

Jan. 15, 1963

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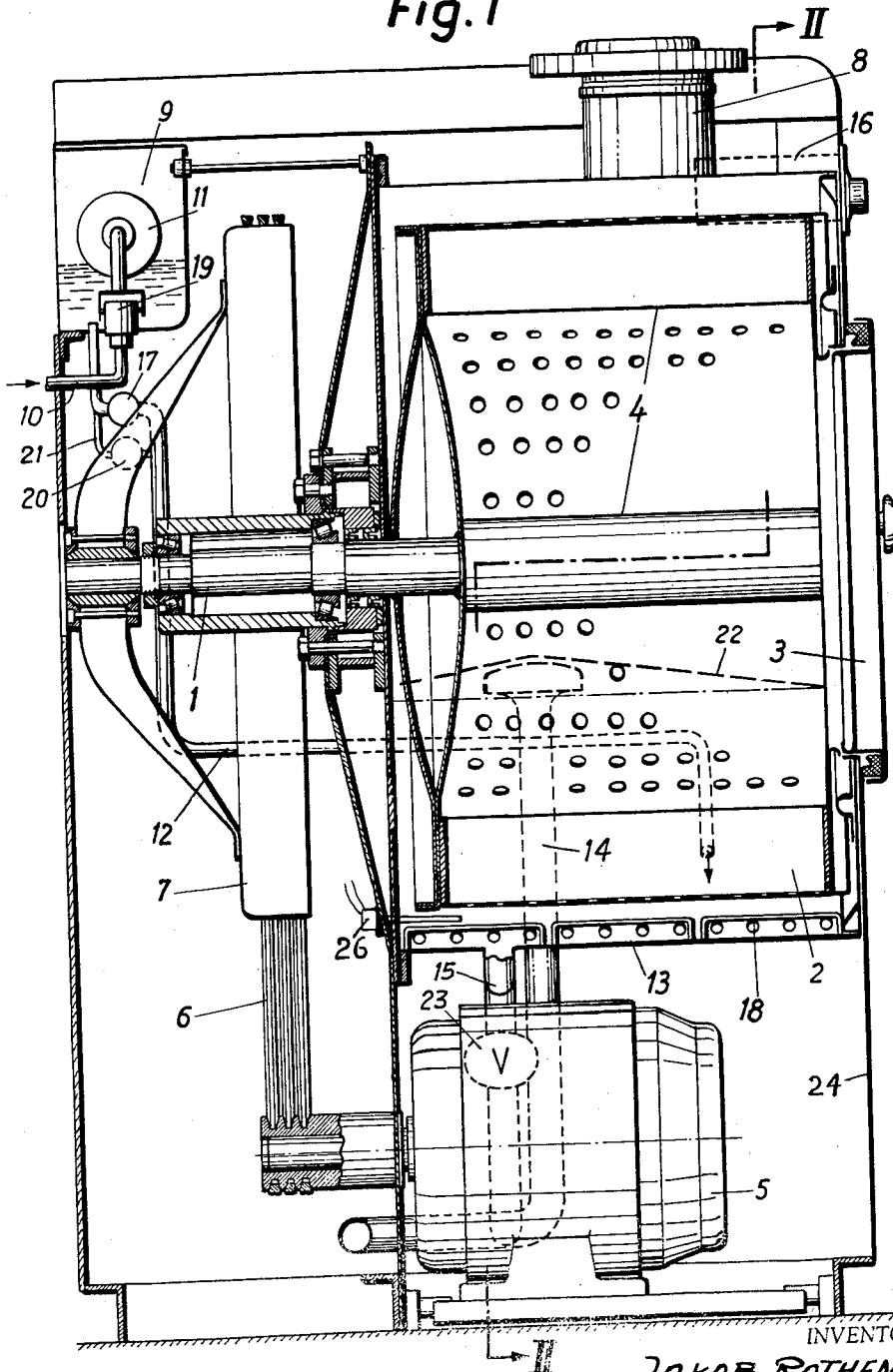
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METHOD OF TREATING MATERIALS IN A WASHING MACHINE

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3 Sheets-Sheet 1

Fig. 1



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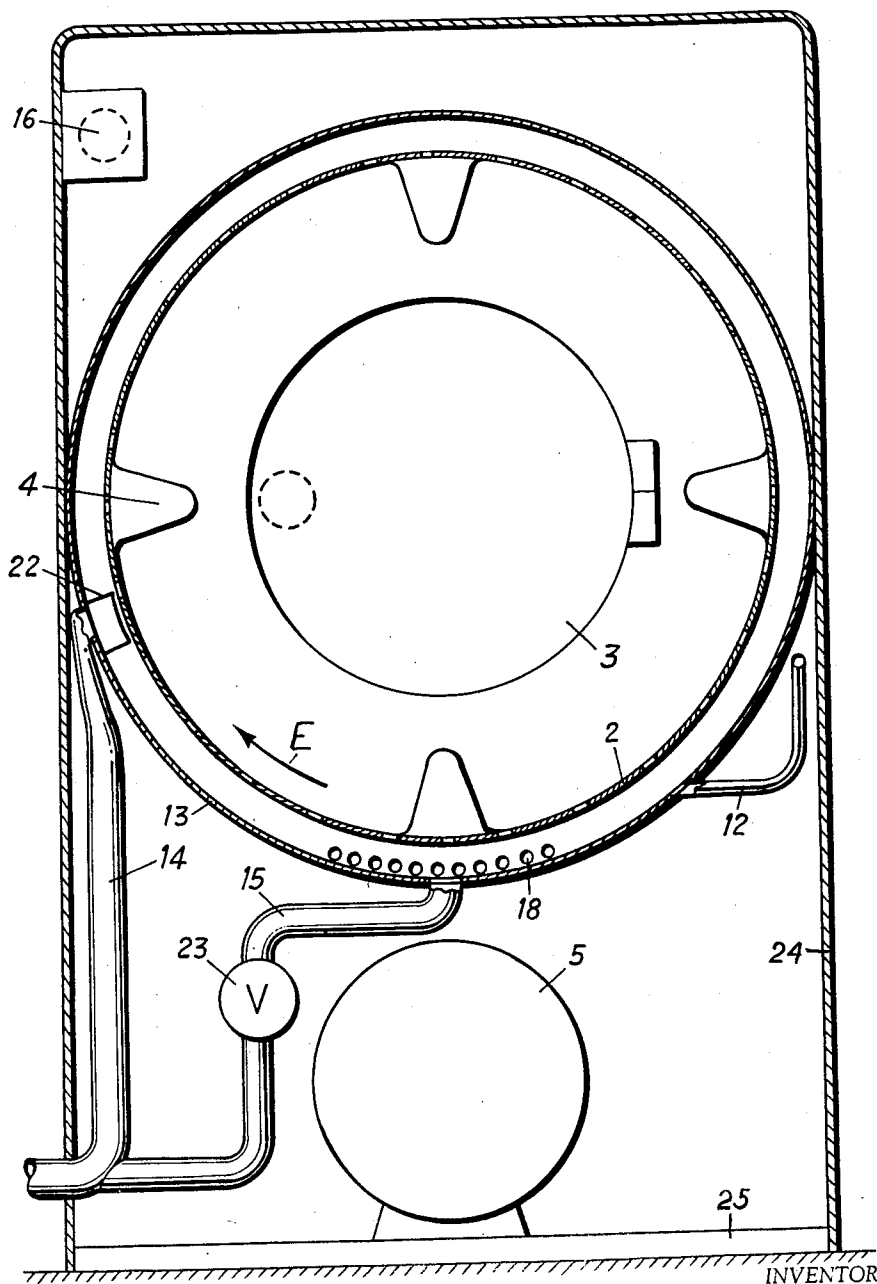
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Fig. 2



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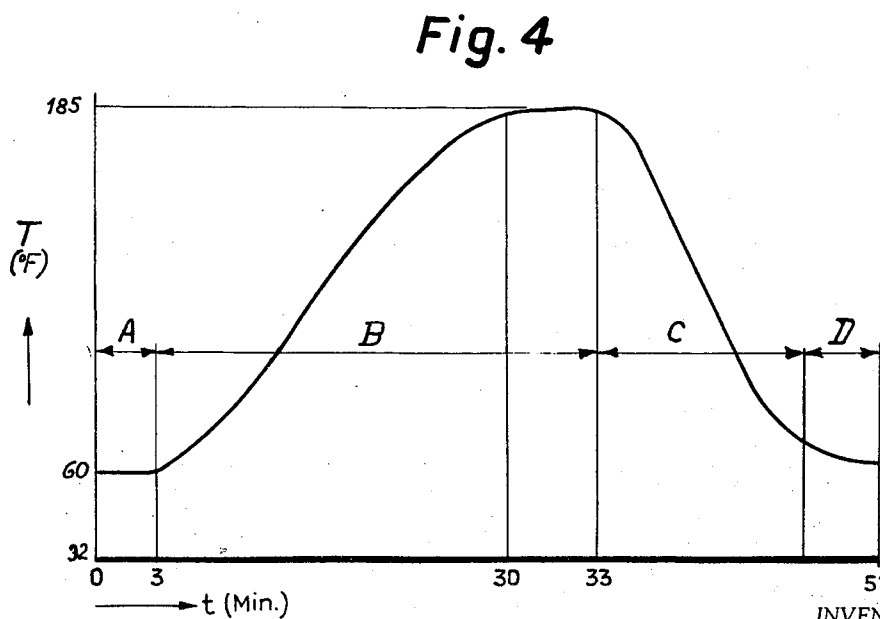
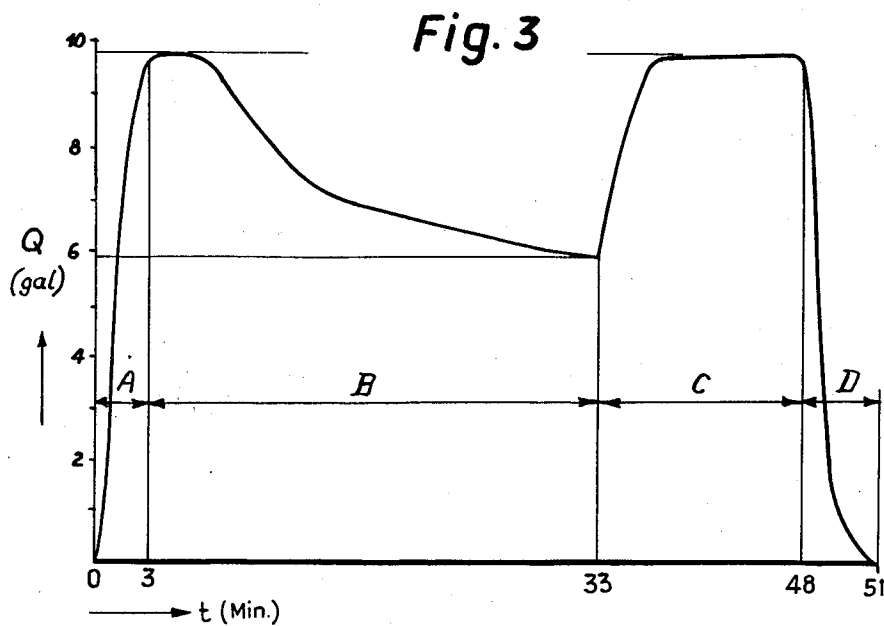
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METHOD OF TREATING MATERIALS IN A WASHING MACHINE

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3 Sheets-Sheet 3



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METHOD OF TREATING MATERIALS IN A WASHING MACHINE

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This invention relates to a washing machine and more particularly to a washing machine automatically operating through a series of cycles.

The present application is a continuation-in-part of my co-pending patent application Serial No. 597,084, filed July 11, 1956, now abandoned.

One object of this invention is to provide a washing method and a washing machine requiring only a small amount of fluid, detergent and heating energy.

It is a further object of the invention to provide for a method of washing and a washing machine which will substantially shorten the duration of the washing operation.

A further object of the present invention is the control of the dirt and detergent concentration or content in the sud so as to reduce the dirt content faster and to a higher degree than the detergent content of the sud.

It is another object of the invention to provide for a reduction of the liquid volume in the sud during the washing period, to therewith reduce the energy consumption during the heating period of the sud.

Still a further object of the present invention is the provision of a washing machine which is very simple in design, effective and reliable in operation.

These and other objects of the invention will become better apparent from the following description, taken in connection with the accompanying drawings in which:

FIG. 1 is a vertical sectional view of a washing machine embodying one form of the invention,

FIG. 2 is a vertical sectional view taken on the line II-II in FIG. 1,

FIG. 3 is a graph schematically representing the liquid content of the shell and the drum during the washing cycles,

FIG. 4 shows a temperature diagram of the sud in the washing machine according to the invention.

The washing machine according to FIGS. 1 and 2 comprises a hollow inner cylinder or drum 2 rotating about a shaft 1, into which the laundry or textile fabrics to be washed are placed. A stationary exterior cylinder or shell 13 is surrounding the drum 2 and is coaxially arranged with respect to this drum. Upon a base 25 is supported a box-like casing 24, which encloses the mechanism. The laundry is inserted into the drum 2 through a frontal access opening after opening the door 3. The drum 2 is perforated in a uniform manner so that the liquid flows through the perforations of the inner drum when it is admitted to the outer shell. The hollow partially open tumbling ribs or fins 4 extend from end to end of the drum 2 and cause the laundry to be moved along with the rotation of the cylinder. The drum 2 is driven by a reversible electric motor 5 arranged in the base 25 of the washing machine. The drive is transmitted via V-type belts 6 to a driving pulley 7 which is rigidly connected with shaft 1.

In the casing 24 an opening 8 is provided for the addition of detergents, soap and like material between the shell and the drum. Cold water may be supplied to a hopper or container 9 through a pipe 10. Arranged in this container 9 is a float 11 which is mounted upon a lever for controlling the opening of the admission valve 19 to admit water to the interior of the container 9 when a certain minimal level is reached in this container. This arrangement is designed to eliminate variable inlet

2

pressure of the fresh water through pipe 10. It would also be possible to replace this container by a volume control valve designed to deliver and maintain one set rate of water regardless of variable inlet pressure.

The discharge opening of container 9 or said volume control valve is connected with pipe 12, forming a first inlet, which is opened and closed by an electromagnetically controlled valve 17. This pipe 12 opens into the shell 13 below the axis of rotation of the drum.

A further line or pipe 21 with a valve 20 forming a second inlet controlled by a further solenoid joins the container 9 with the shell 13 for delivering a quantity of liquid into the drum which is substantially smaller than the quantity flowing through valve 17 in equal times. At a vertical distance up to about $\frac{1}{3}$ of the drum diameter from the bottom, a continually open overflow pipe 14 with a relatively large opening is arranged, so that the liquid may not increase above this level.

This pipe 14 is designed for draining the liquid out of the machine.

A further drain pipe 15 connected to shell 13 serves for draining only when the washing machine is completely emptied after operation or before the door 3 is in special cases opened during the washing cycles by opening the valve 23.

A lead sheet 22 forming an angle (see FIG. 1) is mounted above the overflow opening for leading the liquid to this opening.

A timer or time switch 16 of conventional construction is installed near the top of the casing 24 which performs the electrical control of the machine. According to the position of the switch mechanism the impulses for the control of the electromagnetic valves 17 and 20, the motor 5 and the electrical heating elements 18 are generated from this timer.

Between the shell and the drum a thermostat or thermostat switch 26 is arranged to switch off the heating elements after a predetermined temperature of the liquid has been reached.

FIG. 3 shows the liquid quantity in the shell and the drum during the wetting-, washing-, rinsing- and centrifuging process.

In FIGS. 3 and 4 the time t in minutes is entered on the abscissa and the quantity of liquid in the shell and the drum in U.S. gals., respectively, whereas the temperature of the suds in ° F. is entered on the respective ordinates.

The process for cleaning the textile fabrics or the laundry according to this invention is subdivided into 4 cycles:

	Minutes
Wetting (A) -----	About 3.
Washing (B) -----	About 30-40.
Rinsing (C) -----	About 15.
Centrifuging (D) -----	About 3.

During the wetting cycle A, cylinder and drum are filled with fresh cold water by opening the valve 17 to the overflow level so that the loose dirt is removed by the liquid flowing over the overflow. The duration of this wetting cycle is determined mainly by the degree of soiling of the goods to be washed.

In the subsequent washing cycle B, the valve 17 is closed and the valve 20 is opened, so that only a substantially reduced quantity of water is supplied to the cylinder 13 during a period longer than half the washing period B, preferably during the entire length of the washing period. At the beginning of the cycles A or B, the driving motor 5 is started. As a result of the rotation of the drum 2, in direction of arrow E in FIG. 2, the liquid is pushed against the overflow opening, so that the liquid level is gradually decreasing during the wash-

ing period B. The drained liquid quantity is therefore greater than the supplied water quantity during the washing period B.

At the end of the washing period the liquid volume in the shell and the drum is only $\frac{1}{2}$ – $\frac{2}{3}$ of the liquid volume at the beginning of the washing period (see FIG. 3).

At the beginning of the rinsing cycle C, the valve 29 is closed and valve 17 is again opened, so that the level is increasing rapidly until the overflow opening is reached to float the remainder of the washing detergents through the overflow opening.

At the end of the rinsing cycle, the valve 17 is closed and during the following spinning or centrifuging cycle D all of the liquid will be thrown out of the cylinder 13, the drum 2 and the laundry therein by centrifugal force rotating direction of drum=E. The timer 16 controls therefore a second higher speed of the motor 5.

This first and second valve 17 and 20 may of course be replaced by a single two-stage valve having openings of different size for different flow volume.

FIG. 4 shows the temperature diagram of the suds in a washing machine according to the present invention, for washing cotton textiles. The cycles A–D are the same as in FIG. 3. During the wetting cycle A no heating is effected which is started at the beginning of the washing cycle B. Heating is effected by electric power but may be replaced also by steam, gas or other source of heat. Some minutes before the washing period is ending, the max. temperature reaches 160° F.–210° F. and in the following rinsing and spinning period the temperature will continuously drop.

Between the reverse of the rotating direction of the drum a short motionless period is provided.

As a variation, at least one further centrifugal period of about $\frac{1}{2}$ –1 minute could be applied during the rinsing period, whereby the fresh water flow is preferably not interrupted.

The duration of the washing period B depends mainly from the heating capacity of the heaters 18 and further from the soiling degree of the laundry and may be longer than 30 minutes.

Example of a Machine

Diameter of the drum	21½ inches (550 mm.).
Length	12 inches (300 mm.).
Content	18½ U.S. gals. (70 lt.).
Diameter of the shell	24 inches (610 mm.).
Length	13¼ inches (330 mm.).
Load of dry laundry	13 lbs. (6 kg.).
Electric heating	7.5 va.
Motor	3000 r.p.m. and 1.2 va. during centrifuging step; 500 r.p.m. and 0.4 va. during washing step.
Circumferential speed of the drum	3.8 ft./sec. during washing; 23 ft./sec. during centrifuging.
Quantity and time of water supply:	
Wetting (A)	About 3¼ U.S. gals. (12 l.) / min. during 3 min.
Washing (B)	At least ½ U.S. gal. (0.3 l.) / min. during 30 min.
Rinsing (C)	About 3¼ U.S. gals. (12 l.) / min. during 15 min.
Spinning (D)	3 min.
Maximal temperature preset by thermostat	85–100° C.=185° F.–210° F.

The washing method is therefore carried out by opening the first water valve controlling a first inlet. The outer drum is filled to the level of the overflow with water by suitable operation or setting of the automatic switching mechanism, whereupon the driving motor is started and the second inlet valve is opening to add washing liquid to the water and a heater switched on, and after the washing temperature is reached, during continuous flow of washing liquid from the second inlet, the heater is switched off by a contact thermostat and, after the preset washing times has elapsed, the second inlet valve is closed and the first inlet or rinsing valve is opened to introduce rinsing water.

Then the rinsing water valve is closed, the rotational

speed of the laundry container is increased and the rinsing water in said container is automatically drained.

The inlet and overflow could also be so arranged on the outer cylinder that the working liquid is passed axially through the drum.

Owing to the level of the liquid being kept low as a result of the overflow, a greater height of fall and a more thorough rinsing of the laundry is achieved while continually supplying washing liquid. In further operation soiled washing and rinsing water is constantly replaced.

All additives, chemicals, etc. required for the washing or rinsing process are added by hand or automatically by the automatic switching mechanism, 0–10 min. after beginning of the washing period B.

The laundry is centrifuged simply by switching off the rinsing water supply and by increasing the rotational speed of the drum whereby the rinsing water is drained through the perforations in the inner drum and to the outer shell from there through the overflow opening 14.

Various changes and modifications may be made without departing from the spirit and scope of the present invention and it is intended that such obvious changes and modifications be embraced by the annexed claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a method of treating materials and the like in an automatic washing machine, including the steps of placing materials to be washed into said washing machine, supplying a first volume of liquid per unit time to said washing machine to imbue said materials to define a material wetting step, continuing the supply of said first volume of liquid per unit time until at least a portion of said first liquid overflows externally of said washing machine to carry therewith any undesirable loose dirt and foreign particles to be removed from said materials, the point of overflow of said first liquid defining a maximum quantity of first liquid retainable in said washing machine, subjecting said materials to a washing action by agitation thereof while exposed to a sud bath and while supplying a second volume of liquid per unit time to said materials while permitting overflow of a portion of said combined first and second liquids at a rate such that the quantity of total liquid appearing in said washing machine during said washing action is decreasing below the value of the maximum quantity of first liquid appearing in said washing machine during said wetting step.

2. In a method of treating materials and the like in an automatic washing machine having a rotatable drum, including the steps of placing materials to be washed into said rotatable drum, supplying a first volume of liquid per unit time to said washing machine to imbue said materials to define a material wetting step, continuing the supply of said first volume of liquid per unit time until at least a portion of said first liquid overflows externally of said washing machine to carry therewith any undesirable loose dirt and foreign particles to be removed from said materials, the point of overflow of said first liquid defining a maximum quantity of first liquid retainable in said washing machine, subjecting said materials to a washing action by agitation thereof while exposed to a sud bath and while supplying a second volume of liquid per unit time to said materials which is less than said first volume of liquid per unit time while permitting overflow of a portion of said combined first and second liquids at a rate such that the quantity of total liquid appearing in said washing machine during said washing action is decreasing below the value of the maximum quantity of first liquid appearing in said washing machine during said wetting step.

3. In a method of treating materials and the like in an automatic washing machine having an inner rotatable drum rotating about a horizontal axis, including the steps of placing materials to be washed into said inner rotatable drum, supplying a first volume of liquid per unit time to said washing machine to imbue said materials to

define a material wetting step, continuing the supply of said first volume of liquid per unit time until at least a portion of said first liquid overflows externally of said washing machine to carry therewith any undesirable loose dirt and foreign particles to be removed from said materials, the point of overflow of said first liquid defining a maximum quantity of first liquid retainable in said washing machine, subjecting said materials to a washing action by agitation thereof while exposed to a sud bath and while supplying a second volume of liquid per unit time to said materials which is less than said first volume of liquid per unit time while permitting overflow of a portion of said first and second liquids at a rate such that the quantity of total liquid appearing in said washing machine during said washing action is decreasing below the value of the maximum quantity of first liquid appearing in said washing machine during said wetting step, thereafter supplying a third volume of liquid per unit time until the total volume of combined first, second and third liquids disposed in said washing machine at least approaches the value of said maximum quantity of first liquid retainable in said washing machine and overflow of at least a portion of said combined first, second and third liquids from said washing machine subjects said materials to a rinsing step, and then subjecting said materials to a centrifuging step to substantially remove said first, second and third liquids therefrom.

4. A method of treating materials and the like in an automatic washing machine having an inner rotatable drum, including the steps of placing materials to be washed into said inner rotatable drum, supplying a first volume of liquid per unit time to said washing machine to imbue said materials to define a material wetting step, continuing the supply of said first volume of liquid per unit time until at least a portion of said first liquid overflows externally of said washing machine to carry therewith any undesirable loose dirt and foreign particles to be removed from said materials, the point of overflow of said first liquid defining a maximum quantity of first liquid retainable in said washing machine, adding detergents to said first liquid, subjecting said materials to a washing action during rotation of said inner drum while exposed to a detergent bath and while supplying a second volume of liquid per unit time to said materials which is less than said first volume of liquid per unit time while permitting overflow of a portion of said first and second liquids at a rate such that the quantity of total liquid appearing in said washing machine during said washing action is decreasing below the maximum quantity of first liquid appearing in said washing machine during said wetting step, heating said quantity of total liquid appearing in said washing machine at least during said washing step and at least during such time that said total liquid is at a minimum quantity value, thereafter supplying a third volume of liquid per unit time until the total volume of combined first, second and third liquids disposed in said washing machine at least approaches the value of said maximum quantity of first liquid retainable in said washing machine and overflow of at least a portion of said combined first, second and third liquids from said washing machine subjects said materials to a rinsing step, and then subjecting said materials to a centrifuging step to substantially remove all of said first, second and third liquids therefrom by overflow thereof externally of said washing machine.

5. In a method of treating materials and the like in an automatic washing machine having an inner rotatable drum, including the steps of placing materials to be washed into said inner rotatable drum, supplying a first volume of liquid per unit time to said washing machine to imbue said materials to define a material wetting step, adding a second volume of liquid per unit time until at least a portion of said first and second liquids overflow externally of said washing machine to carry therewith any

undesirable loose dirt and foreign particles to be removed from said materials, the point of overflow of said first and second liquids defining a maximum quantity of combined first and second liquids retainable in said washing machine, subjecting said materials to a washing action by agitation thereof while exposed to a sud bath and while further supplying said second volume of liquid per unit time to said materials at a rate which is less than said first volume of liquid per unit time while permitting overflow of a portion of said first and second liquid volumes at a rate such that the quantity of total liquid appearing in said washing machine during said washing step is decreasing below the maximum quantity of the combined first and second liquids appearing in said washing machine, thereafter supplying a third volume of liquid per unit time until the total volume of first, second and third liquids disposed in said washing machine at least approaches the value of said maximum quantity of combined first and second liquids retainable in said washing machine and overflow of at least a portion of said combined first, second and third liquids from said washing machine subjects said materials to a rinsing step, and then subjecting said materials to a centrifuging step to substantially remove all of said first, second and third liquids therefrom by overflow thereof externally of said washing machine.

6. In a method of treating materials and the like in an automatic washing machine, including the steps of placing materials to be washed into said washing machine, supplying a first volume of liquid per unit time to said washing machine to imbue said materials to define a material wetting step, continuing the supply of said first volume of liquid per unit time until at least a portion of said first liquid overflows externally of said washing machine to carry therewith any undesirable loose dirt and foreign particles to be removed from said materials, the point of overflow of said first liquid defining a maximum quantity of first liquid retainable in said washing machine, subjecting said materials to a washing action by agitation thereof while exposed to a sud bath and while continuously feeding during a period at least greater than half the duration of said washing action a second volume of liquid per unit time to said materials which is less than said first volume of liquid per unit time while permitting overflow of a portion of said first and second liquids at a rate such that the quantity of total liquid appearing in said washing machine during said washing action is decreasing below the value of the maximum quantity of first liquid appearing in said washing machine during said wetting step, simultaneously heating said first and second liquids appearing in said washing machine at least during the period of continuous feed of said second volume of liquid, thereafter supplying a third volume of liquid per unit time until the total volume of combined first, second and third liquids disposed in said washing machine at least approaches the value of said maximum quantity of first liquid retainable in said washing machine and overflow of at least a portion of said combined first, second and third liquids from said washing machine subjects said materials to a rinsing step, and then subjecting said materials to a centrifuging step to substantially remove said first, second and third liquids therefrom.

7. In a method of treating materials and the like in an automatic washing machine, including the steps of placing materials to be washed into said washing machine, supplying a first volume of liquid per unit time to said washing machine to imbue said materials to define a material wetting step, continuing the supply of said first volume of liquid per unit time until at least a portion of said first liquid overflows externally of said washing machine to carry therewith any undesirable loose dirt and foreign particles to be removed from said materials, the point of overflow of said first liquid defining a maximum quantity of first liquid retainable in said washing machine,

subjecting said materials to a washing action by agitation thereof while exposed to a sud bath and while supplying a second volume of liquid per unit time to said materials and during overflow of a portion of said combined first and second liquids at a rate such that the quantity of total liquid appearing in said washing machine during said washing action decreases to a desired value which is below the value of the maximum quantity of first liquid appearing in said washing machine during said wetting step.

8. In a method of treating materials and the like in an automatic washing machine according to claim 7; where-
in said desired value is between approximately one-half to two-thirds the volume of liquid in said washing machine at the beginning of the washing action.

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