AUTOMATIC WASHING MACHINE
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This invention relates to automatic washing machines, and more particularly to automatic washing machines of the type wherein the control enabling a correctly regulated progress of individual operations during the washing process and adjustable to miscellaneous types of clothes.

The washing operations may consist of, for example, the filling of a tub or other container with water, the preliminary washing, the water discharge, the refilling of the tub with water, the main washing operation, emptying, hot rinse, emptying, cold rinse, emptying and dry spinning and, consequently, also of the spinning of the washed clothes after each emptying operation of the tub or of the container with the detergent.

An object of the invention is to provide an improved planned control so as to facilitate the various working processes only when the tub has been correctly filled with water. In particular, the invention proposes to adjust the filling time of a wash tub automatically in accordance with the pressure of the water in such a way that for normal and higher water pressures the total time required for the washing cycle is exactly fixed whereas, in the case of a lower pressure at the water inlet, the waiting periods are reduced to a minimum so that, during the washing cycle, the wash tub is always filled to the correct water level.

Between the individual washing operations are periods of delay required to fill the wash tub with the amount of warm or cold fresh water necessary during any given washing operation as well as for emptying the used water. Since the quantity of the cold or warm fresh water to be introduced at any given time into a particular washing machine is fixed, the control of the inlet valve could be made dependent on the time if no assurance, through the water inlet were assured. However, the water pressure at the inlet is usually subject to fluctuation and therefore when the inlet valve is controlled according to time, the wash tub will not be filled to the specified level, for example, in the event of low water pressure so that the following washing operation does not take place under the anticipated conditions. Furthermore, if the planned control is so arranged that the water supply will be shut off only after filling is completed and so that the subsequent washing operation is introduced after a predetermined time regardless of the degree of filling, the washing operation may nevertheless start without the proper amount of water so that once more the correct operating conditions do not obtain.

A fixing of the total washing time, while avoiding intermediate intervals between the washing operations following each other is particularly important for commercial laundries. The advantage resulting from such a fixing of the washing time is, however, destroyed if the individual washing operations according to the aforementioned design of the controlled planning do not take place under the proper conditions.

The planned control may be also so arranged that at the commencement of the filling of the wash tub with fresh water the further continuance of the planned control is interrupted until filling is completed and is again activated after filling is completed by means of a controlled float assembly. However, such a plan makes it impossible to anticipate the total time required by a washing operation because such a planned control merely regulates the washing operations themselves, whereas the inflow of the fresh water is not subject to its regulation.

The invention provides for the introduction of each operating stage dependent on the filling of the tub with the correct amount of water while, however, a certain filling time is set for a predetermined water pressure in the inlet. Thus, for the normal case, the total time of a washing operation is exactly fixed and extended waiting periods, resulting from insufficient pressure at the water inlet, are reduced to a minimum.

According to the invention, in an automatic washing machine, initiation of the planned operations, in addition to the regulated, adjustable time setting for filling the wash tub, is made dependent on whether prescribed water level in the wash tub has been attained.

Accordingly, the planned operations will continue without interruption only if both the time set for filling the wash tub has elapsed and the specified water level has been likewise attained. If the water pressure at the inlet corresponds to the pressure anticipated for normal planned operations, the invention assures an uninterrupted progress of the washing cycle. Even when the water pressure is higher than planned, no changes in the time setting will occur. If the water pressure in the inlet is below the anticipated pressure and, therefore, the wash tub will not fill within the specified time after the scheduled time has run, planned operations will not continue until the required water level in the wash tub has been attained.

The invention is preferably put into effect by interconnecting, into the circuit of a servo-motor which regulates planned operations, a controlled circuit breaker and, parallel thereto, a circuit breaker controlled by the water level in the wash tub. The controlled circuit breaker is cut in automatically according to the time which has been set as the norm for filling the wash tub with water, so that the servo-motor is cut out if the correct water level in the wash tub has not been attained and the second circuit breaker has not been closed.

Other objects and structural details of the invention will be apparent from the following description when considered in conjunction with the accompanying drawings showing an automatically operating, front loaded washing machine with a horizontal drum, wherein:

FIG. 1 is a vertical sectional side view through the center of the washing machine.
FIG. 2 is a flow diagram of the entire water circuit of the washing machine.
FIG. 3 is an electric wiring diagram of the principal parts of the washing machine, and
FIG. 4 is a diagrammatic view of the device for planned operations.

Referring now to FIG. 1, the washing machine comprises a housing consisting of base 1, front wall 2a, rear wall 2b, the side walls and top 3, with the inside frame 4a, 4b accommodating tub 5 (for the detergent) which is provided with a cylindrical jacket 5a, front wall 5e and rear wall 5f, while the latter may constitute an integral part of frame 4b. A cylindrical drum 6 is provided to accommodate the clothes to be washed and expose them to the detergent, wherefore jacket 6a is airtight in the manner of a sieve. Front wall 6b is provided with a loading aperture which is closed by means of door 5d of tub 5. Rear wall 6c of the drum is securely fastened to a horizontally placed drive shaft 7. Access to the loading aperture of drum 6 is gained through door 2c in the housing front wall 2c. Drum jacket 6a may also be provided on the inside with ribs (not shown) to assure the tumbling of the clothes. Shaft 7 is driven by means of a pair of pulleys 8, 10a and belt 9 by shaft 10b of an electromotor 10. Shaft 7 is rotatably
mounted in a bearing 7a of rear wall 5b of tub 5 and is supported by a bearing bracket 7b. During the main washing process, the rotation of the inside drum is cyclically reversed in known manner by means of an appropriate reverse switch (not shown) so that the washed clothes are thoroughly washed by the water. To spin the clothes for removing the liquid therefrom after the water has been drained from tub 5, a high-speed spin operation is provided.

A closed container 11 serves to heat the fresh water to the temperature required by the type of clothes. Containment of the water is heated by means of heating element 24 and accommodates a thermostat control 27 for the heating current. Tub 5 is provided at the bottom with a heating vessel 5e comprising electric heating elements 25 and a temperature tester 28. Heating device 25 maintains the washing fluid during the various washing operations at the required temperature. The washing machine is also provided with a connection to the fresh water inlet 17, a used water drain 18 and a connection 19 for electric power and heating current, and a container 12 to accommodate the powdered or liquid washing agents. A main switch 14 and a programmer 15 cooperating with the planned operations control device are mounted on the front wall 2a.

The water circuit system shown in FIG. 2 comprises the cold water conduits 32 and 33 connected to the fresh water inlet piping 17 and controlled by valves 29 and 30, which lead to wash tub 5 and to heating container 11, respectively.

With valve 30 open, the water heated in container 11 will flow, under the action of the water pressure at inlet 17, through conduit 34 into container 12 where it will dissolve the detergent contained therein (during the rinsing operations, the water will merely pass through vessel 12) and through conduit 35 into the wash tub 5. From the vessel 5e at the bottom of wash tub 5, a conduit 26, controlled by valve 31, leads to drain 18. Into the drain 18, furthermore, opens an overflow pipe 26a from tub 5. Valves 29, 30, 31 are controlled electromagnetically in accordance with the washing schedule.

A level switch 23 is connected to tub 5 and operates by means of a float 23d accommodated in a vertical tube or regulator 23c and by means of control rod 23d and circuit breakers or reversing switches 23a, 23b (see also FIG. 4), for the electric control circuits. The washing machine is connected to the three-phase circuit of network 19 (see FIG. 3), while the entire device may be switched on or shut off by means of main switch 14. The planned-operation device comprises operations regulator 13, switch boxes 36 and 37 for the heating of water in vessel 11 and wash tub 5, respectively, a switch box 39 with reverse switch 40 for the alternate operation of driving motor 10 for inside drum 6 and a switch box 38 for the high-speed spinning operation of motor 10. The driving motor is preferably an asynchronous motor with a short-circuited rotor whereof the speed depends on the number of windings on the rotor.

The planned-operation regulator 13 includes a motor 47, for driving shaft 15a whereon are mounted control disks 41a to 46a (see FIG. 4). Contact disks 41a to 46a cooperate with circuit breakers 41 to 46. Circuit breaker 41 is provided in branch lines 49, 50 and 51 and thus controls the drive of motor 47 whereof shaft 47a is coupled to switch shaft 15a. The circuit of regulating motor 47 is closed by means of switch 15 at the beginning of the washing cycle while the switch, after the running of the washing cycle, is automatically opened so that the circuit is interrupted and the drive of the washing machine is stopped. A switch 16 is connected into line 52, in front of the neutral wire 53, the operation of which switch may likewise interrupt the progress of the washing stages, as planned so that any given phase may continue for any desired time. A control lamp 21 in branch line 59 indicates the readiness of the washing machine for operation.

Circuit breaker 42 controls heating elements 24 and 25, and is connected through line 64 to electromagnetic switch box 37 which, when the circuit is closed, will supply heating current for the tub via line 67.

When switch 14 is closed, switch 36 for the heating of vessel 11 is supplied with current via lines 48, 61, 62, 63 and 53, because circuit breaker 37 which is normally open in the position illustrated is cut in only on closing of switch 42. Switch 36, which connects heating element 24 to the supply network via line 66, will close, so that vessel 11 is heated. The further progress of the heating is regulated by the thermostat, because circuit breaker 42 in the circuit including lines 50, 64, 65, 73, 73a and 53 when closed, will supply current to switch 37 and thus not only closes the heating circuit 67 for tub heating element 25, but also opens control switch 37a thus disconnecting switch 36. At this time, control lamp 22 in series with lines 60 and 53 will indicate that vessel 11 has been heated.

Thermostat controls 27 and 28, are inside of vessel 5e and vessel 11, respectively, and will control the water temperature so as not to exceed the desired temperature. In addition, float contact 23b, which is controlled by the water level in tub 5, assures a heating of vessel 5e only in the event that tub 5 is filled.

Circuit breaker 45 controls the inflow and outflow of the used water and/or of the fresh water into and out of tub 5. To drain the soiled water from tub 5, drain valve 31 is opened through branch line 59. The inflow of fresh water to tub 5 depends on the position of circuit breaker 44, i.e., whether via lines 57 and 74 the warm water valve 30, or via lines 56 and 74 the cold water valve 29 is opened.

The inflow of fresh water is, furthermore, interrupted if, in the case of a correctly filled tub 5, level regulator 23 will break circuit 74, 73a by means of circuit breaker 23b.

By means of control 43, depending on the planned operations, either switch box 39 via lines 68, 75 and 53 or switch box 38 via lines 69, 75 and 53 for driving motor 10 is supplied with current. The two switch boxes 39 and 38 connect the three-phase current for the stator windings through lines 72. By means of switch box 39, over contact 39a and lines 70, 75 and 53, the servo-motor 40a for reverse switch 40 is likewise cut in so that the pole connection of moving coil 40a, and thus the direction of rotation of drum 6 will alternate at regular intervals, whereby the clothes being tumbled inside of drum 6 will be subjected to an intensive washing process. Switch box 38 controls the high speed of motor 10 for fast rotation of drum 6 and the clothes, therein.

In accordance with the invention, in the illustrated embodiment, the circuit breaker 46 is connected into the circuit including lines 48, 49, 50 and 51 connected to servo-motor 47, which circuit is controlled by the main circuit breaker 41 and is opened by disk 41a after the washing process has run, the additional circuit breaker being controlled by cam disk 46a. Cams 46b of said disk 46a are so distributed that they will open circuit breaker 46 in accordance with a predetermined time for the filling of the wash tub, in connection with the operating stages brought about by the other circuit breakers 41 to 45. Circuit breaker 46 is bridged over by an additional circuit 54 and 55 which is parallel to this circuit breaker and wherein is connected circuit breaker 23a controlled by float 23d according to the water level in tub 5. This parallel circuit will be closed as soon as the water level in tub 5 has been attained, in accordance with the specified level.

In the case of the correct or higher water pressure in the inlet pipe 17, when circuit breaker 46 is opened circuit breaker 23a is closed so that the washing cycle proceeds in the provided time-limit.

If the pressure in the water piping 17 is below the anticipated operating pressure, then at the disconnecting of circuit breaker 46 by the corresponding cam 46b of
disk 46a, drum 6 is not yet filled with the required amount of water. Inasmuch as circuit breaker 23a, controlled by float 23d, in this case is not yet closed, the circuit of servo-motor 47 is interrupted and the planned control stops until with the attaining of the required filling level in the drum, circuit breaker 23a will again close the circuit over lines 54 and 55.

This arrangement assures that in the event of the anticipated pressure in inlet 17, the washing cycle will progress without any interruption within the predetermined time-limit whereas in the case of a lower pressure, however, in water inlet 17, the cycle will be correspondingly extended, so that the introduction of an operating phase which is to follow at any given time will be effected only when through the corresponding filling of tub 5 with fresh water the requirements for an orderly progress of the washing cycle are complied with.

Float 23d of level control 23 preferably actuates both the circuit breaker 23b which, in the case of the attainment of the prescribed water level permits the heating of the tub or in the event that it is empty, the inflow of fresh water, and the additional circuit breaker 23c which is connected parallel to circuit breaker 46 in the circuit of servo-motor 47.

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

An automatic washing machine comprising a tub for accommodating clothes to be washed, a source of water for said tub, first means for controllably rotating and reversing said tub, a valve coupling said source to said tub, a drain coupled to said tub for draining water therefrom, control means controlling said valve and drain according to a predetermined time schedule and including a motor and a programmer driven by said motor to control the schedule, said programmer being operatively coupled with and controlling said first means, a source of electric power, said control means including a switch coupling the source of electric power to said motor, said control means controlling said valve and drain to effect a filling of said tub and causing an opening of said switch after a period of time enabling said tub to be filled to a predetermined level for a predetermined pressure at said source of water, said switch being closed during said period of time to enable said motor to drive said programmer for controlling said first means, and means shunting said switch and adapted to connect the source of electric power to said motor independently of said switch with said tub filled to said predetermined level so that said motor maintains said schedule, said means including a switch which is open until said predetermined level is achieved so that said schedule is extended for pressures lower than said predetermined pressure.

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