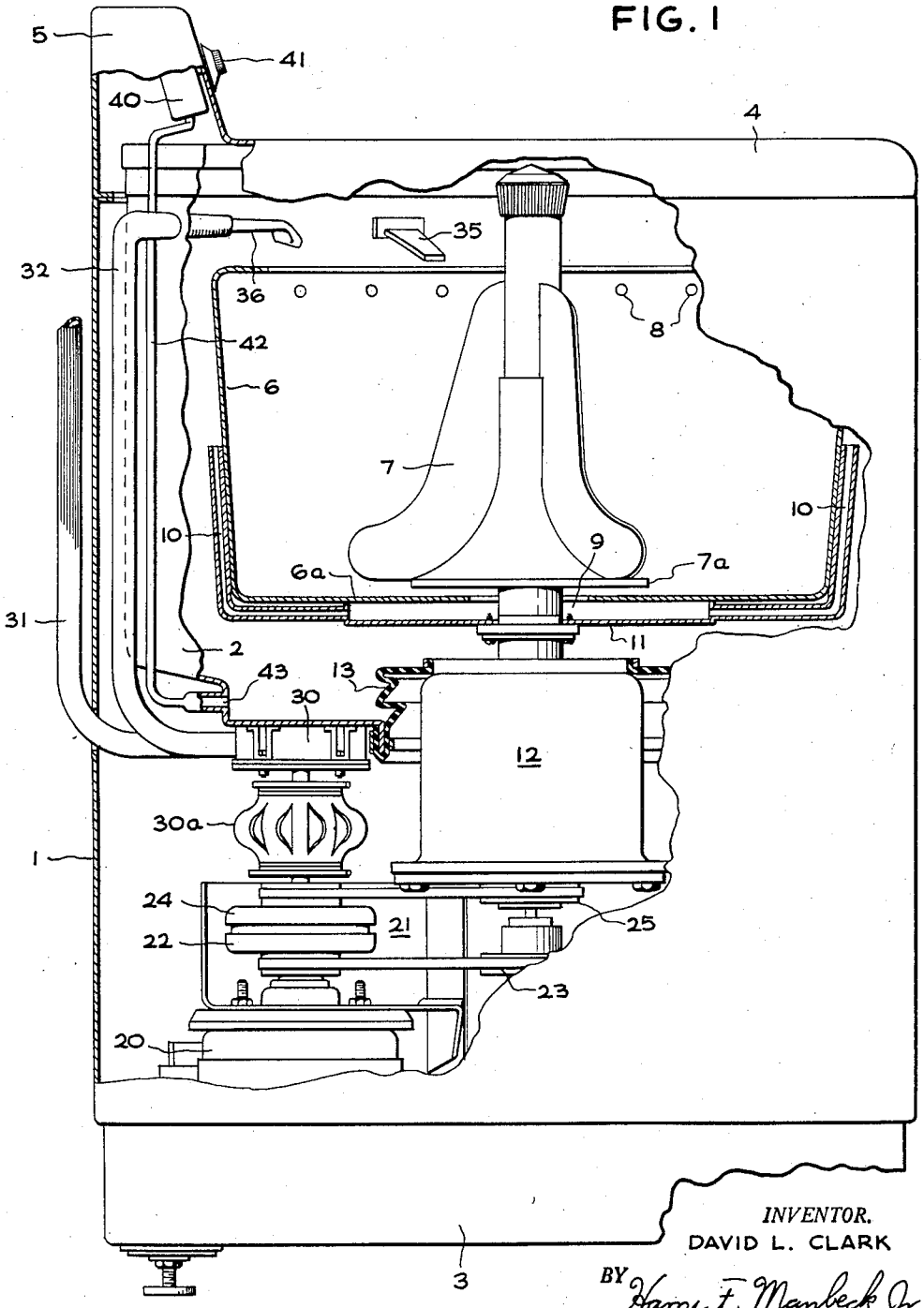
Nov. 10, 1959 D. L. CLARK 2,911,811

CLOTHES WASHER WITH ADJUSTABLE WATER LEVEL CONTROL

Filed Sept. 19, 1955 2 Sheets-Sheet 1

FIG. 1



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Filed Sept. 19, 1955 2 Sheets-Sheet 2

FIG. 2

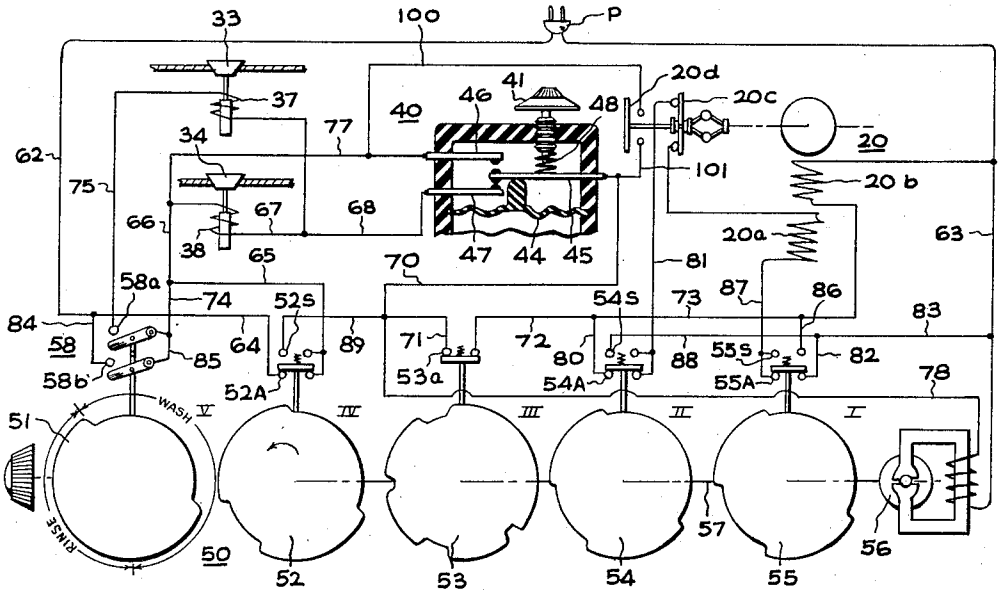


FIG. 3

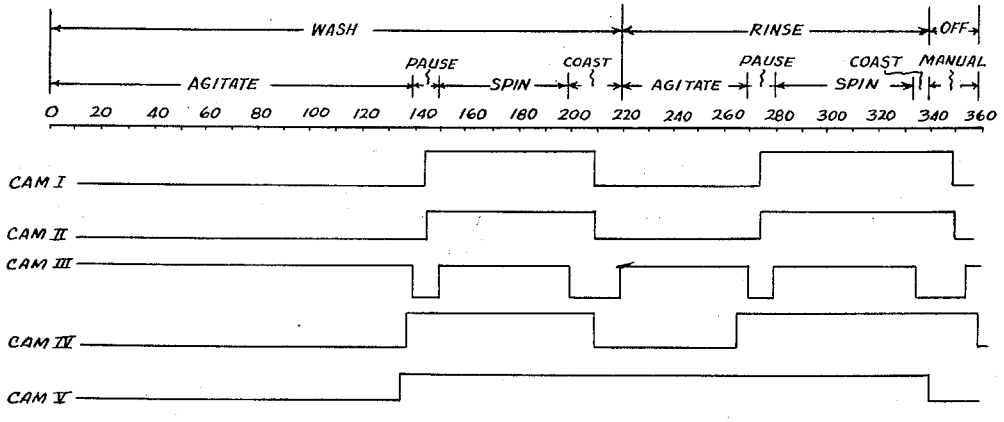


FIG. 4

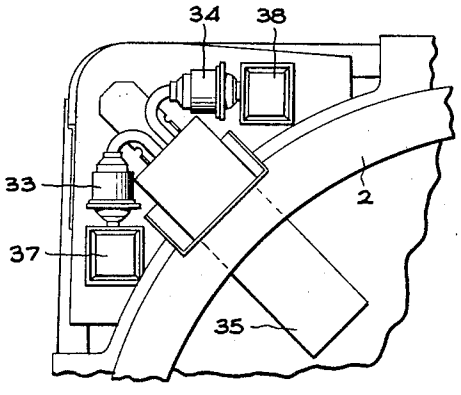
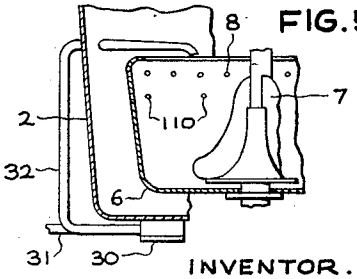


FIG. 5



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2,911,811

CLOTHES WASHER WITH ADJUSTABLE WATER LEVEL CONTROL

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Application September 19, 1955, Serial No. 534,931

6 Claims. (Cl. 68—12)

This invention relates to clothes washing machines of the spin basket type provided with an outer tub and a spin basket within it, and wherein the clothes are washed and rinsed in the basket and the basket is rotated to extract the water from the clothes after being washed; and also wherein the water is continuously recirculated from the tub to the basket during the washing operation. The invention is especially useful in such machines wherein the several operations are performed automatically.

An object of my invention is to provide an improved system for supplying water to a clothes washing machine of this character under a water control arrangement contributing to conservation of water.

Another object is to provide an improved water control arrangement wherein the washing or rinsing operation is initiated by the accumulation in the outer tub of a predetermined level of water overflowing from the basket, which arrangement utilizes in the washing stage conducted within the basket the amount of water previously accumulated outside the basket for control purposes.

A further object is to provide an improved system for supplying water to a clothes washing machine under a water control arrangement adapted for variable setting commensurate with the load of clothes contained in the basket.

According to my invention, I provide water supply means for supplying water to the basket, and a pressure operated switch having a variable setting for different water levels in the basket as desired, which switch is responsive to the accumulation in the outer tub of water overflowing from the basket. The basket is provided with overflow means which during the water fill period limits the amount of water supplied to the basket to the amount suitable for washing the minimum clothes load, which for example may be one-half load. I call this quantity of water the base amount. Thus, the water responsive control switch responds only to the water which is supplied in excess of the base amount and which excess overflows from the basket into the outer tub. This switch is designed to respond to various selected amounts of water allowed to collect in the outer tub, and thus in effect measures the base quantity of water plus various selected excess increments. During the washing operation, the circulating means circulates the water from the tub to the basket at a greater rate than water can overflow from the basket, and thus the base amount of water plus the excess allowed to collect in the tub initially constitutes the total water supplied to the basket for the washing operation.

This insures accuracy of measurement of the water supplied to the basket, and also positively insures at least the minimum or base supply of water in the basket at the start of the wash operation when the water is shut off from the machine and the washing action is initiated.

Other features and advantages of my invention will be apparent from the following detailed description read in conjunction with the accompanying drawings which show a presently preferred embodiment of my invention applied to an automatic domestic washing machine.

Fig. 1 of the drawings is an elevation, partly in section, of a washing machine of the centrifugal extraction type embodying my invention;

Fig. 2 is a representation of a circuit suitable for use in operating the automatic washing machine incorporating my invention and with cam actuated and pressure operated control switches shown schematically;

Fig. 3 is a chart showing the operation of the cam mechanism at any particular instant during the operating cycle;

Fig. 4 is a fragmentary plan view showing an arrangement of the electrically energized hot and cold water supply valves; and

Fig. 5 is a fragmentary view of a washing machine embodying my invention in an alternate form thereof.

Referring to Fig. 1, there is provided an outer casing **1** of a clothes washing machine within which is secured a suitable tub **2**. The outer casing includes a rigid base frame **3** and a cover **4** having a removable lid adapted to fit in a suitable aperture, not shown, in the cover for the purpose of placing or removing clothes in the machine. A backsplash panel **5** is mounted at a convenient location upon the cover and serves to mount and enclose a portion of the apparatus for controlling the water supply to the machine.

Within the tub is a spin extraction type of basket **6** in which the clothes are placed to be washed by oscillation of an agitator **7**. During the washing operation the basket is held stationary. Thereafter the cleansing liquid is centrifugally extracted from the clothes by rotating the basket at high speed. During this spinning extraction operation the basket and agitator are rotated as a unit and the liquid is discharged through openings **8** at the basket's upper edge. This used water is collected in and removed from the tub **2**.

At the center portion of its bottom wall **6***a* the basket is provided with an aperture **9** connecting with a plurality of overflow tubes **10** adapted to discharge into tub **2**. These tubes preferably are of equal length and at their upper ends serve as overflow weirs of equal height, the height of which corresponds to a base level or load of water intended to be contained in the basket during a washing operation. The tubes, moreover, are disposed upon the outer surface of the basket in affixed enclosing relation thereto and are attached at their inner ends to a plate **11** serving as a basket support member and as a portion of the basket drive structure. It will be noted that in my preferred embodiment the tubes **10** communicate with the basket beneath the skirt **7***a* of the agitator **7**. In other words the aperture **9** leading to the tubes is disposed beneath the agitator skirt.

The basket and the agitator are respectively mounted on concentric independently rotatable shafts driven by a mechanism indicated generally at **12**. Such mechanisms are well known and as such form no part of my invention. For example, the mechanism as disclosed in McNairy Patent 2,639,794, for Drive Clutch for Washing Machines or the Like, granted May 26, 1953, which is owned by the General Electric Company, assignee of the present invention, may be employed in the washing machine of my invention. The mechanism **12** is mounted below the bottom of tub **2** by suitable supporting means (not shown) and in turn supports the basket **6** within the tub. The top of the mechanism case protrudes upwardly through a passage in the bottom of the tub and a leak-

proof seal is formed between the case and the tub by a flexible boot 13.

Also mounted within casing 1 is a reversible drive motor 20 having a conventional start winding 20*a* (Fig. 2), a running or main winding 20*b* and a centrifugal cut-out switch 20*c* for the start winding. Power for agitation and spin of the basket is transmitted from the drive motor through the directionally responsive clutch means 21 (Fig. 1) which has an agitate clutch 22 adapted to be connected to sheave 23 and a spin clutch 24 adapted to be connected to sheave 25. Sheaves 23 and 25 of the mechanism 12 are in turn connected through that mechanism to the respective oscillatable agitator and rotatable basket spinning shafts.

When the drive motor is rotated in the agitate direction, only clutch 22 is driven and when the drive motor is rotated in the spin direction, only clutch 24 is driven. Snubber means, as disclosed in said McNairy patent, preferably are employed to insure the holding of the basket stationary during the oscillation of the agitator.

As an important feature of my invention the motor 20 is connected to a pump 30 adapted to pump when rotated in either direction and having a capacity sufficient to pump at a substantially higher rate than the rate at which the aggregate discharge of tubes 10 can spill into tub 2. Pump 30 preferably is a centrifugal pump of known type having a central opening for entry of water and a peripheral discharge opening. The pump is mounted in the bottom of tub 2 and is connected with the shaft of motor 20 by a flexible connection 30*a* so that rotation of the motor in either direction simultaneously rotates the pump in the same direction as the motor. Water entering the pump from tub 2 is directed into either a washer discharge conduit 31 leading to the house drain or a recirculation conduit 32 leading to the top of the basket 6. A suitable two-position valve, not shown, located in the pump outlet controls into which conduit the water is directed. The actuation of this valve may conveniently be accomplished by suitable means subject to the direction of rotation of the pump shaft. Accordingly, as reversible motor 20 is driven in the agitate direction, the pump 30 likewise is driven in the agitate direction and the valve setting is such as to cause water to be pumped into recirculation conduit 32. Conversely when the motor is driven in the spin direction the pump 30 likewise is driven in the spin direction and the valve setting is such as to cause water to be pumped into the discharge conduit 31. A suitable pump and valve arrangement which may be used is shown and described in the copending application of John Bochan, Serial No. 468,460, filed November 12, 1954, now Patent No. 2,883,843, and assigned to the same assignee as the present invention.

For the purpose of filling basket 6 to the desired level, water is supplied from a suitable external source directly to the basket. The washing machine may be provided with conventional solenoid operated valves 33 and 34 having solenoids 37 and 38 (Figs. 2 and 4) and intended respectively for connection to a cold water and a hot water source and feeding into a common spout 35 which reaches over the top of the basket 6 to discharge thereinto; the valves are opened when their solenoids are energized, and closed when de-energized. Likewise recirculating conduit 32 is provided with a spout 36 (Fig. 1) reaching over the basket top to discharge thereinto. Mounted upon panel 5 is a pressure actuated control switch 40 having a knob 41 for selective setting of the switch. Extending from said switch housing into the bottom of tub 2, in the water collecting region thereof, is a pressure tube 42 open at its lower end 43 into which water accumulated in tub 2 may rise to a level determined by the level of water in the tub and by the resisting action of the air compressed in tube 42 by the water rising therein. The upper end of the tube communicates with the lower portion of the housing of switch 40 (Fig. 2) within which is contained a diaphragm 44 adapted to determine the position of a switch arm 45 with respect to contacts 46 and 47, in accordance with the pressure of air beneath the diaphragm. By means of a suitable biasing spring 48 the control knob 41 may determine the pressure at which the switch arm is actuated to cause a switching of the circuit. As will later appear, the switch arm 45 is movable between a first position (as shown in Fig. 2) in which water may be supplied to the machine by the solenoid valves, and a second position (with contact 46 closed) in which recirculation of water within the machine may be permitted.

Preferably the several operations of the washing machine of this invention are under the control of a motor driven program controller suitably mounted on the machine convenient to the operator. Such a control is disclosed in Welch et al., Patent 2,654,239, granted October 6, 1953, for Automatic Washing Machine Electrical Control System, owned by the General Electric Company, assignee of the present invention. The program controller which I identify generally in Fig. 2 by reference 50 may embody a cam bank and switch arrangement similar to that described and claimed in said Welch et al. patent.

Such an arrangement has a suitably indexed dial 51, a plurality of cams 52, 53, 54 and 55 and a timer motor 56. These cams, including the dial 51 (which is also a cam) are also designed by the numerals I, II, III, IV, and V, as shown in Fig. 2 for easier reference to the cam shart of Fig. 3. The respective cams and indicating dial are keyed on the timer motor driven shaft 57 and the mechanism (not shown) connecting the timer to the shaft is such that the dial 51 may be manually operated to advance the timing system to any selected operating position, or, as is frequently desirable, to shorten any particular operation cycle.

In each of the cams of 52, 54 and 55, the high portions represent operative positions associated with spinning of the basket and the low portions represent operative positions related to clothes washing. The circuit includes a manually operable double pole single throw switch 58 pursuant to which the operator may optionally use only hot water, or a fixed mixture of hot and cold water for washing. Regardless of the wash water temperature selection, the fixed mixture is supplied for rinsing because the cam follower on the periphery of dial 51 automatically causes both poles of switch 58 to close after the first fill of the basket. The poles of said switch are designated 58*a* and 58*b*, respectively, and to choose the hot and cold mixture for washing, the operator merely closes the contact 58*a* manually, using a suitable lever, not shown, the upper arm of switch 58 being movable to closed position independently of the lower arm.

The circuit also includes the single pole double throw switch 40, having contacts 46 and 47 and which, as above described, is arranged to be actuated by the diaphragm 44 responsive to the level of water in tube 42 and concomitantly to the level of water in tub 2. In the schematic circuit representation of Fig. 2, it is assumed that the switch arm 45 engages the upper contact 46 when the water reaches a predetermined level in the tub.

Cams 52, 54 and 55 each operate single pole double throw switches. The lower contacts of each switch carry the identification number of the cam with the subscript "A" (for agitate) and the upper contacts have subscripts "S" (for spin). Cam 53 operates a single pole single throw switch 53*a*. The circuit is connectable to a source of electrical energy, for example, 110 volts, 60 cycle A.C. by a conventional plug P. The main leads of the circuit comprise the supply conductor 62 and the return conductor 63.

The impedance of timer motor **56** is made greater than that of the water valve solenoids **37** and **38** and they, in turn, have an impedance greater than that of the drive motor **20**. The several cams are in the position of Fig. 2 when the operator has rotated dial **51**, which also causes rotation of shaft **57**, from the "Off" position to the "Fill" position. This may be to any position within the space marked "Agitate," the position depending upon the agitating time desired. The switch actuator of cam **52** has dropped off a high portion of the cam; the switch actuator of cam **53** has entered onto a high portion of its cam; and the switch actuators of cams **54** and **55** have dropped off high portions of their cams. The fact that the manually operable switch **58** is in the position shown with pole **58***a* open indicates that the operator has chosen to use hot water at line temperature for washing.

The machine then begins to fill with hot water by reason of the following circuit: from the plug P through conductors **62**, **64** to the bridged contacts **52**A of cam **52**, conductors **65**, **66** to hot water solenoid **38**, conductors **67**, **68** to the "empty" position contact **47** of water level responsive switch **40** and switch arm **45**, conductors **70**, **71** to the bridged contacts **53***a* of cam **53**, conductors **72**, **73** to the main winding **20***b* of motor **20** and through return conductor **63** to the plug P. Because the impedance of solenoid coil **38** is much higher than that of the drive motor, and the timer motor is in parallel with the drive motor, which, by the way, offers a parallel return path for the solenoid circuit just described, practically full line voltage is drawn across the coil **38** to energize it and thereby open the valve **34**, and as a result water is admitted, but neither the timer motor nor the drive motor will start. Thus it will be seen that during the fill period the control cams are not turned. Had the operator chosen to use a mixture of hot and cold water for washing, pole **58***a* of switch **58** would have been closed manually before starting the machine, whereupon the branch circuit **74**, **75** would have connected cold water solenoid **37** in parallel with the solenoid **38** across the conductors **65**, **68**.

Water is supplied to basket **6** and, upon reaching the base level corresponding to the overflow top portions of tubes **10**, begins to spill into tub **2**. As the level rises in the tub, the level in the basket remaining at the base level, a greater and greater pressure is developed upon the air contained in tube **42**. When this pressure reaches the value established by the setting of variable control knob **41** for actuation of the switch **40**, the diaphragm **44** lifts switch arm **45**, opens lower contact **47** and closes contact **46**, thereby removing coil **38** from the circuit and thus permitting the water valve **34** to close. Also timer motor **56** is energized through conductor **77**, closed contact **46** and conductors **70**, **78**. The main winding **20***b* of drive motor **20** is energized in a circuit including contacts **53***a* and conductors **72**, **73** as before, and start winding **20***a* is energized in a circuit including conductors **72**, **80**, bridged contacts **54**A, conductor **81**, the normally closed centrifugal switch **20***c*, winding **20***a*, bridged contacts **55**A, and conductors **82**, **83** to return conductor **63**. Thus, the start and run windings of the drive motor are in parallel circuit relationship with the timer motor, and, consequently when the coil **38** is removed from the circuit, both motors are energized despite the difference in their relative impedances. The timer motor **56** begins to drive the program controlling cams in a counterclockwise direction and the drive motor begins oscillating the agitator **7** through agitate clutch **22**, sheave **23** and mechanism **12**.

Simultaneously with the beginning of the operation of motor **20** the pump **30** begins to recirculate the amount of water which meanwhile has accumulated in the tub **2**. This amount of water comprises a usable increment over and above the base level of water contained in the basket at that time. If, for example, the washing machine is designed for a base level equal to one-half the water capacity of basket **6** and if the knob **41** is set to permit an amount of water to collect in the tub equal to one-half the water capacity of the basket, then operation of pump **30**, due to its greater rate of pumping than the rate of issuance from tubes **10** can soon fill the basket substantially full of water and continue to maintain it in a substantially filled condition during the agitating phase of washing. In any case no matter how much water is admitted to the tub during the fill period after the base amount is collected in the basket, the pump soon moves substantially all of it into the basket and maintains it therein throughout the agitate period. Thus the water admitted to the tub comprises a variable factor whereby the amount of water used for washing may be controlled by the user. The basket, for example, may be half filled, three quarters filled, filled completely full, or filled to any increment therebetween depending upon the amount of water necessary to wash effectively the clothes load in the basket. The less clothes, the less water is needed.

The selection permitted the user as to the amount of water to be employed results in a more efficient use of water and makes possible a conservation of water not possible when the agitation is initiated only after the basket is filled to the point of overflow from apertures **8**. In many machines wherein the water level control valve is operated only after the basket is filled, an unnecessary wastage of water occurs. The use of an excessive amount of heated water is particularly undesirable and is avoided in the practice of my invention.

When pump **30** moves the water in the tub into the basket, the water level switch **40** returns to its "empty" position, i.e. arm **45** breaks contact with arm **46** and makes contact with arm **47**. In order to prevent this action from energizing the water valve solenoids, a shorting circuit is provided whereby the valve solenoids are shorted out so long as the motor **20** continues to operate. The shorting circuit comprises a second set of contacts **20***d* of the motor centrifugal switch **20***c*, which are connected between lines **77** and **70** by means of connections **100** and **101**. The contacts **20***d* are closed when the motor **20** comes up to speed and effectively short out the valve solenoids **37** and **38** so long as the motor continues to rotate. Thereby, the water level switch **40** is ineffective to add additional water to the machine during the wash period even though all of the water is pumped out of the tub into the basket.

As above indicated, when the timer motor **56** begins to turn, the time responsive operations, best shown in the cam chart of Fig. 3, are initiated. The portion of the wash cycle labeled "Agitate" in Fig. 3 includes both the fill and agitate space on the dial **51**. Agitation begins in the manner explained above as soon as the switch **40** is actuated. Thus, the timer does not start driving the cams until after the initial fill. The agitation part of the wash cycle may include approximately one-third of the total space on the periphery of the cams, as shown on the cam chart, or considerable variations from this amount, depending on the washing machine to which it is adapted and the amount of the selective time differences to be made available for the user. For example, the user may have a choice, when first turning dial **51**, of washing times varying from five to twenty minutes.

When the drive motor has reached a predetermined speed, the centrifugal switch **20***c* opens, thereby removing the start winding **20***a* from the circuit. The contacts **20***d* of the switch are simultaneously closed to prevent energization of the inlet valve solenoids. The agitate cycle then proceeds with the clothes being washed by the movement of the agitation with substantially all of the water admitted to the tub during the fill period being maintained in the basket to aid in the washing action. Before the agitation cycle has been completed, the cam follower riding on the periphery of the dial **51** enters onto the high portion, closing both poles of switch **58** to insure

that a fixed mixture of cold and hot water is supplied to the basket for subsequent fills. The closing of this switch also provides an alternate path for power from conductor 62 to conductor 70 whenever the contacts 52A are opened and the contacts 52S are closed. Shortly after switch 58 is closed and before the agitate cycle is completed, the cam 52 actuates its follower so as to open the contacts 52A and close the contacts 52S. Since the closing of switch 58 connects line 62 to line 66 through line 84, contact 58*b* and lines 85 and 74, the opening of contacts 52A does not interrupt, even momentarily, the rotation of either the motor or the timer. Rather they continue to rotate as before, only being energized through contact 58*b* instead of through contact 52A. The closing of contacts 52S, however, provides a shunt circuit around the water level switch 40 whereby the solenoids 38 and 34 cannot be energized even when the motor 20 stops rotating. The closing of contacts 52S also completes a circuit for energizing the timer so that it continues to run irrespective of the rotation of the drive motor and the position of the water level switch. In other words once contacts 52S close, power is supplied to the timer even though the contacts 20*d* of the centrifugal switch are opened.

As the timer continues to rotate the cams, the follower of cam 53, or III as shown on the cam chart, drops off the high portion of the cam, thereby opening the contacts of switch 53*a*. This interrupts the energizing circuit for the main winding 20*b* of the drive motor 20, thereby ending agitation as the motor and its driven mechanism come to a stop. This interruption permits switch 20*c* to again close and allows contacts 20*d* to open. However, power is still supplied to the timer through switch 58, lines 74 and 65, closed contacts 52S and lines 89 and 78.

During this pause period the timer motor 56 therefore continues to rotate the cams, and substantially simultaneously the cam followers for cams 55 and 54 (I and II as seen on the cam chart) enter on the high portions of their respective cam peripheries, thereby opening the switch contacts 55A and 54A and closing contacts 55S and 54S. The timer remains energized, since these switches are not in the timer circuit. The opening of contacts 54A and 55A and the closing of contacts 54S and 55S, however, connect the start winding 20*a* in the opposite direction from the connection previously described. But the start winding and the main winding 20*b* are not energized until switch 53 is closed.

When the time allotted for the short pause period is over, the cam follower riding on the periphery of cam 53, or III, as shown in the chart enters onto the high portion, thereby closing switch 53*a*. This completes the reversed connection circuit for the start winding, including conductors 62 and 84, closed contact 58*b*, conductors 85, 74, and 65, closed contacts 52S, conductors 89 and 71, switch 53*a*, conductors 72, 73 and 86, the bridged contacts 55S, conductor 87, winding 20*a*, switch 20*c*, conductor 81, bridged contacts 54S, conductors 88 and 83, and return conductor 63. Also completed is a main winding circuit comprising conductors 62 and 84, closed contact 58*b*, conductors 85, 74 and 65, closed contacts 52S, conductors 89 and 71, closed switch contacts 53*a*, conductors 72 and 73, winding 20*b*, and return conductor 63.

Completion of these circuits starts the motor in the opposite direction of rotation from agitate, and initiates the spin cycle. The basket is rotated through the clutch 24, the sheave 25 and the mechanism 12. Pump 30 is now driven in the direction in which it discharges into drain conduit 31, the control valve of the pump (not shown) having been actuated upon the changing of direction of the pump rotation to close communication between the pump outlet and recirculation conduit 32 and to open communication between that outlet and drainage conduit 31. Immediately the pump starts to discharge the increment of water collected in the tub 2 during the pause period and to discharge also the base load of water in the spinning basket 6, which water now begins to discharge into the tub from the basket through openings 8 due to centrifugal force.

As the motor comes up to speed, the centrifugal switch 20*c* opens, removing the start winding from the motor circuit and at the same time contacts 20*d* are closed providing another shunt around the water level switch in parallel with contacts 52S. The circuit through contacts 20*d* connects with the reversed start circuit and main winding circuit just as the circuit through contacts 52S, i.e. through line 71, switch 53*a*, etc. Both contacts 52S and 20*d* shunt the circuit through solenoids 37 and 38 completed upon the closing of contact 47 of the switch 40 as the water drains from the machine; and thereby they prevent the energization of the solenoids 37 and 38 and the opening of the inlet water valves 33 and 34.

The spin portion of the cycle continues until the cam follower for cam 53 drops into the next depression. By this time all the water has normally been removed from the machine. As best shown in Fig. 3, the cam 53, or III, is provided with a depression of about twice the peripheral length of its previous depression, which initiated the first pause period. When the cam follower drops in this depression, the switch 53*a* is opened, interrupting the drive motor circuit and initiating a coast period.

Shortly after the beginning of the coast period, the centrifugal switch 20*c* closes and later during the coast period the cams 55, 52 and 54 (I, IV and II as shown in Fig. 3) rotate to a point where the respective cam followers drop down upon low portions of the cam peripheries. Consequently, switch contacts 55S, 52S, and 54S are opened and contacts 55A, 52A and 54A are closed. This prepares the circuits for the start winding 20*a* and the main winding 20*b* for the drive motor so that they will be energized, upon the closing of switch 53*a* and the contact 46 of switch 40, by the same circuits as in the case of the earlier agitate period, with the start winding connections opposite to that described for the spin period.

The timer motor continues to operate after contacts 52S are opened and contacts 52A are closed, but is energized in series with the solenoids 37 and 38 and the contact 47 of the water level switch. Although the solenoid shunting circuit has been interrupted, the impedance of the timer is so much greater than that of the solenoid coils that they will not operate to initiate another fill operation rather the timer continues to run. Filling the basket with water at the beginning of this coast period would be undesirable, since the peripheral speed of the basket is so great that the water spray from spout 35 might cause tearing or fraying of the clothes.

The coast period ends when the cam follower from cam 53, or III, as seen in Fig. 3, is elevated once again to a high position of the cam periphery, thereby closing switch 53*a*. Both water valves are immediately opened to begin filling the basket 6 to its base level with a mixture of hot and cold water by reason of the following circuit; from the plug P through conductors 62, 84 to contact 58*b*, through conductor 85, and then alternately through either contact 58*a*, conductor 75 and cold water solenoid coil 37 or conductors 74, 66, hot water solenoid coil 38 and conductor 67, and then to conductor 68, contact 47 of switch 40, conductors 70, 71 to the bridged contacts 53*a*, conductors 72, 73 to the main winding 20*b* of motor 20 and through the return conductor 63 back to plug P.

It will be noted that, just as for the first fill period, the timer circuit offers a parallel return path for the water valve circuit just described, by conductors 70, 78, timer motor 56 and conductor 63 to the plug P. The impedance of the water valve solenoids, being greater than that of the drive motor, is greater than that of the parallel circuit including the drive motor and the timer motor,

and sufficient voltage drop across the solenoids is obtained to energize them, thereby opening the water inlet valves. In fact, practically full line voltage is drawn across the solenoids. Since the start winding **20***a* is in parallel relationship with the main winding **20***b*, its effect is merely to further lessen the impedance of the drive motor and timer motor circuits. Thus, the water valves are opened, but since practically full line voltage is drawn across the water valve solenoids neither the drive motor nor the timer motor operates. The cams remain stationary, therefore, until the water in the tub **2** reaches a sufficient depth, by overflowing from the ends of tubes **10**, to actuate the switch **40**, opening contact **47** and closing contact **46** to remove the water valve solenoids from the circuit. By the time this is accomplished, the desired additional increment of water, over and above the base load in basket **6**, will have been supplied to the washing machine.

Upon the opening of contact **47** of the switch **40**, contact **46** is closed, thereby establishing the identical timer and drive motor circuits that were used at the end of the first fill and the beginning of the initial agitate operation. In addition, a circuit comprising conductors **62**, **84**, closed contact **58***b* and conductors **85** and **74**, is established to form an alternate supply path in parallel with bridged contacts **52**A so that the opening of **52**A will interrupt neither the timer nor the drive motor operation. The contacts **20***d* of the centrifugal switch close when the motor comes up to speed thereby to shunt the water level switch and prevent energization of the valve solenoids as the pump passes the water in the tub **2** into the wash basket **6**.

The end of the second or rinse agitate period, during which the pump **30** maintains substantially all of the added increment of water in the basket **6**, occurs when the cam follower for cam **53** falls to a low position on the cam periphery (see the chart for cam III in Fig. 3), thereby opening the switch **53***a* and interrupting the drive motor circuit. This initiates the second pause period, the coasting to a stop of the motor, pump, and mechanism being referred to as a "pause" following agitation and a "coast" following spinning. The contacts **52**A are opened and the contacts **52**S closed slightly before switch **53***a* is opened thus shunting the water level switch and preventing energization of the water valves as the motor ceases its rotation. The timer motor, of course, remains undisturbed.

The second or rinse spin operation is initiated in the same manner and using the same circuits as the initial or wash spin operation previously described. During the rinse spin the pump **30** discharges the water from the machine through conduit **31**. The only variation in the machine operation over that found in the earlier spin occurs at the end of the extraction period in that following the opening of switch **53***a* to de-energize the drive motor the switch **58** opens when the cam follower for the dial **51**, or cam V, as shown on the cam chart, falls into a low position on its periphery. This opens the circuit to the timer motor and terminates machine operation. It also permits the operator to choose whether hot wash water for the next washing, or a mixture of hot and cold water is desired.

It is apparent, of course, that upon moving the dial manually from the "Off" position to the "Wash" position, switch contacts **55**A and **54**A are closed, then switch **53***a* is closed and finally contacts **52**A are closed to prepare the circuits for another filling operation and wash agitate period to begin the washing of another clothes load.

In accordance with my invention I am able to provide a valuable water conservation feature for existing clothes washing machines without modification of the normal cycle of operation of the same. This feature enables the operation to use an amount of water proportional to the load of clothes being washed, and at the same time avoids a condition of agitating the clothes in the basket without a base level of water being present.

The tubes **10** attached to basket **6**, moreover, serve to discharge any sand or dirt collecting in the basket. During the washing operation the sand and dirt settle to the bottom of the basket and work their way under the oscillating agitator. They then settle through aperture **9** into the space between the bottom wall **6***a* of the basket and the plate **11**. When the machine later proceeds into centrifugal extraction, the sand and dirt is discharged outwardly into the tub through tubes **10**.

The arrangement of aperture **9** beneath the agitator skirt also has the additional advantage that it prevents the clothes from plastering against the entrance into tubes **10**. The movement of the agitator together with the small clearance between the agitator skirt **7***a* and the basket bottom **6***a* prevent the clothes from being sucked into the aperture **9** during the washing and rinsing operation. During centrifugal extraction the clothes are of course thrown outwardly onto the side wall of the basket away from the agitator and the aperture **9**.

However, in its broader aspects the invention is not limited to the precise arrangement of tubes **10** as shown and as an alternative a plurality of secondary apertures, with an equivalent discharge capacity to that of tubes **10**, may be provided in the basket at a selected level on its side wall, using a basket with a closed bottom attached to the basket drive. This alternate embodiment is shown in Fig. 5 of the drawings, and elements in it similar to those in the embodiment of Fig. 1 are indicated by the same reference numerals. In this embodiment a plurality of apertures **110** located at approximately the midpoint of the side wall of the basket **6** serve as the means for providing basket overflow after the establishment of a base amount of water therein. These apertures **110** limit the amount of water supplied to the basket during "Fill" to a predetermined base amount in the same manner as the tubes **10** in the embodiment of Fig. 1. The increment of water overflowing on the tub **2** after the level of apertures **110** is reached may then be selectively varied so as to control the total amount of water supplied to the machine. This provides for varying the total amount of water supplied to the machine so that only the necessary amount is supplied for the particular load of clothes being washed, while at the same time insuring that at least a base or minimum amount of water is supplied to the basket before agitation commences.

During agitation the increment of water supplied to the tub is pumped into the basket through pump **30** and recirculation conduit **32**. The capacity of the pump and conduit is greater than that of apertures **110**, whereby the pump is effective to maintain substantially all of the water on the basket during agitation. Both the base amount supplied to the basket and increment supplied to the tub are thereby used during both the washing and the rinsing operations.

While I have shown particular embodiments of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made; and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

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

1. In a clothes washing machine having a tub, a spin extractor basket in said tub, washing means in said basket, water supply means feeding into said basket, a motor for driving selectively said washing means and said basket during washing and extraction operations, water overflow means in said basket for overflowing water supplied thereto after establishment of a base level of water in said basket only partially filling said basket, said overflow means overflowing said water into said tub, adjustable control means for said water supply means operating to shut off the supply of water responsively to variable

amounts of water accumulated in said tub, and a pump receiving water from said tub and delivering it to said basket during the washing operation, said pump having a delivery rate in excess of the overflow capacity of said water overflow means so that the water level in said basket is raised above said base level during the washing operation by the variable amount of water accumulated in said tub, whereby depending upon the setting of said control means said basket may be filled to different predetermined levels during the washing operation.

2. The combination of claim 1 wherein said overflow means comprises means for centrifugally extracting sand from said basket into said tub during the extraction operation.

3. In a clothes washing machine having a tub, a spin extractor basket in said tub, washing means in said basket, water supply means feeding into said basket, a motor for driving selectively said washing means and said basket during washing and extracting operations, a plurality of tubes opening into the bottom of said basket and extending upwardly along the side wall of said basket for a portion of the height thereof, said tubes forming overflow means effective to overflow the water supplied to said basket after the establishment of a base level of water in said basket only partially filling said basket, said tubes emptying into said tub, adjustable control means for said water supply means operating to shut off the supply of water responsively to variable amounts of water accumulated in said tub, and a pump receiving water from said tub and delivering it to said basket during the washing operation, said pump having a delivery rate in excess of the overflow capacity of said water overflow means so that the water level in said basket is raised above said base level during the washing operation by variable amount of water accumulated in said tub, whereby depending upon the setting of said control means said basket may be filled to different predetermined levels during the washing operation.

4. In a clothes washing machine having a tub, a spin extractor basket in said tub, washing means in said basket, water supply means feeding into said basket, a motor for driving selectively said washing means and said basket during washing and extracting operations, the side wall of said basket including a plurality of apertures for overflowing the water supplied to said basket after the establishment of a base level therein only partially filling said basket, said apertures discharging said water into said tub, adjustable control means for said water supply means operating to shut off the supply of water responsively to variable amounts of water accumulated within said tub, and a pump receiving water from said tub and delivering it to said basket during the washing operation, said pump having a delivery rate in excess of the overflow capacity of said water overflow means so that the water level in said basket is raised above said base level during the washing operation by the variable amount of water accumulated in said tub whereby depending upon the setting of said control means said basket may be filled to different predetermined levels during the washing operation.

5. In a clothes washing machine having a tub, a spin extractor basket in said tub, washing means in said basket, electro-responsive water supply means for feeding

into said basket, a pump receiving water from said tub, an electric motor for driving selectively said washing means and said basket during washing and extracting operations, an adjustable water level switch responsive to the amount of water accumulated in said tub for controlling said water supply means, a timer-operated program control circuit including said switch, said electric motor and said water supply means for conducting a prescribed sequence of washing and extracting operations, water conserving control means including overflow means in said basket adapted to overflow the water supplied thereto into said tub after the establishment of a base level of water in said basket only partially filling said basket, means for selectively driving said pump during the selective driving of said washing means and said basket, said pump being effective to recirculate into said basket water collected into said tub when the washing operation is being conducted in said basket and to drain used water from the machine when the extraction operation is being conducted by said basket, said pump having a pumping rate greater than the rate of overflow from said basket through said overflow means, thereby during the washing operation increasing the amount of water contained in said basket by the variable amount of water supplied to said tub after said base level is established in said basket so that said basket may be filled to different predetermined levels during said washing operation.

6. In a clothes washing machine having a tub, a spin extractor basket in said tub, an agitator in said basket, water supply means feeding into said basket, a motor for driving selectively said agitator and said basket during washing and extraction operations, a plurality of tubes opening into the bottom of said basket beneath said agitator and extending upwardly along the side wall of said basket for a portion of the height thereof, said tubes forming overflow means effective to overflow the water supply to said basket after the establishment of a base level of water in said basket only partially filling said basket, said tubes discharging said water into said tub, adjustable control means for said water supply means operating to shut off the supply of said water responsively to variable amounts of water accumulated in said tub, and a pump receiving water from said tub and delivering it to said basket during the washing operation, said pump having a delivery rate in excess of the overflow capacity of said tubes so that the water level in said basket is raised above said base level during the washing operation by the variable amount of water accumulated in said tub, whereby depending upon the setting of said control means said basket may be filled to different predetermined levels during the washing operation.

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