WASHING MACHINE HAVING CIRCUIT MEANS FOR OPENING AND CLOSING WATER INLET MEANS AND OVERFLOW MEANS ALTERNATELY
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FIG. 1

FIG. 2

FIG. 3

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The present invention relates to automatic washing machines of the type wherein a washing drum receives a predetermined amount of fresh water during a washing cycle or at given intervals while a substantially like amount of washing liquid is removed from the drum through an overflow pipe or by a pump. More particularly, this invention is concerned with an improved actuating mechanism for such washing machines.

In automatic washing machines working on the water flow principle, metered amounts of water are supplied to the rotating drum of the machine during the washing cycle either intermittently or continuously while about equal amounts of used water are withdrawn from the drum fresh water is supplied thereto. The water outlet may either be an opening in the drum whose height determines the water level in the drum, or a pump means may be used to control the water level. If desired, the output of the pump means may be adjustable to obtain the desired water level in the machine.

During the washing cycle, the water inflow is rather small and usually averages about 0.1 liter/minute per kilogram of dry laundry capacity of the drum. On the other hand, it is desirable to supply a relatively large amount of water to the drum during the initial working phase so that the goods to be washed in the drum are to be soaked and distributed evenly. The cycle is continued to the minimum working cycles during which the machine does not actually wash.

In conventional machines of this type, two water inlet valves are so programmed that one valve controls the water flow into the drum during the washing cycle while the other valve controls the main water supply to the drum at the beginning of the washing cycle and the rinsing cycle, respectively. Programming may be effected by a cam shaft with cams operating the valves and also, if desired, the pump means controlling the water level during the washing cycle. The known programming means has already arranged that the water inlet and outlet means are open and closed at overlapping time intervals, i.e., the inlet and outlet means were opened and closed more or less at the same time.

The present invention is based on the insight that the washing effect is considerably improved in the presence of a strong surface current of the wash water during the washing cycle, particularly during the inflow and outflow of the water to and from the drum. In the described operation of conventional washing machines, wherein fresh water is supplied to the drum at the same time that the used washing liquid is removed therefrom, a strong surface current cannot develop.

It is the primary object of this invention to obviate this disadvantage of the prior art and to provide a very simple actuating mechanism for such washing machines, which produces vigorous surface currents in the wash water during the washing cycle.

This and other objects are accomplished by the provision of an electric actuating circuit means for opening and closing the water inlet and outlet means for a washing drum, and a switch in the circuit means, which is movable into a first contact position wherein the circuit opens the inlet means to supply water to the drum and closes the outlet means, and a second contact position wherein the circuit closes the inlet means and opens the outlet means to remove about the same amount of water from the drum as has been supplied in the first contact position of the switch. Preferably, a solenoid valve is mounted in the fresh water inlet means and a pump means is connected to the outlet means, the actuating circuit openings and closing the valve and operating the pump means.

This water inflow without a corresponding outflow and the outflow without a corresponding inflow produces a relatively strong surface current of the water in the washing machine. The inflow lasts for a time interval of the order of seconds and somewhat raises the water level. Subsequently, when the pump begins operation after the inflow is stopped, a surface current corresponding to the output of the pump will be produced and carry away from the wash water all the dirt floating on the surface.

It has been proposed to drive washing drums in washing machines of this type with reversible electric motors so that the drum may intermittently rotate to the left and right, thus preventing the laundry in the drum from balling up. In accordance with a preferred embodiment of the present invention, the switch controlling the water inflow and outflow is operated by the phase reversing means of the drive motor. This switch may be connected in series with the phase reversing means to operate synchronously therewith. A programming means may be connected with the first-named switch to control the start and end of the water flow to and from the drum.

The above and other objects, advantages and features of the invention will be more fully explained in the following detailed description of a preferred embodiment thereof, taken in conjunction with the accompanying drawing wherein:

FIG. 1 is a schematic circuit diagram showing the actuating circuit means and switch of the present invention;

FIG. 2 is an end view of a washing machine incorporating the actuating mechanism of FIG. 1; and

FIG. 3 is a chart showing the washing cycle of such a machine.

Referring first to FIG. 1, there is shown a three-phase electric drive motor 1 for the washing drum of the machine. A phase reversing means 2 is schematically illustrated to show actuation of the motor in intermittently opposite directions, such means being known to prevent balling of the laundry in the drum. The phase reversing switch is shown connected in series with a switch 3 whose contact element is movable into a first contact position 4 and a second contact position 5. In position 4, the circuit to solenoid valve 6 is closed so that the valve is opened and water may flow into the drum. During this time, the circuit operating pump 7 is open so that the pump is idle. In the second position 5, the latter circuit is closed, the pump is operated to remove water from the drum while the circuit to valve 6 is open, thus keeping the valve closed. The programming cam 8 actuates switch 3 so as to determine the start and the end of the water flow cycle.

FIG. 2 schematically shows the essential elements of the washing machine. At the beginning of the washing cycle, water is supplied rapidly to the washing chamber 10 in drum 13 through the main inlet valve 9 until the water has reached level 11. The water supply is controlled by limiting switch 12 set for a desired water level in the washing chamber.

During the washing cycle, for instance, while the drum rotates in one direction, fresh water is supplied to the washing chamber through valve 6, which raises the level of the wash water slightly to line 14. The washing drum
continues rotating in the one direction for a given period of time, for instance, 45 seconds, and after a programmed interval, which may last from 0 seconds to 15 seconds, for instance, the drum is rotated in the opposite direction. Since switch 3 is operated synchronously with phase reversing means 2, the pump 7 will be operated and the valve 6 closed when the rotational direction of the drum is reversed. This will cause the hatched portion 15 of the wash water rapidly to be removed through overflow pipe 16 and conduit 17, the water current force depending on the capacity of pump 7. In any event, the strong surface current will carry all floating dirt away from the wash water.

After the washing cycle is completed, rinsing is initiated, the water inflow during rinsing being effected through inlet valve 9. During the subsequent drying step, the main pump 18 is operated.

The working cycle of the machine is illustrated in the diagram of FIG. 3 wherein the abscissa indicates time $t$ while the ordinate carries the water level $h$ in the drum. At the initial point $a$, the main inlet valve 9 is opened to fill the washing chamber in the drum with water up to the level $a$. In the time interval $\Delta t_1$, the laundry in the drum is soaked and at point $P_1$ the main pump 18 is started to exert a strong centrifugal action on the soaked goods while they are continued to be rotated in drum 13. This cycle is indicated by the hatched area $F_1$ indicating water removal from the drum.

At point $P_2$, the main inlet valve 9 is opened again and the desired amount of water for the washing cycle is let into the washing chamber 10, as indicated by line $b$. As the drum is rotated, valve 6 is programmed to be opened to admit an additional metered amount of fresh water so that the water level rises to line $c$ by the amount of $\Delta h$. After a given number of rotations in one direction or a given time interval, i.e. 45 seconds, the drum rotation is reversed after lapse of time interval $\Delta t_2$. In the above-indicated manner, reversal of the rotational direction of the drum causes operation of pump 7 and closing of valve 6 so that an amount of wash water illustrated by $d$ and corresponding to the amount of water previously supplied through valve 6 is removed from the washing chamber. This process is periodically repeated throughout the washing cycle.

In automatic washing machines using a periodically reversible drum drive, it is known to interrupt the rotations in opposite directions by predetermined pauses $\Delta t_2$ whose length may tend towards zero, as is shown in FIG. 3 by areas $F_2$, $F_2'$, ..., $F_2''$ and $F_3$, $F_3'$, ..., $F_3''$. After completion of the washing cycle, centrifuging starts again, for which purpose, main pump 18 is operated to withdraw water from the washing chamber, as indicated by area $F_4$. Alternating rinsing and centrifuging is then effected in the conventional manner, as shown by areas $F_5$, $F_5'$, etc.

It is obvious that many variations and modifications in the actuating mechanism may occur to the skilled in the art without departing from the spirit and scope of the present invention, as defined in the appended claims. For instance, switch 3 need not to be actuated by the phase reversing means of the drive motor but may be operated by a suitable programmed cam or the like, or by a bi-metallic contact element.

I claim:

1. In a washing machine comprising a washing drum, a water inlet and water overflow means connected to the drum, a solenoid valve in said inlet means and a pump means connected to the overflow means: an electric actuating circuit means for operating the valve and the pump means, and a switch in said circuit, the switch being movable into a first contact position wherein the circuit opens the valve to supply water to the drum and shuts off operation of the pump means, and a second contact position wherein the circuit closes the valve to cut off water supply to the drum and starts operation of the pump means to remove about the same amount of water from the drum as has been supplied in the first contact position of the switch.

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