the invention, and as hereinafter further described, a predetermined amount of water is introduced into the basket 14 by a spray conduit 24 during a sample fill period so that a load to be washed which has been placed in the machine 10 will absorb the fluid proportionately to its mass, volume and absorbency, so that a proportion of the unabsorbed metered fluid thus introduced may be used as a signal to control a pressure-sensitive device 26.

In order to effect such control, a water pickup area is provided to which water is directed by a collector rib 28 which may be secured to the internal surface of the tub 12 by screw means or the like 30 engaging a flange 32 of rib 28 and tub 12, and having a downwardly inclined, inwardly extending rib portion 34 formed integrally with the flange 32. The rib portion 34 is configured to channel water collected during spinning of the basket 14 as the water is sprayed during a determined interval from the conduit 24, the water thus collected being proportionate to the remainder of fluid not absorbed by the load in the basket during the spray interval. It should be understood that collector ribs of different length and shape could also be used.

In a preferred form of the invention, the pressure-sensitive device 26 comprises a manometer including a base portion having a tall leg 36 and a short leg 38, so that the base housing 40 forming the tall and short legs 36 and 38 provides an air trap in short leg 38 as hereinafter further described. The relative heights of legs 36 and 38 may vary since the entire manometer assembly further includes tubular extensions 56 and 68 to be further described.

Fluid collected by the rib 34 is thus introduced into the pressure-sensitive device 26 through a water pickup connection or inlet 42 positioned in tub 12 at the base of the collector rib 28, and having a downwardly turned portion 44 connected to the tall leg 36 by a flexible conduit 46. Suitable sealing rings or the like 48 and 50 are utilized to connect the upper end of the hose 46 to the portion 44 and the lower end of the hose to a lip 52 on the tall leg 36. The hose is controlled by a shut off valve 54 or the like also as hereinafter further described.
In order to transmit further pressure to pressure switch 66 during the wash and deep rinse fill periods to enable pressure switch 66 to be tripped to end the fill periods, a tube 56 of inverted U-shaped configuration is connected to an adaptor structure 88 on the portion 44 by a clamp ring 69 or the like, and communicates with the upper end of the leg 36 by means of an adaptor structure 62 thereon and is sealed by a clamping ring 65 or the like.

A presettable pressure responsive switch 66 is mounted at the upper end of a reduced tube 68 which is connected to the short leg 38 by an adaptor structure 70 and a clamping ring 72. Signal water is removed from the manometer between successive loads by means of a valve 74 normally closing a flexible conduit 76 connected to an outlet 78 in the housing 40 by a sealing or clamping ring 80 or the like, the other end of the conduit 76 being connected to a small filter pump 82 in pump housing 81 through a conduit structure 84 to which the hose 76 is secured by a ring or the like 86. A second filter pump inlet conduit 88 is connected to the other side of the conduit structure 84, as by a ring 90 or the like, it being appreciated that the filter conduit 88 is connected to the side of the tub 12 (not shown). An outlet from the filter pump 82 (not shown) is provided to deliver fluid from conduits 76 and 88 through a filter (not shown) and back into tub 12. A conduit 92 is provided in the bottom of tub 12 to conduit 12. Conduit 92 leads to the main pump portion 83 of pump housing 81. A conduit 94 leads to drain from main pump portion 83. Main pump 83 pumps either from conduit 92 to conduit 94 or from conduit 94 to conduit 92.

Accordingly, a simple and effective metering of a desired amount of water into the tub for washing a specific load without vibration and without waste of water may be accomplished by means of the pressure-sensitive means 26. Thus the operator places the dry clothes in the basket 14 and by pre-selection on a presettable sequential control means (not shown) selects the wash cycle preferred for the type of clothes to be washed whereby the machine will be automatically operated through a programmed schedule of washing, rinsing and extracting periods. When the lid of the machine 10 (not shown) is closed, the machine is started and spins the dry clothes for a predetermined sample fill period, which may, for example, be one minute. During this spin cycle, cold water is sprayed into the basket 14 and tub through the spray conduit 24, as determined by switch means hereinafter described. By using an orifice of known size and a selected time interval, the flow rate may be predetermined so that, for example, 1/2 gallons of water or some other predeterminable amount of fluid is sprayed on the clothes load. Other means could also be used to assure 1/2 gallons. As indicated, the clothes absorb or retain part of this spray while the rest of the spray impinges upon the tub wall due to the centrifugal forces generated by the spinning basket 14. A portion of this unabsorbed spray is collected by the collector rib 28, and is guided into the air trap housing 40 through the inlet 42, by automatic opening of the valve 54. The water thus introduced into the housing 40, if enough is collected in housing 40, rises above the level shown at 41 causing air to be trapped in the short leg 38 to exert pressure on the pressure switch 66 and thereby condition or preset the switch 66. The degree or extent of pressure build up in the tube 68 at the end of the spin and spray period completely determines the quantity of water that will enter tub 12 during the wash and deep rinse fill periods before pressure switch 66 is tripped.

Since collector rib 28 collects only a portion of the fluid which is not absorbed or retained by the fabrics, it will be appreciated that the sensing control apparatus regulated by such reduced portion may be of somewhat smaller proportionate size for accomplishing the objectives of this invention.

At the end of the predetermined spray and spin inter-val, the valve 54 closes and water is introduced into the machine through a conduit 96, the conduits 24 and 96 being connected to a mixing valve 98. Although both conduits 24 and 96 are used in the explanation of this invention, it should be appreciated that to carry out the principle of this invention it would be sufficient to have a system in which mixing valve 98 would control the sample metered amount of water as well as the washing and rinsing water and have only one single conduit from the mixing valve to the machine. When the water level in tub 12 reaches the level shown at 43 in FIGURE 1, the air in inverted tube 56 is entrapped and the air pressure above the sample water in tube 36 will increase as the water level in tub 12 increases. This variable air pressure in tube 56 causes the height of the sample water in tube 65 to be increased causing the air in tube 65 to be further compressed. This increased pressure in tube 65 soon reaches the predetermined value of pressure switch 66 thus causing pressure switch 66 to deenergize mixer valve 98 to stop the flow of inlet water through conduit 96.

The machine then passes through its wash cycle, including draining by means of the main pump 83 upon completion of the washing operation, filling and rinsing, subsequent draining and spinning, as understood by those skilled in the art. The depth of water will automatically fill to the level determined for the wash cycle as a result of the presetting of the switch 66. It will be understood that after the manometer has been set for a particular wash load, the signal water must be drained out before the next load of clothes is put into the machine. This is accomplished by opening the valve 74 at the bottom of the manometer, and this may be done at any time after the deep rinse.

Referring now to FIGURE 3, the circuit for the machine 10 is illustrated schematically as including a power source 100, a push-pull switch 102 and the various electrical devices are controlled by a sequential control means. The control means has a timer motor 121 which rotatably drives a plurality of cam associated with a corresponding plurality of cam operated switches. The circuitry also includes the pressure or water level switch 66, which has a switch element 112 connecting with a contact 114 when the tub is empty as at the beginning of an operation, and engaging a contact 116 when water has been introduced into the tub to the correct level.

The push-pull switch 106 is actuated by the operator and the cam C-1 130 actuates a line switch 102. A cam C-2 117 controls a switch 117 for energizing the motor 120 of the manometer fill valve 54 and the spin solenoid 118 for operating the basket at centrifuging speed.

The cam C-3 regulates energization of the timer motor 121 through switch 124 while the cam C-4 regulates the actuator 134 of the manometer drain valve 74 through the upper contact 136 and the agitator solenoid 132 through the lower contact 130.

The cam C-5 regulates the main drive motor 20 through the switch 108. The cam C-6 regulates the two-way water fill mixer valve 98 to charge the machine with liquid via the inlet 96 when the bottom contact 126 is closed to energize the solenoid 128 and to discharge a metered amount of liquid via the nozzle 24 when the top contact 122 is closed to energize the solenoid 123.

In operation, the spin solenoid 118, manometer fill solenoid 120, and spray solenoid 123 are energized to drive motor 20 are initially energized for a specific time interval to a metered flow of liquid will be introduced into the machine through conduit 24 to condition the switch 66. Thereafter the valve 54 is closed and the contact 126 then energizes the water fill solenoid 128 to introduce fluid through the conduit 96, the water level switch 66 will be at the empty position when contact 112 is contacting contact 114. At this time, cam C-2 has opened switch 117. After the predetermined amount of pressure has been obtained in the switch 66, element 112...
will move to contact 116, to de-energize the solenoid 128 and terminate the flow of fluid into the tub. The agitator 22 will be energized further liquid into the agitator solenoid 132, or the like, it being understood that the main pump means 83 for the machine is mechanically operated to pump from conduit 94 to 92 whenever the agitator solenoid 132 is energized thus acting to hold the water in the tub 12.

The timer solenoid 121 will control the sequential progress of the fill and wash and fill and rinse cycles, the drain cycles and spin cycles, and during the final spin cycle, the manometer drain solenoid 134 will be energized through the upper contact 136 to allow the manometer to drain to the filter pump 62 from where the water is pumped through the filter (not shown) into tub 12 to be pumped to drain. Of course, the manometer fill valve 54 is open whenever the basket 14 is spinning.

The device may be calibrated so that a predetermined minimum water level will always be achieved, e.g., a level of seven inches, and so that a maximum level, e.g., eleven inches, is determined, thereby assuring effective washing conditions for substantially all loads. As a result of the water level control system described, however, appropriate water levels for loads of intermediate mass, volume and absorbency will be afforded with a high degree of accuracy.

Accordingly, there has been provided a washing machine of fully automated character wherein the amount of water is determined pragmatically in accordance with the requirements of the wash load. As a result, the machine will be filled sufficiently so that agitation of the clothes will not produce undue vibration and wear on the machine, which occurs when an insufficient amount of water is present, and also, the amount of fluid is limited to the specific requirements of the particular load so that there is no waste. This water level system also assures that there will always be enough water present to effect a quality wash without using superfluous amounts of water and detergent.

Although I have herein set forth and described my invention with respect to certain specific principles and details thereof, it will be understood by those skilled in the art that these may be varied without departing from the spirit and scope of the invention as set forth in the hereunto appended claims.

I claim as my invention:

1. In a machine for liquid treatment of materials having a container receiving the materials, liquid control apparatus comprising means for determining the relative amount of liquid absorbed and not absorbed by a specific mass of absorbent material disposed in said container, and means controlled by said means for determining from said relative amounts the amount of liquid required in said container and for introducing such required amount of liquid into said container.

2. In a machine for liquid treatment of materials having a container, liquid control apparatus comprising, liquid supply means for introducing a predetermined quantity of liquid into said container, means for determining the amount of liquid not absorbed by a mass of material in said container, and means for introducing an amount of liquid into said container proportionate to the determination of the amount not absorbed.

3. In a machine for liquid treatment of materials having a container, liquid control apparatus comprising, means for determining the amount of liquid absorbed by a specific mass of absorbent material therein, means introducing liquid into said container of obtaining said determination, and means for terminating said introduction of liquid into said container in accordance with the determination provided by said determining means.

4. In a machine for liquid treatment of materials having a container, a liquid control apparatus comprising means for introducing a predetermined quantity of liquid into the container, means for collecting an amount of liquid proportionate to the introduced liquid not absorbed by a mass of material in said container, means for introducing liquid into said container, and control means terminating said introduction of said further liquid in accordance with the amount of collected liquid.

5. In a washing machine having pre-settable sequential control means, a tub and a foraminous basket in the tub, means for spinning the basket, means for introducing a predetermined quantity of liquid into said tub, means for collecting an amount of liquid proportionate to the amount of liquid absorbed by a mass of material in the basket when the basket is spun, and means for introducing further liquid into said tub in proportion to the amount of liquid collected by said collection means.

6. In a washing machine having pre-settable sequential control means, a tub and a foraminous basket in the tub, means for spinning the basket, means for introducing a predetermined quantity of liquid into said tub, means for collecting an amount of liquid proportionate to the amount of liquid absorbed by a mass of material in the basket when the basket is spun, and means for terminating said introduction of further liquid into said tub in accordance with the amount of liquid collected by said collection means.

7. In a washing machine having a tub, a water level control comprising a manometer, means for introducing an amount of water into said manometer proportionate to the absorbency of fabrics placed within said tub, and control means for introducing a further amount of liquid into said tub proportionate to the amount introduced into said manometer.

8. A washing machine having a pre-settable sequential control, a tub, a foraminous basket for receiving absorbent articles to be washed, means for spinning the basket for a predetermined interval, means for introducing a predetermined quantity of liquid into the tub during said predetermined interval, a collector rib on the tub for receiving an amount of liquid from the basket according to the amount of the predetermined liquid absorbed by said articles, a manometer connected to said tub, an entry valve controlling liquid flow from said rib to said manometer, switch means operable in accordance with pressure in said manometer, and means for introducing a further supply of liquid into the tub as determined by said switch means and proportionate to the amount of liquid absorbed by said articles.

9. A washing machine having a pre-settable sequential control, a tub, a foraminous basket for receiving articles to be washed, means for spinning the basket for a predetermined interval, means for introducing a predetermined quantity of liquid into the tub during said predetermined interval, a collector rib on the tub for receiving an amount of liquid from the basket according to the amount of the predetermined liquid absorbed by said articles, an entry valve controlling liquid flow from said rib to said manometer, switch means operable in accordance with pressure in the manometer, and means for introducing a further supply of liquid into said tub as determined by said switch means and proportionate to the amount of liquid absorbed by said articles, a manometer connected to said tub, an entry valve controlling liquid flow from said rib to said manometer, switch means operable in accordance with pressure in said manometer, and means for introducing a further supply of liquid into said tub as determined by said switch means and proportionate to the amount of liquid absorbed by said articles, and a manometer connected to said tub, an entry valve controlling liquid flow from said rib to said manometer.
further supply of liquid into the tub as determined by said switch means and proportionate to the amount of liquid absorbed by said articles, said manometer including air trap means affording pressure in said manometer proportioned additively to the liquid in the manometer and to the liquid in said tub.

11. In a washing machine having container means for receiving liquid and materials to be washed therein, liquid control means comprising, conduit means for supplying liquid to said container including means to wet said fabrics, and means for determining the amount of liquid not absorbed by said fabrics and regulating operation of said conduit means for controlling the amount of liquid supplied to said container means in response to said determination.

12. In a washing machine having container means for receiving fluid and materials to be washed therein, liquid control means comprising, conduit means for supplying liquid to said container means during a sample fill cycle and during a regular fill cycle and including sequential control means regulating the flow of liquid through said conduit means during said cycles, and means influenced by the amount of liquid not absorbed by said fabrics during said sample fill cycle and cooperating with said sequential control means for regulating the amount of liquid supplied to said container means during said regular fill cycle.

13. A method of controlling the amount of liquid in a liquid treatment machine comprising, placing a specific mass of material to be treated in a container in the machine, filling the container with a predetermined amount of liquid, collecting an amount of the liquid proportionate to the amount thereof absorbed by the mass of material, introducing further liquid into the container and using the collected liquid and a portion of the further liquid to energize control means to terminate introduction of liquid to said container.

14. The method of controlling the amount of liquid supplied to a washing machine for washing fabrics during a washing process comprising, wetting said fabrics during a sample fill period, separating from said fabrics the liquid not absorbed by said fabrics during said sample fill period, and subsequently supplying liquid to said machine for said washing process in an amount corresponding to the amount of liquid not absorbed by said fabrics.

15. The method of controlling the amount of liquid supplied to a washing machine for washing fabrics during a washing process comprising, centrifuging said fabrics, wetting said fabrics with a predetermined quantity of liquid, collecting liquid not retained by said fabrics during the centrifuging thereof, adding additional liquid to said machine, and correlating the amount of liquid subsequently supplied to said washing machine with the amount of liquid collected to control the amount of liquid ultimately supplied to said washing machine for said washing process.

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