

July 22, 1952

H. E. MORRISON

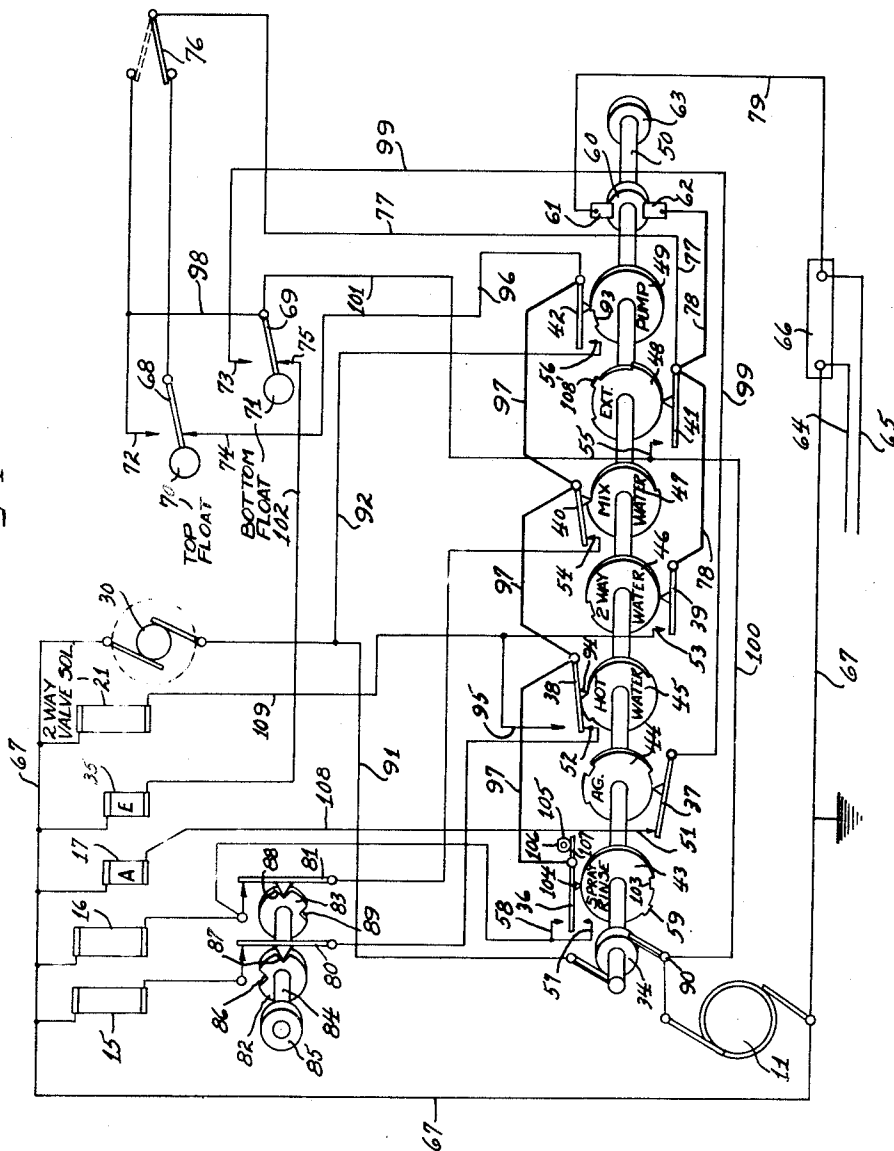
2,604,497

WASHING MACHINE CONTROL CIRCUIT

Filed April 26, 1946

2 SHEETS—SHEET 1

Fig. 1



Inventor  
Harold E. Morrison

by The Firm of Charlesworth & Attys

July 22, 1952

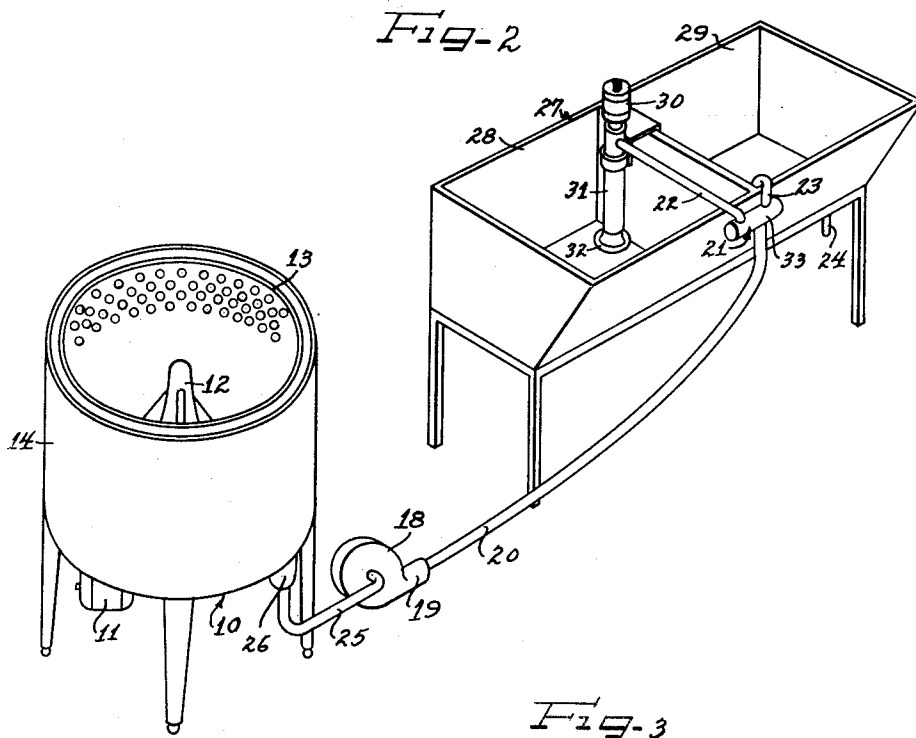
H. E. MORRISON

2,604,497

WASHING MACHINE CONTROL CIRCUIT

Filed April 26, 1946

2 SHEETS—SHEET 2



| MINUTES       | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |  |
|---------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|
| 2 WAY VAL.    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| STORAGE MOTOR |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| AGITATOR      |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| WARM          |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| HOT           |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| EXTRACT       |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| 2 WAY VAL.    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| SPRAY         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| RINSE         |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| AGITATOR      |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| EXTRACT       |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |

INVENTOR.

Harold E. Morrison

BY

The Firm of Charles W. Hill

## UNITED STATES PATENT OFFICE

2,604,497

## WASHING MACHINE CONTROL CIRCUIT

Harold E. Morrison, St. Joseph, Mich., assignor  
to Whirlpool Corporation, a corporation of New  
York

Application April 26, 1946, Serial No. 665,280

3 Claims. (Cl. 171-97)

1

This invention relates to a washing machine control circuit and more particularly to control circuits of automatic washing machines having a storage pump associated therewith for returning suds water previously used to the washing machine tub.

One of the principal features and objects of the present invention is to provide a control circuit for an automatic washing machine which includes the main washing machine motor, a timer motor, and a storage or suds pump motor, and in which the timer motor is always energized either in series with the main washing machine motor or in series with the suds pump motor.

A further object of the present invention is to provide a novel energization circuit for the timer motor of an automatic laundry machine.

Another object of the present invention is to provide a novel energization and control for a pump motor associated with an automatic washing machine.

Still another object of the present invention is to provide novel safety means for substantially eliminating the possibility of burning out the pump motor of a laundry machine.

Still another and further object of the present invention is to provide a novel control circuit for an automatic washing machine in which means is provided for manually selecting the liquid level in the washing machine tub when desired.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization, manner of construction and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings, in which:

Figure 1 is a diagrammatic representation of a novel control circuit embodying the novel features and characteristics of the present invention;

Figure 2 is a diagrammatic representation of the washing machine and storage tub; and

Figure 3 is a schedule setting forth the sequential operation of the device.

The washing machine 10, which is diagrammatically illustrated as embodying the novel features of the invention, includes a main washing machine motor 11 which is preferably a split phase induction motor and is of such a size as to oscillate an agitator 12 in a clothes basket 13 of the washing machine 10. Fresh water admission to the tub 14 in which the agitator 12 and the

2

clothes basket 13 are disposed is under the control of a solenoid 15 and a solenoid 16, which when energized opens suitable valves arranged to admit water to tub 14 at two different predetermined elevated temperatures, or a mixture thereof. Since the structure of the fresh water valve admission mechanism forms no part of the present invention, it has only diagrammatically been referred to. Any suitable conventional structure may be used such, for example, as that illustrated in the Breckenridge Patent No. 2,296,266, entitled "Liquid Mixing Device," issued September 22, 1942.

The agitator 12 is arranged to be operated about a vertical axis and is controlled by a solenoid which, when energized, mechanically connects the agitator with the drive mechanism from the main motor 11, such, for example, as in the manner described in the copending application of Peter Eduard Geldhof and Luther Ringer, Serial No. 491,618, filed June 21, 1943, now Patent No. 2,521,158, entitled "Automatic Washing, Rinsing and Drying Machine," and assigned to the same assignee as the present invention. Thus for operation of the agitator 12 both the agitator control solenoid 17 and the main motor 11 must be energized.

The basket 13 is arranged to be rotated at a relatively high speed by the motor 11 about a vertical axis coincident with the axis of oscillation of the agitator 12. This operation is effected by energization of a solenoid 35 which connects the basket 13 with the drive mechanism from the motor 11, such, for example, as in the manner described in the copending application of Peter Eduard Geldhof and Luther Ringer, Serial No. 491,618, filed June 21, 1943, entitled "Automatic Washing, Rinsing and Drying Machine," and assigned to the same assignee as the present invention.

The washing machine 10 is also equipped with a pump 18 which is always in open communication with the tub 14. The discharge side 19 of the pump 18 is connected to a hose 20 which leads through a two-way valve 21 and a hose 22 to a suds pump 31 and to a discharge nozzle 23, the suds pump 31 being disposed in a storage compartment 28 and the discharge nozzle being disposed over a drain compartment 29 having a drain 24 in the bottom thereof. These compartments or chambers 28 and 29 may conveniently be a set of ordinary household wash tubs 27 with the drain in the compartment 28 stopped up to form a storage compartment. This arrangement of the pump and two-way valve is only diagram-

matically illustrated since the structural features and arrangement per se are described and claimed in the copending application of Peter Eduard Geldhof, Luther Ringer, and myself, Serial No. 630,032, filed November 21, 1945, now Patent No. 2,562,610, entitled "Self-Priming Pumping System," and assigned to the same assignee as the present invention.

Attention is called to the fact that the elevation of the two-way valve or the elevation of the high point of the hose 22 of the nozzle 23 is such that it is higher than the maximum desired water level of the tub 14. Thus, while the intake side 25 of the pump 18 is in open communication with the sump 26 in the bottom of the tub 14, the water is not drained out, for it will only rise to a height in the hose 20 corresponding to the height in the tub 14.

The pump operation control mechanism is under the control of the agitator control solenoid, the pump being mechanically coupled to the main motor 11 at all times when the agitator control solenoid 17 is deenergized. This may be mechanically accomplished in any suitable manner such, for example, as in the manner described in the copending application of Peter Eduard Geldhof and Luther Ringer, Serial No. 619,192, filed September 28, 1945, now Patent No. 2,540,724, entitled "Control Mechanism for Washing Machine," and assigned to the same assignee as the present invention. Thus operation of the pump 18 depends upon two conditions being filled; namely, motor 11 must be running and solenoid 17 must be deenergized.

The intake 32 of the suds pump 31 is adjacent the bottom of the storage compartment 28. The suds pump 31 is driven by the motor 30 and is arranged to pump suds water back from the storage compartment 28 through the hose 22, the two-way valve 21, the hose 20 and the pump 18, and hose 25, to the tub 14 of the washing machine 10. While the complete cycle of operation will be discussed in detail when the detail operation of the control circuit of Figure 1 is described, it may be said at this time that in general the clothes are placed in the basket 13 within the tub 14, and washed therein. After the washing the suds water is pumped by the pump 18 to the storage compartment 28, the two-way valve 21 being energized so that the valve member 33 thereof places the hose connection 22 in communication with the hose 20. The basket 13 is then rotated at high speed to extract water from the clothes. The tub 14 is then filled with fresh water and the clothes are rinsed. After rinsing, the fresh water is discharged by the pump 18 through the two-way valve 21, through the discharge nozzle 23 over the drain tub 29, the two-way valve 21 being deenergized during this stage so that the valve member 33 is in its dotted line position, as shown in Figure 2. The basket is then rotated again at high speed to extract water from the clothes. When a new batch of clothes is to be washed, the suds water, which has been stored in the storage compartment 28, is pumped back into the tub 14 by the suds pump 31 driven by the motor 30.

The washing machine 10 has three motors which are associated therewith; namely, the main washing machine motor 11, which is a split phase induction motor; the suds pump or storage pump motor 30, which is a small series commutator motor; and synchronous motor 34, which is the timer motor for controlling the sequential operation of the automatic washing machine.

These three motors, 11, 30 and 34, are very different in their impedance characteristics, and as will presently be pointed out, advantage is taken of the fact that the impedance of the synchronous motor 34 is relatively high as compared with the impedance of either the induction motor 11 or the series commutator motor 30. Thus, if an E. M. F. is impressed across the synchronous motor 34 and the induction motor 11, with these two motors in series, the synchronous motor 34 will be driven, but the induction motor 11 will not be driven due to the relatively low voltage drop across the induction motor as compared with the synchronous motor. The fact that the induction motor 11 is not running will not affect the operation of the synchronous motor 34. Similarly, if the synchronous timer motor 34 is connected in series with the storage pump or suds pump motor 30 and an E. M. F. is impressed across the two of them while in series, the timer motor will run but the suds pump or storage pump motor 30 will not run. Furthermore, due to the very low impedance of the series motor, there will not be any excessive heating of this motor even though it stands idle and the current to the synchronous flows therethrough.

One of the principal features of the present invention is to provide a novel automatic control circuit wherein safety means is provided to prevent overheating and burning out of the suds pump motor and particularly wherein the sequential timer control mechanism will creep over into the next operation stage if there is an insufficient supply of sudsy water in the storage compartment to raise the upper float of the washing machine, and which will bring in additional fresh water to make up the deficiency.

Referring now particularly to Figure 1 of the drawings, the automatic sequential operation of the washing machine 10 is under the control of a plurality of cam operated switches 36 to 42, which are arranged to be actuated by a plurality of cam disks 43 to 49 respectively, all mounted on a cam shaft 50 driven by the synchronous timer motor 34. Switches 37 and 39 to 42 have single stationary contacts 51 and 53 to 56 associated therewith respectively. Switch 36 has a lower contact 57 and an upper contact 58, while switch 38 has a lower contact 52 and an upper contact 95. In this connection it will be noted that the cam disks 43 and 45 not only have notches or depressed portions in the peripheral surface thereof, but also have raised portions 59 and 94 respectively, which are arranged to raise the switches 36 and 38 into engagement with the upper contacts 58 and 95.

The cam shaft 50 is also provided with a bridging contact 60 which closes across the gap between the contacts 61 and 62. The shaft 50 is axially movable so as to disengage the bridging contact 60 from the stationary contacts 60 and 61 to open the entire control circuit. The shaft 50 is provided with a control knob 63 which enables the shaft 50 to be axially moved to position the bridging contact into and out of engagement with the stationary contacts 61 and 62, and is also arranged to advance the cams in a counter-clockwise direction as viewed in Figure 1 of the drawing, which is the direction of normal rotation of the cam shaft 50 by the synchronous motor 34.

Energy is supplied to the control circuit through a pair of power supply conductors 64 and 65 which are connected to the terminal block 66. The power supply conductor 65 is connected to

the stationary contact 51. The return circuit to the power supply conductor 64 is through the conductor 67, which, for purposes of this discussion, may be considered as the grounded side of the control circuit.

Two float operated switches, 68 and 69, are provided for the washing machine 10. The float operated switch 68 is the upper fluid level control and the float operated switch 69 is the lower fluid level control. These two switches 68 and 69 are diagrammatically represented as being actuated by the upper fluid level float 70 and the lower fluid level float 71. The lower level float 71 is positioned so as to be in its lowermost position only when the tub 14 is substantially empty. The float switches 68 and 69 are provided with upper contacts 72 and 73 respectively and with lower contacts 74 and 75 respectively. The movable contact arm 68 of the upper float 70 is connected to the power supply conductor 65 through a switch 76, conductor 77, bus 78, bridging contact 60 and conductor 79.

The hot and mix fluid control solenoids 15 and 16 are connected through a pair of manually operable switches 80 and 81 respectively, which are actuated by a pair of cams 82 and 83 mounted on a control shaft 84 which may be turned by the knob 85. The cam 82 is provided with a pair of notches 86 and 87, while the cam 83 is provided with a pair of notches 88 and 89. The notches 87 and 88 are angularly aligned and for that reason it will be apparent that when the control shaft 84 is in one position only switch 80 is closed; while in a second position switches 80 and 81 are closed; and while still further and in a third position only switch 81 is closed. It will thus be apparent that water may be supplied to the tub 14 at any one of three different temperatures as selected by the control knob 85.

Switch 80 is connected to the stationary contact 52 associated with the cam disk 45, while switch 81 is connected to stationary contact 54 associated with the cam disk 47. It will thus be seen that the hot and warm fluid solenoids 15 and 16 are under the control of the cam switches 38 and 40. Warm fluid solenoid 16 is also under the control of the cam switch 36, for the lower end of the solenoid 16 is directly connected to the stationary contacts 57 and 58 associated with the switch 35. The agitator and pump control solenoid is connected to the stationary contact 51 and is under the control of the switch 37. The lower end of the extractor solenoid 35 is directly connected to the lower contact 75 of the low level float switch 69. The movable float switch 69 is connected to the stationary contact 55 of the cam switch 41 and also to the midpoint 90 between the main motor 19 and the synchronous motor 34. The lower side of the two-way valve solenoid 21 is connected to the stationary contact 53 of the cam switch 39 and also to contact 95 of switch 38.

The lower side of the suds motor 30 is connected through a conductor 91 to the timer motor 34 and also through conductor 92 to the stationary contact 56 of the cam switch 42.

The position of the cams 43 to 49 and a comparison thereof with the schedule as illustrated in Figure 3 will show that the cam shaft 50 has just passed the suds pump stage of the operation of the complete cycle and is at the point where additional water will be introduced into the tub if the suds water has not raised the liquid level to a height sufficient to raise the top float 70. It is not deemed necessary to illustrate the cams in

all of their different relative positions during the successive stages of the cycle of operation, for the following description of the operation will be sufficient to understand the operation of the control circuit.

Assume that the cam shaft 50 has been rotated to a point where the cam switch 42 has just dropped into the cam recess 93 so as to close the switch 42 against the contact 56 and that the cam shaft 50 has been moved axially so as to close the bridging contact 60 across the contacts 61 and 62. With the cam shaft 50 in this particular position, the elevated portion 94 of the cam 45 has come into engagement with a depending engaging portion of the switch 38 and raised the switch 38 into engagement with an upper contact 95 which is connected to the lower side of the two-way valve 21 through conductor 109. The cam 44 has also caused the cam switch 37 to close against the stationary contact 51; the remaining cam switches 36, 39, 40 and 41 being open.

The manual switch 76 is normally in the full line position as shown in Figure 1 of the drawings, and is only moved to its dotted line position in a manner hereinafter to be described to eliminate the operation of the top float and control the water height in the tub. Let it also be assumed that the control knob 85 is in the position as shown in Figure 1 of the drawings so that switches 80 and 81 are both closed.

Thus in this initial position of the elements of the control circuit 51 the suds pump 30 is energized from the conductor 65 through conductor 79, bridging contact 60, conductors 78 and 77, switch 76, float switch 68, lower contact 74 of the upper float switch 68, conductor 96, cam switch 42 and conductor 92, to one side of the suds motor 30. The other side of the suds motor 30 is connected to the return conductor 67 to the other supply conductor 64. The two-way valve 21 is also energized through the upper contact 95 of the cam switch 38, the power therefor being obtained from conductor 65 through conductor 79, bridging contact 60, conductors 78 and 77, switch 76, float switch 68, lower contact 74, conductor 96, bus 97, cam switch 38, upper contact 95 and conductor 109 to the lower side of the two-way valve 21.

The other side of the two-way valve 21 is connected to the return conductor 67. The energization of the two-way valve 21 is of course necessary to place the hose connection 22 from the pump 31 into connection with the hose 20 which is the return path for the suds water.

Although the cam switch 37, which is associated with the agitator solenoid 17, is closed, the agitator control solenoid 17 is not energized until after the top float 70 raises to close the float switch 63 against the upper contact 72. That means that the agitator does not start to oscillate until after the desired water level has been reached within the tub 14. When the top float 70 rises to close the float switch 68 against the upper contact 72 the agitator control solenoid 17 is energized from the supply conductor 65, the conductor 79, bridging contact 60, conductors 78 and 77, switch 76, top float switch 63, contact 72, conductor 98, lower float switch 69, upper contact 73 of lower float switch 69, conductor 99, cam switch 37 and conductor 108, to the lower side of the agitator control solenoid 17. The other side of the solenoid 17 is connected to return conductor 67.

This means that while the cam switches are

still closed in the manner above described, the suds pump and the two-way valve 21 are energized to pump water back into the tub and that after the water level in the tub has reached the desired height, the agitator is placed into operation. Since the two-way valve 21 and the suds pump motor 30 are both energized through the top float switch while it is in its lower position it will be apparent that as the top float switch 68 moves off of the lower contact 74, the two-way valve 21 and the suds pump motor 30 are deenergized.

It will be observed that during the time that the suds pump motor is being energized through the cam switch 42, the synchronous timer motor 34 is connected in series with the split phase induction motor 11 across the line. More particularly, it has already been pointed out that the conductor 92, during this stage of the operation, is in connection with the supply conductor 65. Since the upper side of the synchronous timer motor is connected to the conductor 92 through the conductor 91, it will be apparent that the synchronous motor is connected in series between the conductors 92 and 67 which are in turn connected to the power supply conductors 65 and 64. This causes operation of the synchronous motor 34 to rotate the cam shaft 50. It will be remembered that the synchronous motor 34 has a relatively high impedance as compared with the split phase induction motor 11 so that during this stage of the operation the induction motor 11 does not have a sufficient voltage impressed thereacross to cause operation thereof.

At the time when the top float switch 68 is raised from its lower position to its upper position the induction motor 11 is energized from supply conductor 65, conductor 79, bridging contact 69, conductors 78 and 77, switch 76, float switch 68, top contact 72, and conductors 98, 101 and 100 to the upper side of the motor 11. The lower side of the motor 11 is connected to the return conductor 67.

It will be observed that if some additional connection is not provided for the timer motor 34, its operation would cease at this point. It will be noted, however, that at this time the synchronous motor is connected in series with the suds pump motor 30 across the line. The power connection from the supply conductor 65 up to the point 90 has been traced. From here it passes through the synchronous motor 34, conductor 91 and suds pump motor 30 to the return conductor 67. It will thus be observed that the timer motor continues to rotate the cam shaft 50 although it is now being energized serially with the suds pump motor 30 rather than with the induction motor 11. Since the relative impedance of the timer motor 34 is very high with respect to the commutator motor 30, the commutator motor 30 does not have a sufficient voltage impressed thereacross to cause operation thereof.

From the above it will be apparent that irrespective of whether there is sufficient water stored in the storage compartment 28, the timer motor will continue to operate to advance the cam shaft 50 out of the first stage or cycle of operation of the washing machine 10. The second stage in the cycle of operation is the stage reached when the cam switches are in the position as shown in Figure 1 of the drawings. At this time the two-way valve 21 and the suds pump motor 30 have been deenergized, but the agitator cam switch 37 is still in engagement

with the stationary contact 51 which is connected to the agitator control solenoid 17 through the conductor 108.

At this point in the cycle of operation cam switch 38 has dropped into engagement with the lower stationary contact 52 which is connected, in turn, to the switch 80 associated with the hot fluid inlet solenoid 15. Cam switch 40 has similarly dropped into engagement with the stationary contact 54 which is connected to the switch 81 associated with the mixed fluid inlet control solenoid 16. Since power to the cam switches 38 and 40 is obtained through the top float switch 68 being in engagement with the lower contact 74, it will be apparent that if the suds water returned from the storage compartment 28 has not been sufficient to raise the top float 70, then the solenoids 15 and 16 are energized through the cam switches 38 and 40 to introduce additional water to the tub. This introduction of additional water continues until the top float 70 is raised.

Whether or not one or the other, or both, of the solenoids 15 and 16 are energized, will, of course, depend upon the relative position of the control knob 85 which determines the temperature of the water being introduced into the tub.

After the top float 70 has been raised, either by the addition of fresh water under the control of solenoids 15 and 16, or by admission of sufficient suds water in the original instance, the agitator continues to operate for the length of time determined for the washing cycle. As shown by the cam, this will continue until the cam 44 has been rotated sufficiently to separate the cam switch 37 from the stationary contact 51. At this same time the cam switch 39 falls into engagement with the stationary contact 53 to energize the two-way valve 21 from the bottom bus 78 through conductor 109. At this point in the operation the cam switch 38 is returned to an intermediate position which is out of engagement with both of its stationary contacts. The cam switch, at this time, has also been lifted out of engagement with its associated contact 54. Also, we find that cam switch 41 has now dropped into engagement with its associated stationary contact 55.

By virtue of the fact that the cam switch 41 has closed against the stationary contact 55, the main motor 11 is directly energized from supply conductor 65 through conductor 79, bridging contact 69, bus 78, cam switch 41 and conductor 100 on one side and through conductor 67 to supply conductor 64 on the other side.

As has previously been pointed out, when the agitator solenoid 17 is deenergized and the motor 11 is in operation, the pump 18 is placed into operation to pump water from the pump 14 through the hose 20 in the two-way valve 21 to the storage compartment 28. As the water level in the tub falls the top float switch drops to its lower position against stationary contact 74. After substantially all of the water has been pumped from the tub 14 so that the bottom float 71 causes the float switch 69 to close against the stationary contact 75, the extractor solenoid 35 is energized. This energization is from the supply conductor 65, conductor 79, bridging contact 69, bus 78, cam switch 41, contact 55, conductor 101, lower float switch 69, contact 75, and conductor 102 to one side of the solenoid 35. The other side of the solenoid 35 is connected to the return conductor 67. Upon energization of the solenoid 35 the basket 13 is rotated at high speed

by the motor 11. During this period the synchronous motor 34 continues to rotate through its series connection with the pump motor 30.

While the basket 13 is rotated at high speed, the cut out portion 103 of the cam disk 43 moves under the cam follower 104 of the cam switch 36. The cam switch 36 does not immediately fall, however, against the lower stationary contact 57, for it is held in place by the small cam 105. This small cam 105 is a disk having a flattened portion 106 thereon, and the cam 105 is rotated by the synchronous motor 34.

During the time that the cut out portion 103 is under the cam follower 104, the flattened portion 106 rotates into a position opposite the tail 107 of the cam switch 36 and permits the cam switch 36 to close. This is for a spray rinse operation, for it introduces water into the basket while the basket is rotating at high speed. The introduction of water is only momentary.

It will be observed that all of the time that the agitator solenoid 35 is energized and the main motor 10 is energized, the pump is operating to continually pump water out of the bottom of the tub 14.

After the end of the first extractor period the cam switch 41 opens by virtue of the high point 108' on the cam disk 48. At this time the high point 59 on the cam disk 43 also raises the cam switch 36 to close it against the upper contact 58. Furthermore, at this time, the cam switch 37 closes again to connect the agitator solenoid 17 to the conductor 108 which is energized only through both float switches 68 and 69 in their upper positions.

At this point in the cycle of operation the timer motor 34 is not energized and hence water under the control of the solenoid 16 is introduced into the tub. This continues until both of the floats 70 and 71 are raised. At this time the agitator control 17 is energized, as is also the timer motor 34, the latter being energized through the top float switch 68 and conductors 101 and 100 in series with the suds pump motor 30. This is the deep rinse stage of the cycle of operation of the automatic washing machine 10. At the end of this stage in the cycle of operation the agitator 17 is deenergized and the main motor 11 is again energized through the cam switch 41. It will be noted that at this time, however, the two-way valve 21 is not energized. Thus the water which is pumped from the hub 14 now is discharged into the drain compartment 29 where it flows by gravity out through the drain pipe 24. The timer motor 24 is energized during this stage through the cam switch 41 and in series with the suds pump motor 30.

After all of the water has been pumped out so that the lower float switch 69 closes against the lower stationary contact 75, the extractor is energized through the cam switch 41 and the float switch 69. At the end of this operation the cams move to a position where all of the cam switches are open, and in this position no power is supplied to any of the motors 11, 30 or 34, nor to any of the control apparatus, and the cycle of operation is complete.

If only a few items are to be laundered in the tub 14, it is desirable to arrange the control circuits so that a full tub of water is not required, but which will enable the other automatic portions of the cycle of operation to be carried forward. This is accomplished by the switch 76. When the operator of the machine has observed that the liquid level has reached a

sufficient height to satisfactorily launder the few items desired, the manually operated switch 76 is thrown from its full line position to its dotted line position as shown in Figure 1 of the drawings. This has the same effect as though the top float switch 68 had moved to its upper position against the stationary contact 72. Otherwise the circuit is the same.

It will be observed that the provision of the upper contact 95 on cam switch 38 and the energization of the two-way valve 21 therethrough instead of through its separate cam switch 39 provides an antisiphoning arrangement for the time when the suds motor 30 is deenergized. The reason is that the two-way valve 21 is deenergized at the same time the suds motor 30 is deenergized.

From the above description it will be observed that one of the peculiar and novel characteristics of the present invention lies in the manner in which the timer motor is energized serially either through the main washing machine motor or through the storage pump motor. The many other and further features of the novel control circuit and control mechanism are apparent from the foregoing description, and as will be obvious to those skilled in the art, provides an extremely simple and efficient control mechanism for a complicated and detailed cycle of operation of an automatic washing machine.

The schedule of cyclic steps in the operation of the automatic washing machine is exemplified by the diagram shown in Figure 3 of the drawings, and with the aid of this diagram the ready understanding of the operation of the control mechanism will be greatly enhanced.

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

I claim as my invention:

1. A control circuit for a machine having a pair of motors which are selectively and automatically operated one at a time, sequence switch control means, a timer motor for driving said sequence switch control means, said timer motor having an impedance of many times the impedance of either of said motors of said pair, means for energizing one of said motors of said pair while said timer motor is energized serially through the other of said motors of said pair.

2. A control circuit for a machine having a first motor and a second motor which are selectively and automatically operated one at a time, sequence switch control means, a timer motor driving said sequence switch control means, said timer motor having an impedance of many times the impedance of either of said first two motors, means for energizing said first motor while said timer motor is energized serially through said second motor, and means for energizing said second motor while said timer motor is energized serially through said first motor.

3. A control circuit particularly adapted to control the sequential operation of a washing machine having a drive motor of a low impedance for carrying out certain operations of the machine, sequence switch control means, a timer motor for driving said sequence switch control means, said timer motor having an impedance many times the impedance of said drive motor, means including said sequence switch control

means energizing said drive motor in series with said timer motor to stop said drive motor while said timer motor continues to operate and energizing said drive motor in parallel with said timer motor to operate said low impedance drive motor with said high impedance timer motor.

HAROLD E. MORRISON.

#### REFERENCES CITED

The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

| Number    | Name                    | Date          |
|-----------|-------------------------|---------------|
| 2,029,335 | Oberhoffken et al. .... | Feb. 4, 1936  |
| 2,225,407 | Basset .....            | Dec. 17, 1940 |
| 2,391,561 | Geldhof et al. ....     | Dec. 25, 1945 |
| 2,395,591 | Staples et al. ....     | Feb. 26, 1946 |
| 2,425,788 | Edwards .....           | Aug. 19, 1947 |
| 2,444,645 | Geldhof et al. ....     | July 6, 1948  |
| 2,498,885 | Geldhof et al. ....     | Feb. 28, 1950 |