Nov. 18, 1969 H. O. McBRIDE ET AL 3,478,374

AUTOMATIC WATER LEVEL CONTROL

Filed March 28, 1968 2 Sheets-Sheet 1

Fig. 1

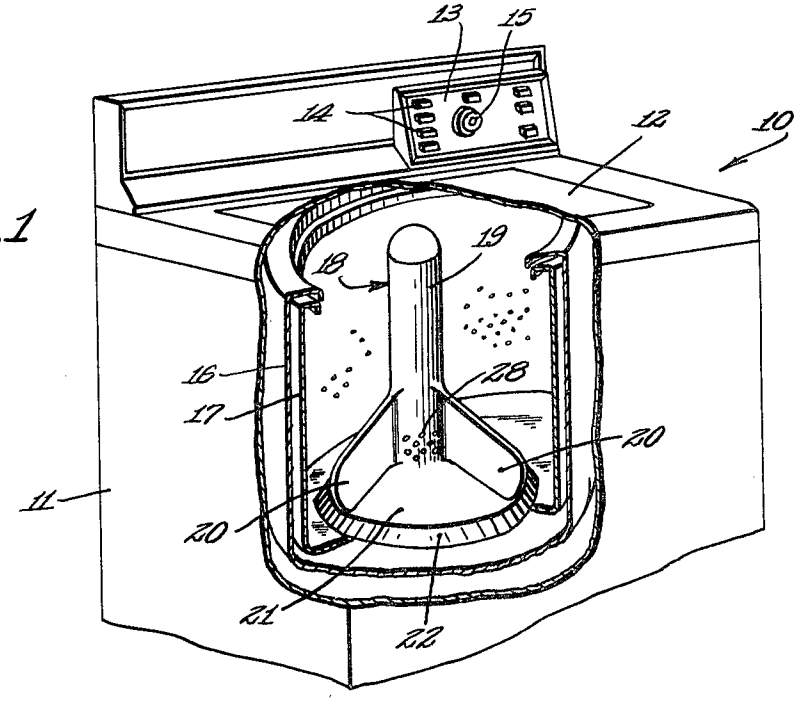


Fig. 2

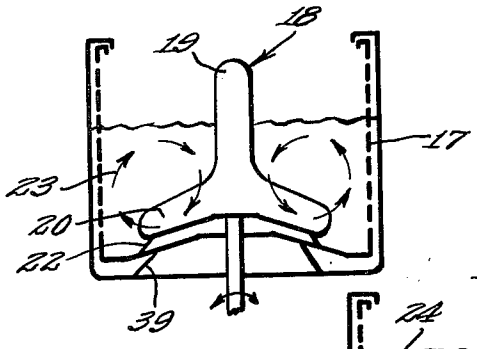


Fig. 3

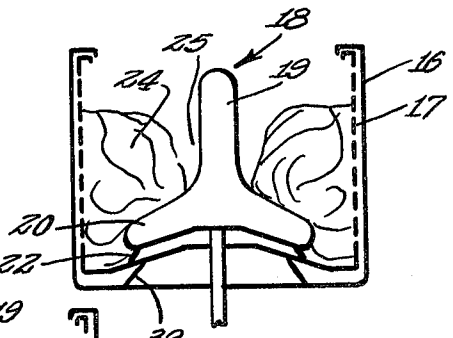
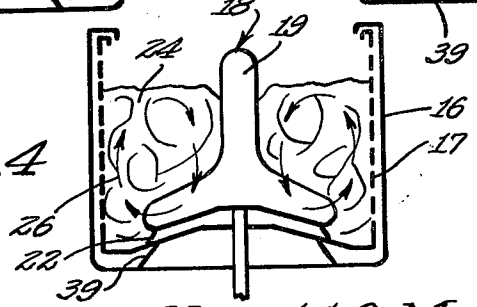


Fig. 4



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AUTOMATIC WATER LEVEL CONTROL

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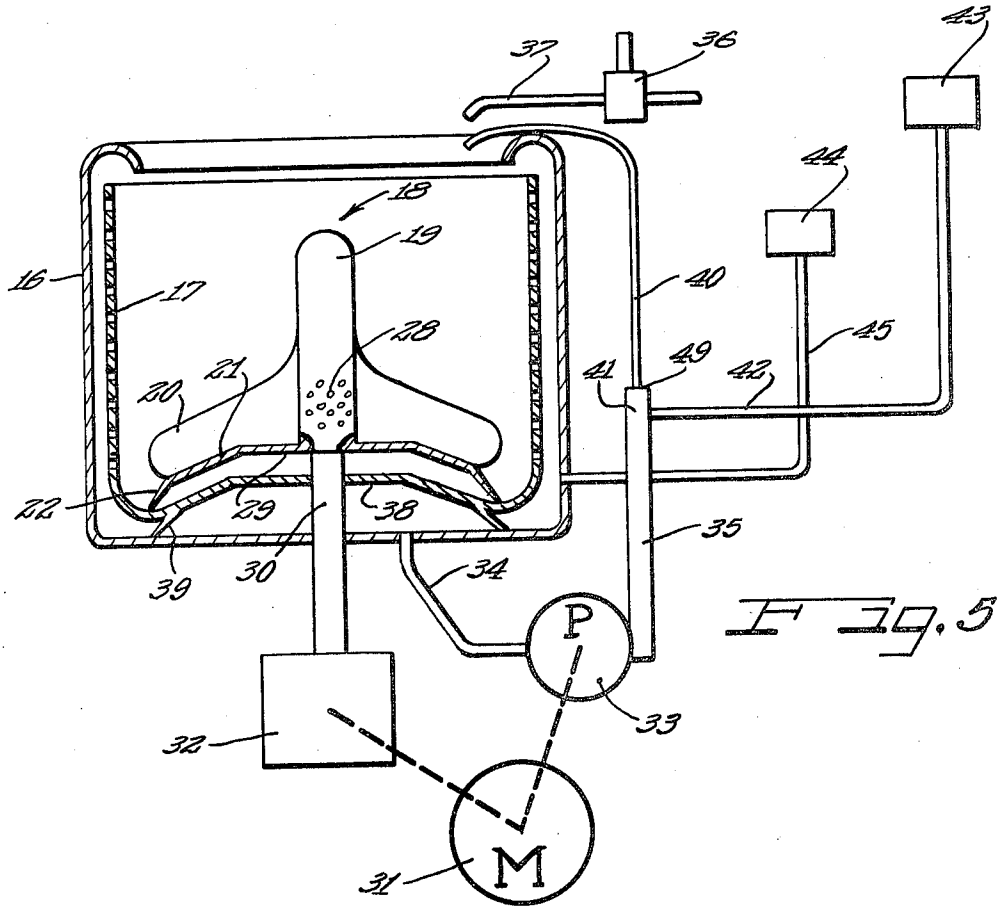


FIG. 5

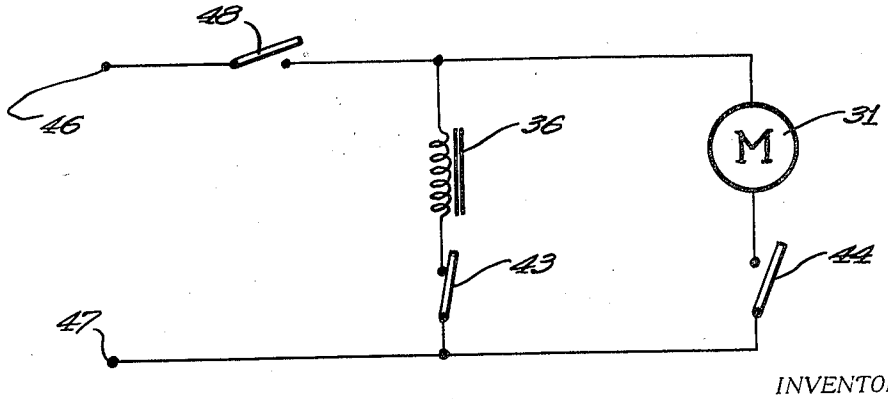


FIG. 6

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AUTOMATIC WATER LEVEL CONTROL

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U.S. Cl. 8—158 9 Claims

ABSTRACT OF THE DISCLOSURE

Method and apparatus for controlling the introduction of washing liquid into a washing machine having an oscillatory agitator which involves employing a sensing zone in proximity to the axis of the agitator, applying a reduced pressure at the sensing zone, and then introducing additional amounts of water into the machine when the water has been depleted from the sensing zone as a result of an excessive amount of wash being present in comparison to the amount of washing liquid.

BACKGROUND OF THE INVENTION

Field of the invention

The invention deals with methods and apparatus for automatically introducing the proper amount of washing liquid into the tub of an automatic washing machine in response to signals generated in the washing machine itself, the signals emanating from a sensing zone positioned adjacent the axis of the oscillatory agitator with means being provided to sense the presence or absence of water in the sensing zone, the latter condition being used to actuate fluid pressure sensitive devices and introduce additional amounts of water into the tub when air rather than water is present at the sensing zone.

Description of the prior art

There are apparently very few disclosures in the prior art which sense the actual conditions existing during washing of fabrics in the washing machine as a basis for controlling the amount of washing liquid introduced into the tube of the machine. The most pertinent references known to us are U.S. Patents Nos. 3,030,790; 3,065,618; and 3,093,841 all assigned to the same assignee as the present application. These patents deal with a water level control which relies on sensing torque transmitted from the agitator to the tub of the machine through the clothing load as a means for determining when addition of water is necessary. While these devices operate satisfactorily, the present invention provides an entirely different approach to the problem of sensing operating conditions existing during the washing of fabrics and with the use of simplified circuitry.

SUMMARY OF THE INVENTION

This invention is based upon observations of the liquid flow patterns developed in an automatic washing machine having an oscillatory agitator under varying ratios of washing to washing liquid. The water level control of the present invention provides the correct amount of water for a clothing load regardless of the type of fabric being laundered or the load size. This insures optimum washing action since agitation of clothing in too little water may damage the fabrics, whereas agitation of fabrics in too much water does not permit proper washing action of fabrics by the agitator.

Our observations have shown that when there is too high a ratio of fabric to washing liquid in the tub, there is an actual depletion of water from about the immediate vicinity of the agitator shaft because of the blocking of

water currents by the excessive amount of fabrics. In accordance with the present invention, we position a sensing zone in the area which is most likely to be depleted of water when this condition arises, and apply a produced pressure to that zone. Consequently, as long as water is continuously withdrawn from the sensing zone, there is an indication that the amount of water present in the machine is adequate for washing purposes. However, if the amount of water is insufficient in the tub, the sensing zone will sense air and, through suitable responsive devices, this pickup of air in the sensing zone is used as a signal to operate electrical circuitry which introduces additional amounts of water into the tub for more efficient washing action.

One of the advantages of the present invention is the fact that hot water is saved because the tub does not fill above the level necessary to launder the clothing properly. This saves the user both in terms of water consumption and fuel. Furthermore, the same saving is effected in the use of laundering detergent, since the amount of detergent needed is proportional to the water level. The control of liquid level within the tub of the machine is also based upon a signal whose reliability does not appear to be adversely affected by the size of the load being laundered. In addition, the mechanism for controlling the level of liquid in accordance with the present invention is simple in operation and does not involve the addition of any costly parts to the present structure of an automatic washing machine.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a view in perspective, and partially broken away illustrating the type of automatic washing machine with which the improvements of the present invention can be used;

FIGURE 2 is a somewhat diagrammatic showing of the washing machine illustrating the flow pattern of washing liquid when no fabrics are present in the machine;

FIGURE 3 is a view similar to FIGURE 2 but illustrating the conditions which exist when a large load of fabrics is present in the basket with an insufficient amount of laundry liquid;

FIGURE 4 is a view similar to FIGURES 2 and 3, but illustrating the flow pattern of the washing liquid when an adequate amount of washing liquid has been added to the load of fabrics;

FIGURE 5 is a somewhat schematic drawing of a washing machine assembly including the improvements of the present invention; and

FIGURE 6 is a circuit diagram for the electrical circuit involved.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIGURE 1, reference numeral **10** indicates generally an automatic washing machine including a cabinet **11** having an access door **12** for loading fabrics to be washed into the machine. The machine has a control panel **13** which carries a plurality of push-button selector switches **14** and a control knob **15** for selecting different washing cycles, dependent upon the nature of the fabrics being washed, and for selecting washing cycles of varying duration, respectively.

Within the cabinet **11** there is a stationary tub **16** and a perforate basket **17** in which the fabrics to be washed are received. Centrally of the basket **17** is an agitator **18** including an agitator column **19** and a plurality of radially disposed vanes **20** extending from a perforate apron **21**. A flexible sealing lip **22** extends from the perforate apron **21** to provide a sealing engagement with the basket **17**, as will be explained in a succeeding portion of the specification.

Turning now to FIGURE 2, it will be noted that with no fabrics present in the basket **17**, oscillation of the agitator **18** causes water currents to be established in a generally toroidal path as illustrated by the arrows **23** in that figure. As the agitator **18** oscillates, its vanes **20** effectively pump water away from the area next to the agitator barrel **19**. When there is a large clothing load **24** present in the machine, as illustrated in FIGURE 3, however, this large load prevents return of water to the area adjacent the barrel **19**. Consequently, an air cavity **25** exists immediately adjacent the barrel **19** when the relative amount of fabrics is greater than the amount of washing liquid available.

With the introduction of a sufficient amount of washing liquid, however, as illustrated in FIGURE 4, the fabric load **24** is suspended in a sufficient amount of washing liquid and, as the agitator **19** oscillates, water currents are established as indicated by the arrows **26** which continuously circulate liquid against the agitator barrel **19** and thereby fill up the air cavity **25**. In this condition, there is sufficient water present for efficient washing action and no more water need be added to the tub **16**. The sensing of the existence of the air cavity **25** in accordance with the present invention is used as a means for initiating introduction of additional amounts of liquid into the tub **16**.

As shown in FIGURE 5, the agitator **18** is driven by means of a motor **31** through a transmission **32**. The motor **31** also operates a positive displacement pump **33** which draws laundry liquid from the bottom of the tub **16** through a conduit **34** and circulates it to the upper portion of the tub through a conduit **35**. An electrically actuated valve **36** controls the addition of supplementary water into the tube **16** through an inlet conduit **37**.

As previously mentioned, the skirt **21** of the agitator **18** carries a flexible sealing lip **22** whose marginal edge engages the bottom wall of the basket **17**. This sealing lip effectively creates a sealed cavity **29** between the agitator skirt **21** and the lower wall of the basket **17** except for an opening **38** in the bottom wall of the basket **17**. Apertures **28** are provided along the column **19** to sense the presence of liquid or air in proximity to the agitator. There is, for about one-third of its height, fluid communication between the apertures **28** and the cavity **29** by virtue of the space that exists between the hollow interior of the column **19** and its drive shaft **30**.

A similar resilient sealing lip **39** depends from the bottom wall of the basket **17** and engages the bottom wall of the tub **16**. Consequently, any water pumped from the tub **16** by the recirculation pump **33** through conduit **34** must pass through the apertures **28** of the agitator column **19** and through the opening **38** in the bottom wall of the basket **17**. The lip **21** is sufficiently flexible so that it is lifted from engagement with the tub **16** when the basket **17** is subjected to centrifugal speeds during a spin drying operation.

As the laundry liquid is pumped by the pump **33** through the conduit **35**, it encounters a restriction **49** existing between the relatively large diameter conduit **35** and a smaller diameter conduit **40** which delivers the recirculated laundry liquid back into the tub **16**. The restriction **49** causes a considerable back pressure to be developed at the zone identified at reference numeral **41** in FIGURE 5. A tube **42** transmits the pressure developed at point **41** to a pressure switch **43**. A second pressure switch **44** communicates with the tub pressure by means of a tube **45**.

Referring next to FIGURE 6, electrical energization for the control circuit is derived from a pair of terminals **46** and **47** connected to a suitable alternating current source. A timer actuated switch **48**, when closed at the initiation of the cycle, applies alternating current potential across the control elements. Upon the initial application of power, the pressure switch **43** is closed and the pressure switch **44** is opened, as illustrated in FIGURE 6. This energizes the solenoid operated valve **36** and water begins flowing into the tub **16** through the inlet conduit **37**. When the water in the tub reaches a level of approximately 8 inches or so, pressure switch **44** closes, and the rotor **31** is energized. The rotor **31** drives the agitator **18** in oscillatory fashion through transmission **32** and also operates the positive displacement pump **33**. The latter applies suction through conduit **34** to the bottom of the tub **16**. If sufficient water is present within the tub for the clothing load being laundered, water is present adjacent the barrel **19** of the agitator **18** and all of the apertures **28** are closed by liquid. Consequently, only water is drawn through the apertures **28**, the opening **38**, the conduit **34** and into the discharge conduit **35**. The restriction at point **49** creates back pressure at point **41** and this pressure is transmitted to the pressure switch **43**, whereup pressure switch **43** opens and solenoid **36** is deenergized.

If, however, the fabric load in basket **17** is too large for the quantity of water present, the pumping action of the agitator **18** evacuates the area near the barrel **19** of water. Thus, pump **33** sucks in some air along with liquid which is ultimately pumped to the conduit **35**. As the entrapped air reaches the point **41**, it relieves the pressure on the diaphragm of the pressure switch **43**. Thus, pressure switch **43** closes and additional water is admitted to the basket by energization of the solenoid **36**. The addition of water continues until such time as sufficient water is present in the tub **16** to insure that water is always present adjacent the agitator barrel **19**. When this occurs, and air is no longer drawn through the conduit **34**, the proper amount of laundry fluid will be present in the tub for the clothing load being laundered, and further additions of water are terminated by the reestablishment of the pressure conditions in the conduit **35** sufficient to open the pressure sensitive switch **43**. It should be noted that relatively few apertures **28** need be exposed to air in order to relieve the pressure on the diaphragm of switch **43**.

From the foregoing, it will be understood that the liquid control device of the present invention is completely responsive to the actual conditions existing in the tub at the time of washing operation to provide the optimum amount of washing liquid for any given size load. This insures optimum washing action with a saving in hot water and laundering detergent. The mechanism employed is simple in operation and does not involve the addition of any costly parts to existing automatic washer structures.

It should be evident that various modifications can be made to the described embodiments without departing from the scope of the present invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. The method of controlling the introduction of washing liquid into a washing machine having an oscillatory agitator which comprises oscillating said agitator about a centrally disposed axis, applying a reduced pressure at a sensing zone in proximity to the axis of said agitator, and introducing additional liquid into said machine when the liquid level is reduced in said sensing zone .

2. The method of controlling the introduction of washing liquid into a washing machine having an oscillatory agitator which comprises oscillating said agitator about a centrally disposed axis, continuously withdrawing washing liquid from a sensing zone in close proximity to said axis, continuously recirculating withdrawn washing liquid back into said machine, and introducing additional amounts of washing liquid into said machine in response to the drawing of air into said sensing zone.

3. A washing machine comprising a tub, a basket mounted for rotation within said tub, a vaned agitator disposed within said basket, means for oscillating said agitator, means for continuously withdrawing washing

liquid from a sensing zone in proximity to the axis of said agitator, pressure sensitive means receiving the withdrawn liquid, said pressure sensitive means being responsive to the presence of air in the withdrawn liquid, and inlet means controlled by said pressure sensitive means for introducing additional amounts of liquid into said tub upon sensing of said air by said pressure sensitive means.

4. The washing machine of claim 3 which also includes a flexible sealing slip about the vanes positioned to engage said basket and provide a seal between the agitator skirt and said basket.

5. The washing machine of claim 3 which also includes a flexible sealing lip about the periphery of said basket, said lip being positioned to engage the bottom wall of said tub and being sufficiently flexible to be lifted from said bottom wall during rotation of said basket at centrifugal speeds.

6. A washing machine comprising a tub, a basket mounted for rotation within said tub, an agitator mounted within said basket for oscillation about the rotary axis of said basket, said agitator having radially extending vanes bottomed by a skirt position and having an apertured column, sealing means extending between said skirt portion and said basket, the bottom wall of said basket having an aperture therein, a pump having its inlet side communicating with the space between said tub and the bottom wall of said basket, a conduit receiving the discharge of said pump, restriction means disposed

in said conduit, a pressure sensitive means sensing the pressure at said restriction means, and inlet means controlled by said pressure sensitive means for introducing additional amounts of washing liquid into said tub.

7. The washing machine of claim 6 in which said sealing means includes a flexible lip on said skirt extending into sealing relation with the bottom wall of said basket.

8. The washing machine of claim 6 which includes flexible sealing means extending between said basket and said tub to thereby define a cavity into which liquid access occurs only through said aperture in the bottom wall of said basket.

9. The washing machine of claim 8 in which said sealing means is sufficiently flexible to be lifted from said tub during rotation of said basket at centrifugal speeds.

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U.S. Cl. X.R.

68—12, 207; 137—387