July 31, 1956 G. P. CASTNER 2,756,580

APPARATUS FOR WASHING CLOTHES

Filed July 22, 1952

FIG. 1

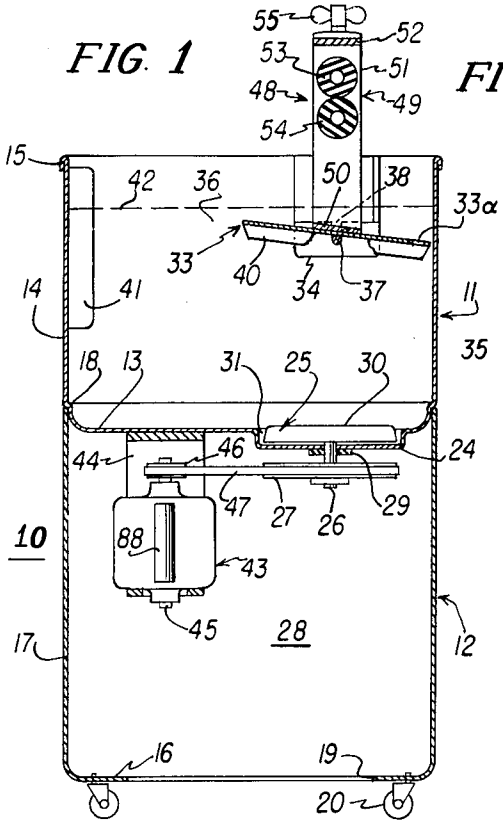


FIG. 2

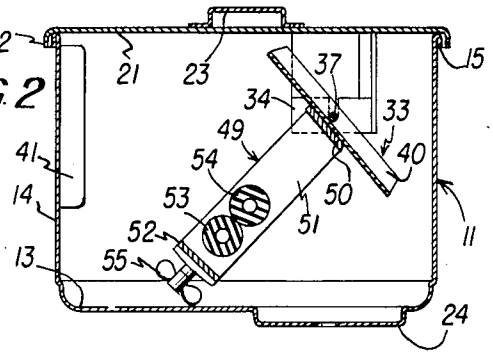


FIG. 3

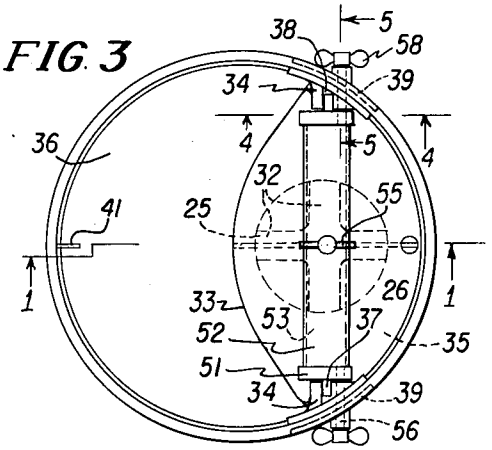


FIG. 4

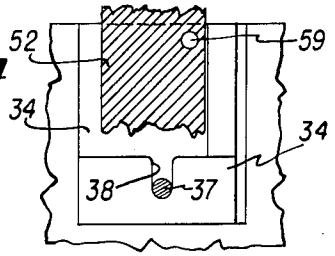
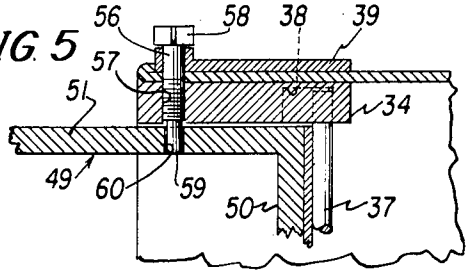


FIG. 5



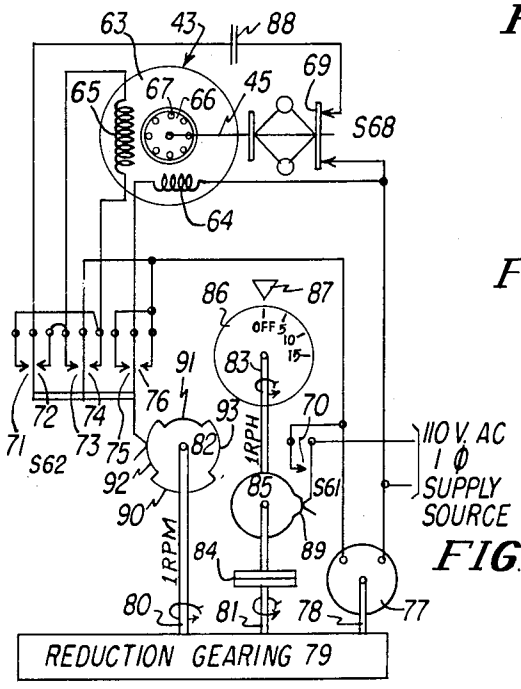


FIG. 6

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APPARATUS FOR WASHING CLOTHES

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4 Claims. (Cl. 68—22)

The present invention relates to apparatus for washing clothes, or the like.

Heretofore it has been proposed to provide apparatus for washing clothes, or the like, that involves a clothes washing machine comprising a stationary upstanding tub provided with a substantially horizontal bottom wall carrying a flat disk-like dasher adjacent thereto that is continuously rotated in a single direction about a substantially vertical axis at a relatively high speed for the purposes of effecting circulation of the wash liquid and the clothes contained in the tub and of producing a washing action upon the clothes. However, this machine was not productive of a satisfactory washing action upon the clothes due to the formation of an upstanding open vortex in the substantially vertically disposed column of the wash liquid located directly above the face of the dasher incident to the continuous rotation of the dasher at the relatively high speed, whereby the clothes became trapped in the upstanding open vortex in the wash liquid and the wash liquid was circulated in an upstanding torus about the clothes, so that the clothes were badly tangled and poorly washed. In view of this difficulty, it was concluded that the production of a satisfactory clothes washing machine of the character noted was not feasible since no arrangement was apparent that would prevent the formation of the undesirable upstanding open vortex in the wash liquid incident to the continuous rotation of the dasher at the necessary relatively high speed.

Accordingly, it is the general object of the present invention to provide an improved apparatus for washing clothes involving a stationary upstanding tub and a continuously rotated substantially horizontally disposed dasher arranged adjacent to the bottom wall of the tub, whereby the elements of the apparatus are so constructed and arranged that the formation of the upstanding open vortex in the wash liquid contained in the tub incident to the continuous rotation of the dasher about the substantially vertical axis thereof at the relatively high speed is prevented, and that the tangling and balling-up of the clothes are greatly minimized or eliminated.

Another object of the invention is to provide an improved apparatus for washing clothes in a stationary upstanding tub in which the clothes are subjected to a plurality of successive washing cycles; wherein, in each washing cycle, the clothes and the wash liquid are continuously whirled and centrifugally discharged during a first short time interval in a first direction outwardly away from a substantially horizontally disposed active area in the tub and sucked back inwardly toward the center of the active area, then the clothes and the wash liquid are brought to a substantially quiescent condition during a second short time interval, then the clothes and the wash liquid are continuously whirled and centrifugally discharged during a third short time interval in a second spiral path in a second direction outwardly away from the substantially horizontally disposed active area in the tub and sucked back inwardly toward the center of the active area, then the clothes and the wash liquid are brought

to a substantially quiescent condition during a fourth short time interval, each of the first and third short time intervals being of insufficient time duration to accommodate the formation of any substantial upstanding open vortex in the wash liquid in the tub, the first and second directions being opposite to each other to minimize tangling of the clothes, and rubbing and pulsating the clothes as they are moved through the substantially horizontally disposed active area.

Another object of the invention is to provide an improved apparatus of the character described, wherein the mass of the wash liquid and the clothes are substantially completely confined on all sides in the tub, and wherein each of the second and fourth short time intervals is of a sufficiently long time duration so that therein any slight tangling of the clothes is substantially completely relieved.

A further object of the invention is to provide a clothes washing machine of the character noted that comprises an improved and simplified mechanism for carrying out the washing cycle of the character described.

A still further object of the invention is to provide a clothes washing machine of the character noted that comprises an improved arrangement for mounting a clothes wringer in the upper portion of the tub so that the clothes wringer may be readily and conveniently moved between an operative position disposed above the tub and a storage position disposed within the tub.

The present invention is predicated upon the discovery that in a clothes washing machine of the character described, the formation of the objectionable upstanding open vortex in the wash liquid incident to the continuous rotation of the substantially horizontally disposed dasher may be prevented either by constructing the tub so that the wash liquid and clothes receiving compartment therein is completely full during rotation of the dasher, leaving no air space to accommodate the formation of the upstanding open vortex, or by controlling the dasher drive mechanism so that the direction of the continuous rotation of the dasher is periodically reversed, coupled with intervening periods in which rotation of the dasher is arrested. Moreover, the control of the dasher drive mechanism mentioned substantially completely eliminates the normal tendency of a clothes washing machine of the character described to tangle the clothes during the washing operation. Thus by employing in the clothes washing machine both the construction of the tub mentioned and the control of the dasher drive mechanism mentioned, the formation of the upstanding open vortex in the wash liquid and the tangling of the clothes are substantially completely eliminated.

In the construction of the tub, the compartment is defined in an upstanding position above the face of the dasher and between the bottom wall of the tub and a baffle arranged in the upper portion of the tub, and a throat opening is provided that is offset with respect to the substantially vertical axis of rotation of the dasher, the throat opening communicating between the compartment and the exterior, and the normal wash liquid level in the tub being disposed above the throat opening to insure complete filling of the compartment with the wash liquid and the clothes. In the control of the dasher drive mechanism, the dasher is continuously rotated in a first direction during a first short time interval, whereby there is no formation of an upstanding open vortex in the wash liquid and there is only a slight tendency to wrap-up the clothes in the first direction; and during a following second short time interval, rotation of the dasher is arrested, whereby the clothes nicely unfold in the wash liquid as the clothes and the wash liquid assume a substantially quiescent condition. Then the dasher is continuously rotated in a second direction during a third short time in-

terval, whereby there is no formation of an upstanding open vortex in the wash liquid and there is only a slight tendency to wrap-up the clothes in the second direction; and during a following fourth short time interval, rotation of the dasher is arrested, whereby the clothes nicely unfold in the wash liquid as the clothes and the wash liquid again assume a substantially quiescent condition. Thus in the two complementary active portions of each washing cycle there is no formation of an upstanding open vortex in the wash liquid and the tendencies to wrap up the clothes are in opposite directions, so that in each active portion of each washing cycle, the clothes are unwrapped with respect to the wrap-up in the immediately preceding active portion of the washing cycle. Further, in each substantially quiescent portion of each washing cycle, the centrifugal forces tending to form an upstanding open vortex in the liquid are removed, and not only are the clothes nicely unfolded in the wash liquid as previously noted, but the clothes are subjected to what may be termed a soaking action that is very beneficial in causing soil that has been previously loosened from the clothes to separate therefrom in the wash liquid. In fact, it has been discovered that the two soaking actions that take place between the two oppositely directed washing actions in the washing cycle are productive of an overall reduction in the total washing time interval required to obtain a given washing effect upon a given load of clothes.

While it is not essential that the two time intervals of rotation of the dasher in the two opposite directions are identical, it is convenient in the construction of the cycle control mechanism or timer to provide this arrangement; and likewise, while it is not essential that the two time intervals during which rotation of the dasher is arrested are identical, it is convenient in the construction of the timer to provide this arrangement; and, in fact, in the interest of simplification of the timer, it has been found that each of the four time intervals mentioned in the washing cycle may be conveniently made of about 15 seconds.

Further features of the invention pertain to the particular arrangement of the elements of the clothes washing machine and of the steps of the method, whereby the above-outlined and additional operating features thereof are attained.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawing, in which Figure 1 is a vertical sectional view of a clothes washing machine embodying the present invention, taken in the direction of the arrows along the line 1—1 in Fig. 3, and illustrating the clothes wringer in its operative position with the tub cover removed;

Fig. 2 is a vertical sectional view, similar to Fig. 1, of the upper portion of the clothes washing machine, illustrating the clothes wringer in its storage position with the tub cover in place;

Fig. 3 is a plan view of the clothes washing machine, illustrating the clothes wringer in its operative position with the tub cover removed;

Fig. 4 is an enlarged vertical sectional view of the upper portion of the tub, taken in the direction of the arrows along the line 4—4 in Fig. 3, illustrating the pivotal mounting arrangement of the clothes wringer;

Fig. 5 is another enlarged vertical sectional view of the upper portion of the tub, taken in the direction of the arrows along the line 5—5 in Fig. 3, illustrating the pivotal mounting arrangement of the clothes wringer; and

Fig. 6 is a schematic diagram of the electric control circuit incorporated in the clothes washing machine.

Referring now to Figs. 1 to 5, inclusive, of the drawings, the clothes washing machine 10 there illustrated, and embodying the features of the present invention is of the portable home laundry type, and comprises an upper upstanding tub 11 and a lower upstanding housing 12

The tub 11 is substantially cup-shaped in configuration, including a substantially horizontal bottom wall 13 and a connecting substantially cylindrical side wall 14 having an open top and terminating in a downwardly and outwardly folded or rolled rim 15. Also the housing 12 is substantially cup-shaped in configuration, including a substantially horizontal bottom wall 16 and a connecting substantially cylindrical side wall 17. The bottom wall 13 of the tub 11 is downwardly dished and an annular shoulder 18 is provided at the junction thereof with the lower portion of the side wall 14; which annular shoulder 18 receives the upper end of the side wall 17 of the housing 12. The bottom wall 16 of the housing 12 has an enlarged opening 19 formed therein for the purpose of accommodating ventilation of the machinery disposed in the housing 12, and further carries a plurality of casters 20 accommodating ready rolling movement of the machine 10. The tub 11 and the housing 12 are retained in assembled relation in any suitable manner, as by welding; and the tub 11 is provided with a removable cover 21 having a downwardly turned annular rim 22 and carrying a substantially centrally disposed handle 23.

The tub 11 is of the stationary type, with reference to the washing action, and has a downwardly projecting annular depression 24 formed therein in offset relation with respect to the vertical center line thereof that receives a substantially horizontally disposed annular disk-like dasher 25. The dasher 25 is rigidly secured to the upper end of a substantially vertically disposed stub shaft 26 projecting through an opening provided in the central portion of the depression 24, the lower end of the stub shaft 26 having a V-pulley 27 rigidly secured thereto and disposed within a machinery compartment 28 defined in the housing 12. A suitable bearing and packing gland member 29 is arranged in surrounding relation with respect to the stub shaft 26 in order to mount it for rotation in either direction and to prevent the escape of wash liquid therealong from the tub 11. Preferably, the dasher 25 is substantially crown-shaped having a substantially smooth outer face 30 projecting upwardly from the bottom wall 13 into the tub 11 and terminating in a substantially annular skirt 31 projecting downwardly into the depression 24. More particularly, the face 30 of the dasher 25 is provided with a plurality of shallow ribs or vanes 32 that are preferably substantially equally annularly spaced-apart and radially disposed, four of the ribs 32 being shown for purpose of illustration. The dasher 25 may be of integral die-pressed sheet metal construction, whereby the ribs 32 comprise upwardly directed embosses in the face 30 thereof. Thus it will be understood that the dasher 25 is mounted for rotation in either direction within the tub 11 with the stub shaft 26.

A substantially segmental baffle 33 is arranged in the upper portion of the tub 11 and offset with respect to the vertical center line thereof and mounted for pivotal movements upon a pair of laterally spaced-apart brackets 34 also disposed in the upper portion of the tub 11 and secured to the adjacent portions of the side wall 14. More particularly, the baffle 33 is disposed above the dasher 25 and cooperates therewith and with the adjacent portion of the side wall 14 to define an upstanding compartment 35 within the tub 11 and adapted to receive wash liquid and clothes to be washed, the front edge of the baffle 33 being spaced well away from the side wall 14 to define a substantially crescent-shaped top opening or throat 36 into the compartment 35 and communicating between the compartment 35 and the exterior. More specifically, the baffle 33 is rigidly secured to a laterally extending shaft 37 that is removably mounted in a pair of laterally opposed and aligned bearing recesses 38 provided in the brackets 34. As best shown in Figs. 3, 4 and 5, the opposite ends of the shaft 37 are removably received in the upwardly opening pair of recesses 38 provided in the pair of brackets 34 and the pair of brackets 34 are secured in place upon the adjacent portions of the side wall 14 of

the tub 11 by a cooperating pair of plates 39; whereby the baffle 33 is movable between an operative position, illustrated in Fig. 1, and a storage position, illustrated in Fig. 2.

When the baffle 33 occupies its operative position, illustrated in Fig. 1, it is slightly upwardly inclined toward the front edge thereof and cooperates with the side wall 14 of the tub 11 to define the compartment 35 and the throat opening 36, as previously explained. Also a substantially longitudinally extending and downwardly facing rib 40 is carried by the lower surface of the baffle 33 in intersecting relation with respect to the shaft 37. Further, an upstanding fin 41 is carried by the side wall 14 within the tub 11 in the throat opening 36, the fin 41 extending both above and below the normal wash liquid level in the tub 11, as indicated by the broken line 42. Also, it is noted that the normal wash liquid level 42 within the tub 11 is disposed above the throat opening 36 completey submerging the baffle 33 in its operative position so that the compartment 35 is completely full of the wash liquid and the clothes to be washed in the normal operation of the machine 10.

For the purpose of rotating the dasher 25, there is provided an electric motor 43 of the single-phase alternating current induction type that is mounted upon a bracket 44 which is suitably secured to the bottom wall 13 and supported by the tub 11 within the machinery compartment 28. The motor 43 is of the reversible type and includes an upstanding operating shaft 45 that has a V-pulley 46 rigidly secured to the upper end thereof. The stub shaft 26 and the operating shaft 45 are arranged in substantially parallel relationship; and the V-pulleys 27 and 46 carried on the lower and upper ends of the respective shafts 26 and 45 are aligned with respect to each other. Finally, the V-pulleys 27 and 46 are interconnected by an appropriate V-belt 47; and in the arrangement, the V-pulley 46 is considerably smaller than the V-pulley 27, since the speed of rotation of the operating shaft 45 is considerably greater than that of the stub shaft 26. Specifically, the operating shaft 45 of the electric motor 43 may have a normal speed of rotation of about 1750 R. P. M.; and the normal speed of rotation of the stub shaft 26 may be about 700 R. P. M.

Also, a manually operable clothes wringer 48 is mounted with the baffle 33 upon the shaft 37 for pivotal movements between an operative position, illustrated in Fig. 1, and a storage position, illustrated in Fig. 2. The clothes wringer 48 includes a frame 49 provided with a laterally extending bottom element 50 directly secured to the upper surface of the baffle 33, two laterally spaced-apart upstanding side elements 51, and a laterally extending top element 52. Arranged within the frame 49 are upper and lower laterally extending pressure rolls 53 and 54 that are mounted for rotation for the purpose of exerting a squeezing action upon clothes placed therebetween. The upper roll 53 is mounted for movements toward and away from the lower roll 54 in order to control the pressure therebetween; and the movement of the upper roll 53 with respect to the lower roll 54 is governed by a mechanism, including an adjustable wing nut 55 carried by the top element 52. Also, the shaft of the lower roll 54 is adapted detachably to receive a manually operable crank, not shown, that is employed in the manual operation of the clothes wringer 48. When the clothes wringer 48 occupies its operative position, as shown in Figs, 1, 3, 4, and 5, it is held firmly in place by an arrangement, including a pair of laterally disposed and aligned screws 56 arranged in threaded engagement in a pair of aligned openings 57 formed in the pair of brackets 34. Each of the screws 56 terminates at the outer end thereof in a thumb wing 58, and terminates at the inner end thereof in a projecting pin 59 that is arranged to extend into a cooperating hole 60 formed in the adjacent side element 51. Accordingly, when the clothes wringer 58 is moved into its operative position, the two thumb wings 58 are appropriately rotated so as to project the pins 59 into the cooperating holes 60 provided in the side elements 51 of the frame 49, thereby securely holding the clothes wringer 48 in its operative position. After use, the clothes wringer 48 may be returned into its storage position, as illustrated in Fig. 2, by appropriately manipulating the thumb wings 58 so as to withdraw the pins 59 from the holes 60, whereby the frame 49 may be pivoted, along with the baffle 33 upon the shaft 37. Also, it will be understood that after the withdrawal of the pins 59 from the holes 60, the clothes wringer 48, along with the baffle 33 and the shaft 37, may be removed, as a unit, from the brackets 34 by exerting a lifting action thereupon, since the bearing recesses 38 provided in the brackets 34 are open at the top thereof, as clearly illustrated in Fig. 4. When the clothes wringer 48 and the baffle 33 are thus removed from the tub 11, the tub 11 may conveniently serve as a covered clothes hamper. Also, it will be understood that when the clothes wringer 48 occupies its storage position, as illustrated in Fig. 2, the tub cover 21 may be placed upon the rim 15 of the tub 11 providing a complete closure for the tub 11. When the machine 10 is to be used, the tub cover 21 is first removed and the clothes wringer 48 returned to its operative position and secured in place by means of the wing screws 57, as previously described.

In the construction of the washing machine 10, the diameters of the tub 11 and the housing 12 may be about 15"; the distance between the bottom wall 16 of the housing 12 and the bottom wall 13 of the tub 11 may be about 18"; the distance between the bottom wall 13 of the tub 11 and the top of the rim 15 thereof may be about 11"; the distance between the center line of the shaft 37 and the top of the rim 15 of the tub 11 may be about 3"; the distance between the top of the rim 15 of the tub 11 and the top of the thumb nut 55 carried by the clothes wringer 48, when the clothes wringer 48 occupies its operative position, may be about 6"; the overall height of the machine 10 from the floor to the top of the thumb nut 55, when the wringer 48 occupies its operative position, may be about 32⅝"; the overall height of the machine 10 from the floor to the top of the rim 15 of the tub 11 may be about 26⅝"; the radius of the dasher 25 may be about 2½"; and the tub 11 may have a capacity of about 6 gallons of wash liquid, when it is filled to the normal head indicated by the wash liquid level 42.

As shown in Fig. 6, the electric motor 43 is provided with a manually settable cycle control arrangement that includes a source of electric current supply of 110 volts, A. C. single-phase, a master switch S61 and a control switch S62. The electric motor 43 comprises a stator 63 provided with respective main and auxiliary windings 64 and 65 arranged in quadrature relation, and a rotor 66 mounted upon the operating shaft 45 and provided with a squirrel-cage winding 67. Also operatively associated with the shaft 45 is a start switch S68 of the centrifugal type provided with a contact control member 69. The master switch S61 is provided with a single pair of contacts 70; while the control switch S62 is provided with six pairs of contacts 71, 72, 73, 74, 75 and 76. The cycle control mechanism further comprises a timer motor 77 of the synchronous type having an operating shaft 78 that is connected to an associated gear box 79 housing suitable reduction gearing, not shown. Projecting from the gear box 79 are first and second driven shafts 80 and 81 that are respectively rotated at one revolution per minute and at one revolution per hour. An insulating control cam 82 is rigidly secured to the driven shaft 80 and is arranged to govern the position of the control switch S62. The driven shaft 81 is operatively connected to a driven shaft 83 by an interposed slip clutch 84 of the friction type. An insulating control cam 85 is rigidly secured to the driven shaft 83 and is arranged to govern the position of the master switch S61. Further, a manually operable control dial or knob 86 is rigidly

secured to the extreme outer end of the driven shaft 83 and is provided with suitable indicia that cooperates with a fixed marker 87. Finally, the circuit control arrangement comprises a capacitor 88 that is employed in the circuit of the auxiliary winding 65 for the purpose of shifting the phase relationship between the starting current traversing the auxiliary winding 65 and the starting current traversing the main winding 64; the electric motor 43 being of the conventional capacitor-start type. As illustrated, the control cam 85 includes a single projection 89 that is arranged to operate the master switch S61 into its open position when the "off" indicia carried by the control dial 86 matches the marker 87; and as illustrated, the control cam 82 comprises a projecting quadrant 90 and an opposed depressed quadrant 91, as well as two intervening medium or reference quadrants 92 and 93.

Considering now the operation of the cycle control circuit, as illustrated in Fig. 6, when the control cam 85 occupies its off position operating the master switch S61 into its open position, the control cam 82 may occupy any position, such, for example, as that illustrated, wherein the control switch S62 is operated into its open position. At this time, the operator may manually rotate the control knob 86 in the counterclockwise direction from its "off" position into its variable on position, as indicated by the cooperation between the marker 87 and the index carried by the control knob 86. When the shaft 83 is thus operated out of its off position, the control cam 85 is operated out of its off position, causing the projection 89 to control the master switch S61 operating it from its open position into its closed position. When the contact pair 70 of the master switch S61 is thus closed, a circuit is completed for operating the timer motor 77, whereby the shaft 78 thereof is rotated at the synchronous speed causing the gearing in the gear box 79 to drive the shafts 80 and 81 at the respective speeds of one revolution per minute and of one revolution per hour. More particularly, the shaft 81 is rotated in the clockwise direction thereby restoring the shaft 83 in the clockwise direction back into its off position during a time interval corresponding to the initial setting of the manual dial 86. The shaft 81 drives the shaft 83 through the slip clutch 84, which slip clutch 84 accommodates initial manual setting of the shaft 83 with respect to the shaft 81. When the shaft 83 is returned into its off position the control dial 86 is returned into its "off" position and the control cam 85 is returned into its off position so that the projection 89 operates the master switch S61 into its open position. When the master switch S61 is thus operated into its open position, operation of the timer motor 77 is arrested. In view of the foregoing, it will be understood that by means of the control dial 86 any overall time interval may be manually set for operation of the timer motor 77.

During operation of the timer motor 77, the shaft 80 is rotated in the counterclockwise direction at one revolution per minute, as previously noted; whereby the four sections 92, 91, 93 and 90 of the control cam 82 sequentially cooperate with the control switch S62 in a cyclic manner. As illustrated, when the portion 92 of the control cam 82 cooperates with the control switch S62, the control switch S62 is operated into its off position opening each of the contact pairs 71, 72, 73, 74, 75 and 76; whereby the electric motor 43 occupies its open-circuit position. Subsequently, when the portion 91 of the control cam 82 cooperates with the control switch S62, the control switch S62 is operated into one of its on positions (its forward position) closing the contact pairs 72, 74 and 76. In the forward position of the control switch S62, a circuit, including the contact pair 76, is completed for energizing the main winding 64 of the electric motor 43; and a circuit, including the contact pairs 72 and 74, as well as the capacitor 88 and the start switch S68, is completed for poling and energizing the auxiliary winding 65 of the electric motor 43 in the forward direction. Accordingly, the electric motor 43 quickly starts rotating the shaft 45 thereof in the forward direction and causing the start switch S68 to operate the contact control member 69 into its open position so as to deenergize the auxiliary winding 37; whereby the electric motor 43 continues to run in the forward direction by virtue of the energization of the main winding 64 at this time. Thereafter, when the portion 93 of the control cam 82 cooperates with the control switch S62, the control switch S62 is operated back into its off position opening the contact pairs 72, 74 and 76 so as to deenergize the main winding 64 of the electric motor 43 in order that rotation of the shaft 45 is quickly stopped causing the start switch S68 to return the contact control member 69 back into its closed position. Thereafter, when the portion 90 of the control cam 82 cooperates with the control switch S62, the control switch S62 is operated into the other of its on positions (its reverse position) closing the contact pairs 71, 73 and 75. In the reverse position of the control switch S62, a circuit, including the contact pair 75, is completed, for energizing the main winding 64 of the electric motor 43; and a circuit, including the contact pairs 71 and 73, as well as the capacitor 88 and the start switch S68, is completed for poling and energizing the auxiliary winding 65 of the electric motor 43 in the reverse direction. Accordingly, the electric motor 43 quickly starts rotating the shaft 45 thereof in the reverse direction and causing the start switch S68 to operate the contact control member 69 ino its open position so as to deenergize the auxiliary winding 65; whereby the electric motor 43 continues to run in the reverse direction by virtue of the energization of the main winding 64 at this time. Thereafter, when the portion 92 of the control cam 82 again cooperates with the control switch S62, the control switch S62 is operated back into its off position opening the contact pairs 71, 73 and 75 so as to deenergize the main winding 64 of the motor 43 in order that rotation of the shaft 45 is quickly stopped causing the start switch S68 to return the contact control member 69 back into its closed position.

In view of the foregoing, it will be understood that during the overall time interval the master switch S61 occupies its closed position, the control switch S62 is operated cyclically through its off, forward, off and reverse positions. In the arrangement, the control cam 82 governs the cycle of the control switch S62 once each minute, so that in each cycle of the control switch S62, the electric motor 43 is run in the forward direction during a first short time interval of about 15 seconds, the electric motor 43 is stopped during a second short time interval of about 15 seconds, the electric motor 43 is run in the reverse direction during a third short time interval of about 15 seconds, and the electric motor 43 is stopped during a fourth short time interval of about 15 seconds. Of course, the cyclic control of the electric motor 43, described above, is repeated throughout the overall time interval during which the master switch S61 occuplies its closed position, and when the master switch S61 is operated into its open position, further operation of the motor 43 is arrested, regardless of the position of the control switch S62.

Considering now the method of washing clothes in the clothes washing machine 10, the tub cover 21 is removed from the top of the tub 11; the clothes wringer 84 is moved from its storage position to its operative position, the wing screws 56 are set in order securely to hold the clothes wringer 48 in its operative position; the wash liquid, the clothes to be washed, and a suitable detergent are placed in the tub 11; and the control knob 86 is manually set to the desired overall washing time interval so as to initiate the cyclic control of the electric motor 43 previously described. More particularly, the electric motor 43 operates the dasher 25 through a plurality of washing cycles; and in each washing cycle, the dasher 25 is rotated in the forward direction during the first short time interval, the rotation of the dasher 25 is ar-

rested during the second short time interval, then the dasher 25 is rotated in the reverse direction during the third short time interval, and then rotation of the dasher 25 is arrested during the fourth short time interval. More particularly, during the first short time interval mentioned, the dasher 25 is quickly accelerated from its rest position and continuously rotated in the forward direction substantially at its full speed of 700 R. P. M.; and during the second short time interval mentioned, rotation of the dasher 25 in the forward direction is quickly arrested. Similarly, during the third short time interval mentioned, the dasher 25 is quickly accelerated from its rest position and continuously rotated in the reverse direction substantially at its full speed of 700 R. P. M.; and during the fourth short time interval mentioned, rotation of the dasher 25 in the reverse direction is quickly arrested.

During the first short time interval mentioned, continuous rotation of the dasher 25 in the forward direction whirls and centrifugally discharges the clothes and the wash liquid in the tub 11 in a first spiral path extending in a first or forward direction outwardly away from a substantially horizontally disposed active area arranged adjacent to the face 30 thereof and sucks the clothes and the wash liquid back inwardly toward the center of the dasher 25 along a substantially vertical path; and during the second short time interval mentioned when the forward rotation of the dasher 25 is arrested, the clothes and the wash liquid in the tub 11 assume a substantially quiescent condition. Likewise, during the third short time interval mentioned, the continuous rotation of the dasher 25 in the reverse direction whirls and centrifugally discharges the clothes and the wash liquid in the tub in a second spiral path extending in a second or reverse direction outwardly away from the substantially horizontally disposed active area arranged adjacent to the face thereof and sucks the clothes and the wash liquid back inwardly toward the center of the dasher 25 along the substantially vertical path; and during the fourth short time interval mentioned when the reverse rotation of the dasher 25 is arrested, the clothes and the wash liquid in the tub 11 assume a substantially quiescent condition.

During the forward whirling and centrifugal discharge of the clothes and the wash liquid in the tub 11, the clothes are circulated successively over the face 30 of the dasher 25 and thence upwardly along the side wall 14 of the tub 11, so that they are rubbed and pulsated by the low shallow ribs 32 provided on the face 30 of the dasher 25 in order to loosen soil therefrom; whereby the loosened soil quickly separates from the clothes into the wash liquid when forward rotation of the dasher 25 is arrested. Likewise, during the reverse whirling and centrifugal discharge of the clothes and the wash liquid in the tub 11, the clothes are circulated successively over the face 30 of the dasher 25 and thence upwardly along the side wall 14 of the tub 11, so that they are rubbed and pulsated by the low shallow ribs 32 provided on the face 30 of the dasher 25 in order to loosen soil therefrom; whereby the loosened soil quickly separates from the clothes into the wash liquid when reverse rotation of the dasher 25 is arrested.

During the continuous forward rotation of the dasher 25 and during the continuous reverse rotation of the dasher 25, the centrifugal forces involved tend to create an upstanding open vortex in the wash liquid over the center of the dasher 25; however, the upstanding open vortex in the wash liquid does not materialize by virtue of the construction of the tub 11. Specifically, the center of the dasher 25 is disposed below the baffle 33 in its operative position; and the wash liquid level, indicated by the broken line 42, is well above the throat opening 36 so that the baffle 33 is completely submerged in the wash liquid and covers the area disposed above the dasher 25. Hence the baffle 33 constitutes an anti-cavitation plate preventing the entry of air into the center of the whirling mass of wash liquid disposed therebelow; and consequently preventing the initiation of the formation of the upstanding open vortex in the wash liquid.

Moreover, the continuous rotation of the dasher 25 in either direction is of the first or third short time intervals, whereby the build-up of the centrifugal forces in the mass of wash liquid, tending to produce the upstanding open vortex therein are appropriately limited, so that the following quiescent period is initiated before the centrifugal forces mentioned have had an opportunity to build-up to an undesirable extent. Accordingly, in the operation of the machine 10, the formation of the upstanding open vortex in the wash liquid is prevented notwithstanding the continuous rotation of the substantially horizontally disposed dasher 25 at the relatively high speed mentioned.

While there is a slight tendency for the clothes to be wrapped-up during the continuous forward rotation of the dasher 25, the clothes are nicely unfolded during the following substantially quiescent period; and while there is a slight tendency for the clothes to be wrapped-up during the continuous reverse rotation of the dasher 25, the clothes are nicely unfolded during the following substantially quiescent period. Moreover since the wrap-up of the clothes produced by the continuous forward whirling action and the wrap-up of the clothes produced by the continuous reverse whirling action take place in opposite directions, each of these complementary actions produces an upwrapping action with respect to the wrapping action of the other. Furthermore, since the two actions take place only during short time intervals, there is never any severe wrapping-up or tangling of the clothes during operation of the clothes washing machine 10. Finally, it appears that the substantially quiescent periods interposed between the complementary whirling actions produce highly desirable soaking actions upon the clothes; whereby the overall washing time interval is actually reduced in order to obtain a predetermined washing effect upon a given load of clothes.

Also during the circulation of the wash liquid and the clothes in the tub 11 during either the forward whirling action or the reverse whirling action, the clothes engage the traversely extending rib 40 carried by the baffle 33 and also the upstanding fin 41 carried by the side wall 14 of the tub 11, whereby the clothes dragging thereupon are turned over so as to obtain a thorough washing of all parts thereof. Furthermore, the clothes in their circulation in the tub 11 have a tendency occasionally to rise up into the throat opening 36, whereby an additional drag is exerted thereupon in order to insure complete turning over and washing of all parts of the load of clothes. Also in the circulation of the wash liquid in the tub 11 some air enters the throat opening 36 into the compartment 35 in order to insure aeration of the clothes in a highly desirable manner; and the air bubbles forming in the wash liquid in the compartment 35 rise up under the baffle 33 and escape adjacent to the front edge thereof into the throat opening 36. Finally, a small hole 33*a* is formed in the baffle 33 adjacent to the rear edge thereof in order to accommodate the return of the wash liquid from thereabove back into the compartment 35.

The forward rotation of the dasher 25 produces the forward whirling and centrifugal discharge of the clothes and the wash liquid in the substantially horizontally disposed active area arranged adjacent to the face 30 thereof and adjacent to the bottom wall 13 of the tub 11 by virtue of the centrifugal forces involved that are produced by the action of the shallow ribs 32 upon the clothes and the wash liquid; and in this case, the forwardly directed spirals of the wash liquid current spread-out in the forward direction away from the center of the dasher 25. Likewise, the reverse rotation of the dasher 25 produces the reverse whirling and centrifugal discharge of the clothes and the wash liquid in the substantially horizontally disposed active area arranged adjacent to the

face 30 thereof and adjacent to the bottom wall 13 of the tub 11 by virtue of the centrifugal forces involved that are produced by the action of the shallow ribs 32 upon the clothes and the wash liquid; and in this case, the rearwardly directed spirals of the wash liquid current spread out in the reverse direction away from the center of the dasher 25. Also, in either direction of rotation of the dasher 25, the suction of the clothes and the wash liquid along the vertical path toward the center of the dasher 25 effects some entrainment of air that is useful in producing aeration of the clothes as they undergo the washing action.

In carrying out the method, it is not essential that the first short time interval of the forward whirling action and the third short time interval of the reverse whirling action be equal; and likewise, it is not essential that the second and fourth short time intervals of the two interposed quiescent periods be equal; however, it has been found to be very convenient in the construction of the cycle control mechanism or timer to provide each of the short time intervals mentioned of a duration of about 15 seconds. Specifically, the 15-second forward and reverse whirling actions are not sufficiently long to effect the formation of the upstanding open vortex in the wash liquid or to bring about substantial wrapping-up of the clothes; and the 15-second quiescent periods are adequate to obtain both the subsiding of the tendencies to form the upstanding open vortex in the wash liquid and the desired unfolding of the clothes in the wash liquid.

In passing, it is noted that the overall circulation of the clothes and the wash liquid in the tub 11 is greatly improved by virtue of the circumstance that the clothes are not permitted to ball-up or become tangled in accordance with the present method, whereby a more effective washing action is in fact achieved during the overall washing time interval, notwithstanding the quiescent periods disposed between the forward whirling action and the reverse whirling action in each of the plurality of washing cycles. Moreover, the load handling capacity of the clothes washing machine 10 is increased approximately 50% by employing the present method; whereby in the clothese washing machine 10, a total load between 6 and 8 pounds, depending upon the character of the clothes, may be thoroughly washed without tangling in a short overall washing time interval.

After the clothes have been washed in the tub 11 of the machine 10, the wash liquid is drained therefrom in any suitable manner, not shown; and then the wash liquid absorbed by the clothes may be readily expressed therefrom by operation of the clothes wringer 48, in an obvious manner.

In view of the foregoing, it is apparent that there has been provided an improved clothes washing machine embodying a minimum number of simple operating parts.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A clothes washing machine comprising a stationary upstanding tub including a substantially horizontal bottom end wall and a substantially vertical connecting side wall provided with a top opening, a baffle arranged in the upper end of said side wall and partially closing the top opening in said side wall so as to define a compartment and a throat opening disposed above said compartment and communicating between said compartment and the exterior, said compartment being readily accessible from the exterior through said throat opening and being adapted to contain wash liquid and clothes to be washed, the normal wash liquid level in said tub being disposed above said throat opening so that said compartment is completely filled with the wash liquid and the clothes, a substantially disk-like dasher arranged in said compartment adjacent to said bottom end wall and positioned below said baffle and having a substantially smooth face and mounted on said bottom end wall for rotation about a substantially vertical axis offset with respect to said throat opening, and drive mechanism for cyclically operating said dasher; said mechanism, in each cycle thereof, continuously rotating said dasher during a first short time interval at a relatively high speed, and then arresting said rotation of said dasher during a second short time interval; in each cycle of said mechanism, said continuous rotation of said dasher during said first short time interval effecting circulation of the wash liquid and the clothes contained in said compartment, and during said second short time interval the clothes and the wash liquid contained in said compartment being brought to a substantially quiescent condition, the wash liquid and the clothese contained in said compartment being circulated from the face of said dasher in outwardly directed spirals across said bottom end wall and thence upwardly along said side wall and then back inwardly and downwardly toward the center of the face of said dasher, and the clothes contained in said compartment being rubbed and pulsated as they are moved across the face of said dasher.

2. A clothes washing machine comprising a stationary upstanding tub including a substantially horizontal bottom end wall and a substantially vertical connecting side wall provided with a top opening and a baffle arranged in the upper end of said side wall and partially closing the top opening in said side wall so as to define a compartment and a throat opening disposed above said compartment and communicating between said compartment and the exterior, said compartment being readily accessible from the exterior through said throat opening and being adapted to contain wash liquid and clothes to be washed, the normal wash liquid level in said tub being disposed above said throat opening so that said compartment is completely filled with the wash liquid and the clothes, a substantially disk-like dasher arranged in said compartment adjacent to said bottom end wall and positioned below said baffle and having a substantially smooth face and mounted on said bottom end wall for rotation in either direction about a substantially vertical axis offset with respect to said throat opening, and drive mechanism for cyclically operating said dasher; said mechanism, in each cycle thereof, continuously rotating said dasher during a first short time interval in one direction at a relatively high speed, then arresting said rotation of said dasher during a second short time interval, then again continuously rotating said dasher during a third short time interval in the opposite direction at a relatively high speed, and then again arresting said rotation of said dasher during a fourth short time interval; in each cycle of said mechanism, said continuous rotation of said dasher during said first and third short time intervals effecting circulation of the wash liquid and the clothes contained in said compartment, and during said second and fourth short time intervals the clothes and the wash liquid contained in said compartment being brought to a substantially quiescent condition, the wash liquid and the clothese contained in said compartment being circulated during said first short time interval from the face of said dasher in outwardly directed spirals in one direction across said bottom end wall and thence upwardly along said side wall and then back inwardly and downwardly toward the center of the face of said dasher, the wash liquid and the clothes contained in said compartment being circulated during said third short time interval from the face of said dasher in outwardly directed spirals in the opposite direction across said bottom end wall and thence upwardly along said side wall and then back inwardly and downwardly toward the center of the face of said dasher, and the clothes contained in said compartment being rubbed and pulsated as they are moved in either direction across the face of said dasher.

3. A clothes washing machine comprising a stationary

upstanding tub including a substantially horizontal bottom end wall and a substantially vertical connecting side wall provided with a top opening, a baffle, means mounting said baffle in the upper end of said side wall for movements between an operative position and a storage position, said baffle in its operative position cooperating with said tub to define a compartment and a throat opening disposed above said compartment and communicating between said compartment and the exterior, said compartment being readily accessible from the exterior through said throat opening with said baffle in its operative position and being adapted to contain wash liquid and clothes to be washed, the normal wash liquid level in said tub being disposed above said throat opening with said baffle in its operative position so that said compartment is completely filled with the wash liquid and the clothes, a substantially disk-like dasher arranged in said compartment adjacent to said bottom end wall and positioned below said baffle in its operative position and having a substantially smooth face and mounted on said bottom end wall for rotation about a substantially vertical axis offset with respect to said throat opening, means for continuously rotating said dasher at a relatively high speed in order to circulate the wash liquid and the clothes contained in said compartment, the wash liquid and the clothes contained in said compartment being circulated from the face of said dasher in outwardly directed spirals across said bottom end wall and thence upwardly along said side wall and then back inwardly and downwardly toward the center of said dasher, said baffle in its operative position presenting a downwardly directed surface completely submerged in the wash liquid in said compartment and extending entirely over said dasher to prevent the formation of any substantial upstanding vortex in the substantially vertically disposed column of the wash liquid extending between the face of said dasher and the downwardly directed submerged surface of said baffle incident to the circulation of the wash liquid, the clothes contained in said compartment being rubbed and pulsated as they are moved across the face of said dasher, and a clothes wringer carried by said baffle said clothes wringer being moved into an operative position disposed above said tub in response to movement of said baffle into its operative position and being moved into a storage position disposed in said tub in response to movement of said baffle into its storage position.

4. The clothes washing machine set forth in claim 3; wherein said baffle is mounted in the upper end of said side wall for pivotal movements between its operative and storage positions, and further comprising selectively operative means for retaining said baffle in its operative position.

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