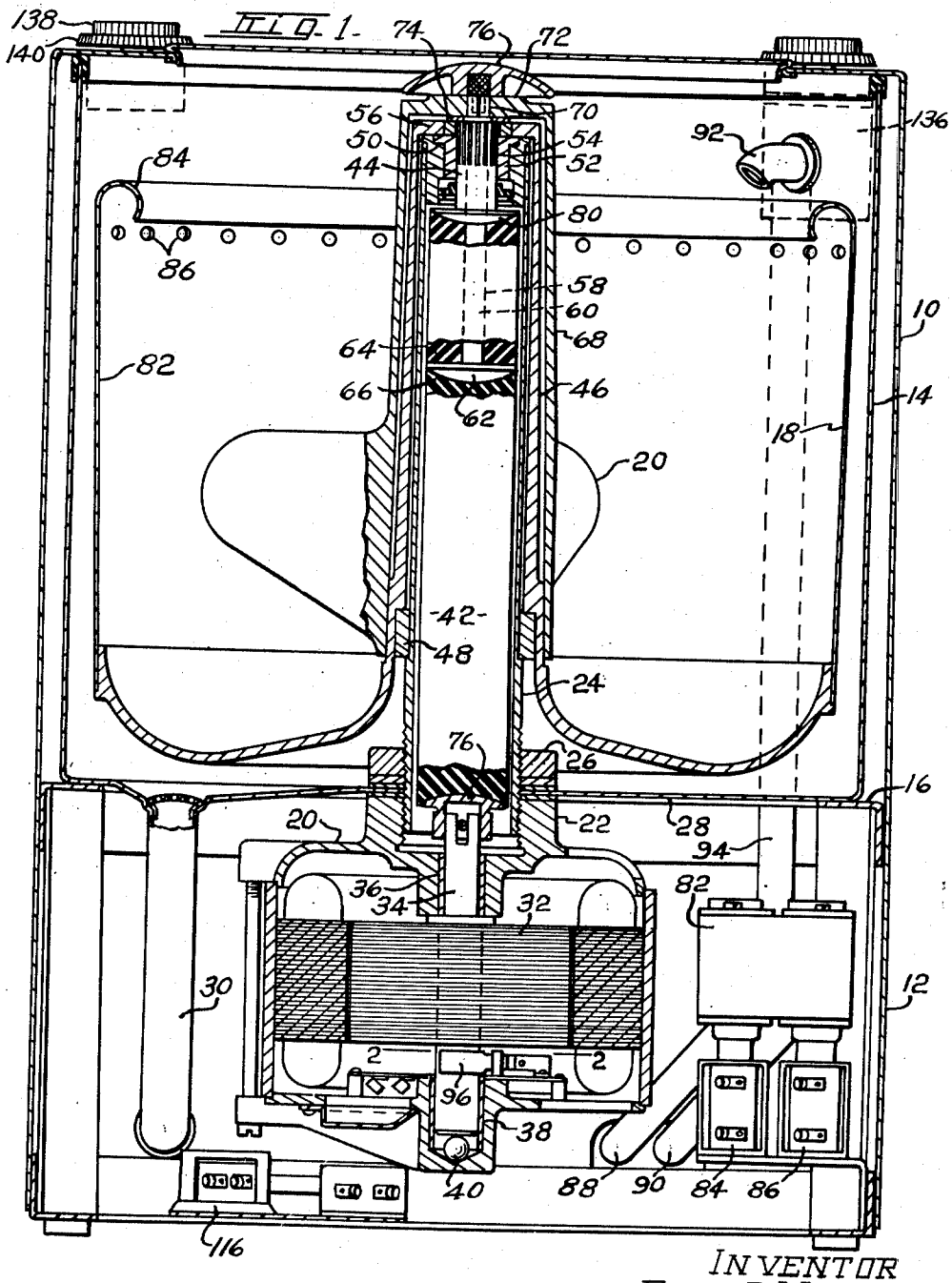
Feb. 23, 1954 E. C. WILLIAMS 2,669,856

WASHING MACHINE WITH INDUCTION MOTOR DRIVE

Filed Sept. 15, 1951

2 Sheets-Sheet 1

FIG. 1.



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WASHING MACHINE WITH INDUCTION MOTOR DRIVE

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2 Sheets-Sheet 2

FIG. 6.

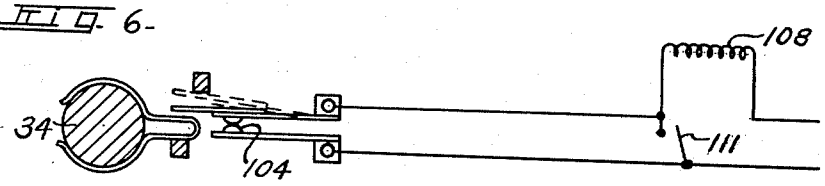


FIG. 2.

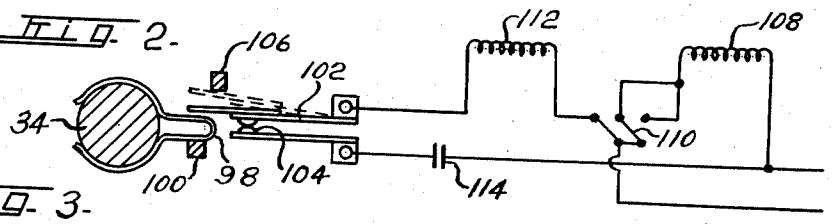


FIG. 3.

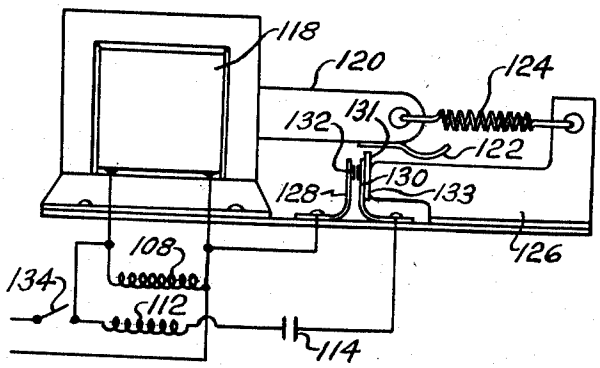


FIG. 4.

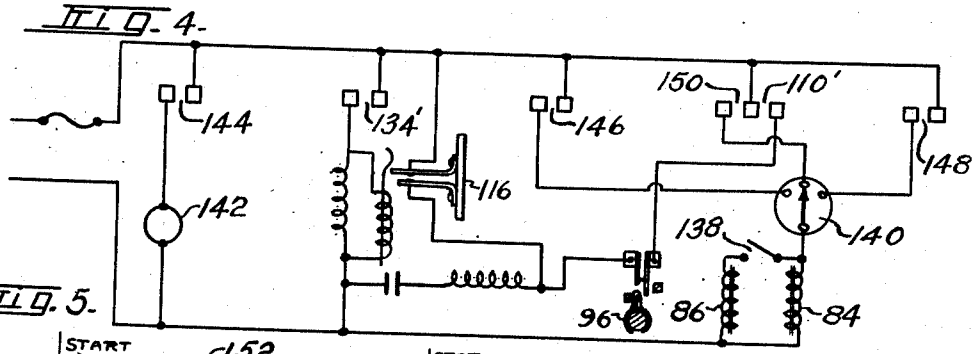
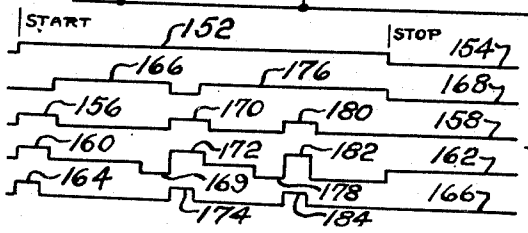


FIG. 5.



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Patented Feb. 23, 1954

2,669,856

UNITED STATES PATENT OFFICE

2,669,856

WASHING MACHINE WITH INDUCTION MOTOR DRIVE

Earl C. Williams, Syracuse, N. Y., assignor to Easy Washing Machine Corporation, Syracuse, N. Y., a corporation of Delaware

Application September 15, 1951, Serial No. 246,759

11 Claims. (Cl. 68—12)

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This invention relates to washing machines, and more particularly to a single tub automatically controlled oscillating agitator centrifugal type machine driven by an oscillating and rotary motor.

In an application Serial No. 206,195, filed January 16, 1951, there is disclosed a single tub washing machine having a vertical axis rotatable clothes-containing tub and an oscillatable agitator, in which the tub and agitator are driven by a motor which may oscillate or rotate depending upon the operation to be performed. In the arrangement shown, the rotor of the motor is connected to the tub and agitator through a resilient link.

The present invention is directed to improvements upon a machine of the foregoing type, and more particularly to an automatic control adapted to establish a timed sequence of operations such as washing, rinsing, and drying. The invention more particularly has to do with means for causing the motor rotor to oscillate during certain stages of the operation, and to rotate during other stages of the operation, and to time such operations with a water supply so that a complete washing, rinsing and drying cycle may be effected automatically. The means for causing the motor to oscillate or rotate are constituted by mechanically actuated electric starting circuits adapted to initiate either oscillation of the rotor or continuous rotation thereof.

The above and other novel features of the invention will appear more fully hereinafter from the following detailed description when taken in conjunction with the accompanying drawings. It is expressly understood that the drawings are employed for purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings, wherein like reference characters indicate like parts:

Figure 1 is a vertical section taken through a washing machine of the type referred to;

Figure 2 is a circuit diagram adapted to establish continuous rotation of the rotor, the mechanical elements of which are shown in section, and taken on the section line 2—2 of Figure 1;

Figure 3 is a circuit diagram adapted to establish oscillatory drive of the motor;

Figure 4 is a timer controlled circuit diagram including the circuits of Figures 2 and 3, and other controls essential to a washing cycle;

Figure 5 is a time diagram illustrating the sequence of operation of the switches actuated by the timer control; and

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Figure 6 is an alternative circuit diagram to that shown in Figure 2, for establishing continuous rotation.

Referring to Figure 1, there is shown a washing machine having a surrounding casing 10 including a base 12, within which is a stationary drain tub 14 resting on an annular platform 16. Within the drain tub is positioned a laundry-containing centrifuge tub 18 and an oscillatable agitator 20. Within the base 12, there is mounted a motor having a stator frame 20 supported from the bottom 28 of the tub 14, such stator frame having an internally threaded collar 22 from which there extends upwardly a central tubular column 24, such column projecting through the tub 14. A jam nut 26, threaded upon the column 24 above the bottom 28 of the tub 14, is adapted to clamp through the column 24 the motor stator 20, and more particularly its collar 22, against the tub bottom 28.

In the arrangement shown, the tub 14 is provided with a drain outlet 30 continuously open.

Within the stator frame 20 is a rotor 32 mounted on a vertical shaft 34 journaled in stator bearings 36 and 38, the lower end of the shaft resting upon a ball thrust bearing 40. Such shaft at its upper end is connected to the lower end of a resilient link 42 extending upwardly through the tubular column 24. Such resilient link, in the form shown, consists of an elongated cylindrical member of rubber or rubber-like material having substantial torsional resiliency.

The upper end of the rubber link 42 is drivably connected through a hollow stub shaft 44 to the central column 46 of the tub 18, such central column being journaled upon the tubular column 24 as at 48 and 50, the latter bearing being a thrust bearing. The stub shaft 44 is journaled in a bearing sleeve 52 mounted in the upper end of the column 24, and for disassembly purposes, such shaft has a splined connection 54 to the inwardly directed flange 56 of the tub column 46.

The upper end of the resilient link 42 is provided with a bore 58 through which extends a shaft 60, such shaft terminating at its lower end in a head 62 which is bonded to the upper and lower portions 64 and 66 of the resilient member 42. The shaft 60 extends through the hollow stub shaft 44, and is drivably connected to an outer agitator sleeve 68 rotatably mounted upon the tub column 46, the shaft being keyed to the agitator column 68 by means of the squared end 70 engaging a similar contoured aperture in the inwardly directed flange 72 at the upper end of the agitator sleeve. The flange 72 may bear on the flange 56 through a thrust washer 74 and is

held in position on the end of the shaft 60 by the knob 76, the latter having threaded engagement with the end of the shaft 60. It will be understood that the resilient link 42 is bonded at its opposite ends to a drive collar 78 at the lower end and the head 80 formed integral with the hollow stub shaft 44. The apparatus thus far described is essentially the same as that disclosed in the aforementioned application Serial No. 206,195, and in such application, an alternative construction employing coil torsion springs is also shown.

The outer circular wall 82 of the centrifuge tub 18 is outwardly and upwardly tapered, and provided with a rolled edge 84 and a plurality of apertures 86 adjacent thereto located above the normal water line within the tub 18.

The motor may be of the single phase induction type in which the rotor may turn in either direction, depending upon the initial direction of rotation. In the arrangement shown, rotation of the rotor may be initiated in one direction, which will result in torsionally stressing the resilient link 42. The initial rotation will be arrested when the torsion is sufficient to stall the rotor. The stored energy in the resilient link thereupon initiates rotation of the rotor in the opposite direction, which rotation is again stalled when the resilient link is torsionally stressed in an amount to cause stalling. The rotor thus periodically oscillates. The weight of the tub 18 with the laundry and wash water contained therein acts as a reaction or movable anchor by reason of its coupling to the upper end of the resilient link 42, and while the tub may angularly move through a few degrees in opposition to the rotation of the motor rotor, the inertia of the tub and the water contained therein is relatively great compared to that of the rotor, so that the rotor may turn through several revolutions while the tub merely rotates through a few degrees. Agitation is effected by reason of the connection of the agitator sleeve to the torsional member 42 at a point spaced from the upper end thereof, such agitator being connected to the torsional member by the head 62 which divides the torsional member into the upper portion 64 and the lower portion 66. Thus, as the rotor oscillates to and fro through several revolutions, the agitator will be caused to oscillate to a lesser extent, for example in the order of 90°–180°.

When it is desired to centrifugally extract wash water or rinse water from laundry contained within the tub 18, it is merely necessary to convert the oscillatory motion to continuous rotation by biasing the torque on the motor rotor in one direction, so that each oscillation includes a greater movement in one direction than in the other. After a series of biased oscillations, the rotor establishes rotation in a continuous direction. Upon increase in speed, water is caused to rise along the outwardly tapered wall 82 for discharge through ports 86.

Located in the base of the casing is a hot and cold water mixing valve 82 controlled by solenoids 84 and 86 for the hot and cold water, respectively. The mixing valve 82 is supplied by hot and cold water inlet pipes 88 and 90, respectively, and the outflow from the valve is led to a discharge nozzle 92 overhanging the tub 18. Such nozzle may be angularly directed toward the center of the tub 18, so that while the tub 18 is spinning, the water jet may be broken up by the agitator vanes 20 and caused to be discharged over laundry compacted against the side wall 18 to effect a centrifugal rinse. The conduit 94 leading to the discharge nozzle 92 has preferably interposed therein, means (not shown) for effecting a constant rate of flow, so that by operating the mixing valve 82 to allow flow of water therethrough for a specified time, the quantity of water delivered to the tub 18 can be selected, regardless of line pressure variations, or whether one or both valves are operated. A common device for this purpose is disclosed in British Patent No. 372,286, or Halenza 2,500,750.

Within the motor casing 20, there is provided a split friction collar 96 riding on the lower end of the rotor shaft 34. Such collar, as shown in Figure 2 or 6, has light frictional contact with the shaft 34, so as to tend to turn with the shaft unless obstructed. The collar has a spring loop 98 which acts as a switch operating arm, as well as an arm for engaging the fixed stop 100. When the shaft 34 rotates in a clockwise direction as shown in Figure 2, rotation of the collar is stopped by engagement of the arm 98 with the stop 100. When the arm 98 rotates in a counterclockwise direction in response to counterclockwise rotation of shaft 34, the arm engages a spring contact finger 102 and is effective to open the contacts 104. The movement of the spring contact 102 is limited by an additional stop 106. The mechanism thus described is utilized in a circuit to cause oscillatory drive of the rotor to change to continuous rotation, the circuit for which is shown in Figure 2.

As previously pointed out, the rotor of the motor, when started in either direction, torsionally stresses the resilient drive link 42, causing the same to stall and initiate reverse rotation of the rotor, whereby oscillatory motion of the armature is established. For such operation, the field winding of the stator 108 is in circuit across the line and the starting winding is removed from the circuit, and the switch 110 is in the right hand position to effect such result. After a washing period has been completed and it is desired to cause the tub 18 to rotate to centrifugally remove the wash water therefrom and extract the wash water from the clothes centrifugally, the motor is caused to discontinue the oscillatory drive and operate as an ordinary motor rotating continuously in one direction. To effectuate this result, the switch 110 is shifted to the left hand position, whereby the starting winding 112 and the starting capacitor 114 are thrown in parallel circuit with the field winding 108, such circuit, however, being opened and closed by the contacts 104. The starting winding is so related to the field as to effect starting in a counterclockwise direction, as shown in Figure 2.

It will be seen that when the starting winding circuit is thus connected in parallel with the field, the contacts 104 will be closed during rotation of the shaft 34 in the clockwise direction and open during rotation in the opposite direction. Thus, the starting winding will be effective to strongly resist rotation of the rotor in a clockwise direction. This has the effect of severely decreasing the angle through which the armature rotates clockwise urging counterclockwise rotation. The motor rotor will thus be stalled quickly, forcing the resilient link to relieve its torsion by rotating the basket in the desired direction through a much greater angle than during oscillation. Before several cycles of attempted oscillation have occurred, continuous rotation has been effected in a counterclockwise direction. In a 60-cycle motor, having 8 poles,

the rotation speed will increase to approximately 860 R. P. M.

The acceleration of the tub 18 first causes the wash water to spill through the apertures 86 and even over the rim 84, carrying the surface scum to be centrifugally removed from the tub. Thereafter, as the speed increases, further water is wrung from the tub by centrifugal force as in ordinary centrifugal extraction. Thus, it will appear that by the mere parallel connection of the starting winding as controlled by the contacts 104, oscillatory motion is converted to rotary motion. Once rotation has been established, the starting winding circuit is held open by the friction arm 98 which holds the contacts 104 open.

While as described in the above referred-to application, oscillatory motion of the motor may be started by manually rotating the tub 18 through a few degrees, automatic starting is provided by an impulse switch, such switch being shown in the base of the casing at 116. Such switch is shown in detail in Figure 3, and comprises a solenoid 118 having a plunger 120 carrying a spring finger 122. The plunger is normally held in the position shown by the biasing spring 124 connecting the plunger resiliently to the solenoid frame 126. Mounted on the frame are a pair of contact fingers 128 and 130, having normally open contacts 132. The finger 130 has an insulated projection 131 extending into the path of movement of the finger 122, so that when the solenoid 118 is energized, the finger 122, in passing over the projection 131, causes the finger 130 to close the contacts 132 momentarily. The abutment 133 holds the finger 130 against any accidental movement tending to close contacts upon the return of the plunger. Such contacts are in circuit with the starting winding 112 and capacitor 114. In the circuit of Figure 3, closing the switch 134 energizes the stator field 108 and at the same time energizes the solenoid 118. This in turn causes the plunger 120 to move to the left momentarily closing the contacts 132 through the starting winding circuit. The momentary passage of current through the starting winding circuit causes the rotor of the motor to move a few degrees against the torsion of the resilient link 42, whereupon the oscillatory movement of the rotor commences. The initial oscillations are of relatively low amplitude, but the amplitude rapidly increases to the maximum required for providing a sufficient angular movement of the agitator 20.

Automatic control of the washing machine is effected through a timer 136 which may be of the usual multiple cam type, such cams sequentially actuating electrical contacts to make and break at prescribed intervals the various circuits essential to performing a washing, rinsing and drying sequence. There is also provided a manual switch actuating control for selecting hot or lukewarm water, the latter being a mixture of cold and hot, as indicated at 138, and a further switch actuating control 140 for selecting the quantity of water used for washing, such quantity being selected in accordance with the size of the laundry load to be washed.

In Figure 4, there is shown a circuit diagram incorporating the switches actuated by the controls 138 and 140, and the timer 136 and its cams, as well as the switches requiring actuation described in connection with the circuit of Figure 2 for changing from oscillatory motion to rotary motion and the circuit of Figure 3 for initiating the oscillatory motion. In the circuit

diagram of Figure 4, the timer motor 142 actuates cams adapted to close contacts 144, 134', 146, 110', and 148, as well as contacts 150. The sequence of operations is commenced by the manual rotation of the cams so as to close the contacts 144 to thereby cause the timer motor to commence rotation and continue the rotation of the cams through the entire cycle of operations.

As shown in the time diagram of Figure 5, the switch contacts 144 remain closed, as is indicated by the elevated portion 152 of the line 154 for a period of time until the cycle is completed. At the time the contacts 144 are closed, switch contacts 146, 150 and 148 are closed. The duration of closure of contacts 146 is indicated by the length of the elevated portion 156 of line 158, and the time during which contacts 150 are closed is indicated by the elevated portion 160 of the line 162. Likewise, the duration of the time contacts 148 are closed is indicated by the length of the elevated portion 164 of line 166.

The contacts 146 and 150 and 148 are connected to a selector switch, indicated on Figure 4 as 140, such switch being actuated by the previously referred-to control 140. By placing the contacts 146 or 150 or 148 in circuit with the hot and cold solenoids 84 and 86, the time such solenoids operate to open the valve 82 to admit water to the tub 18 may be varied, by reason of the difference in lengths of the cams as indicated on the time diagram at 156, 160 and 164. At the same time, whether warm water or hot water is utilized depends upon whether the switch indicated at 138 on Figure 4 is closed or open, such switch 138 being actuated by the manual control also indicated by the reference character 138.

After the lapse of sufficient time to substantially fill the tub 18, the motor circuit contacts 134' are closed by its cam, the length of time being indicated by the elevated portion 166 of the line 168 in Figure 5. Upon the closure of the contacts 134', which in effect performs the function of the switch 134 in the circuit shown in Figure 3, the solenoid 118 is energized as well as the field 108, and the contacts 132 are momentarily closed, energizing the starting winding 112 through the starting capacitor 114. Oscillation of the motor rotor thus commences. The oscillation of the motor rotor causes the agitator 20 to oscillate while the tub 18 and its contents act to anchor the upper end of the resilient link 42.

Toward the end of the period indicated by the elevated portion 166, during which the motor field is energized, it is desirable to remove the wash water from the tub 18, a sufficient washing period having elapsed. For this purpose, the cam, formerly operating to close contacts 150, now closes contacts 110', as indicated by the depressed portion 169 on line 162, thereby establishing the circuit shown in Figure 2 through the starting winding, the starting winding being energized during rotation of the rotor in one direction, and having the braking effect previously referred to. The oscillatory motion is converted to continuous rotation. The contacts 110' remain closed during spinning, so that if a power failure occurs, upon re-establishment of power, the conditions required for starting are present. If stoppage occurred with contacts 104 closed, a starting kick immediately results. Otherwise, solenoid actuating contacts 132 are momentarily closed, thus assuring starting an oscillation, which oscillatory motion is promptly converted to spinning by the unidirectional switch of Figure 2.

Upon the completion of the period of time represented by the elevated portion 166 of line 168, the field circuit of the motor is opened, the wash water formerly contained within the tub will have been removed by centrifugal force, and the tub 18 will come to rest. While retarding, rinse water may be introduced into the tub, the quantity thereof varying in accordance with the wash load as previously, so that the quantity of wash water introduced depends upon the length of time the elevated portion 170 of line 158, or the elevated portion 172 of line 162, or the elevated portion 174 of line 166, holds the respective contacts 146, 150, and 148 closed, it being understood that only one of these contacts will be in circuit by reason of the selector switch 140.

When the tub has had opportunity to partially fill, the motor field is again energized for a period of time as indicated by the elevated portion 176 of line 168. The motor in the manner previously described thus commences its oscillatory drive, thus effecting an agitated rinse. After such rinse has continued for a period, the contacts 110' are again closed as is indicated by the depressed portion 178 of line 162, whereupon the oscillatory drive is converted to a rotary drive and the rinse water is centrifugally discharged from the tub 18. After the rinse water is eliminated from the tub, a spray rinse period commences. Such spray rinse period continues for a period of time as indicated by the elevated portions 180 of the line 158, or 182 of the line 162, or the elevated portion 184 of the line 166, again depending upon which circuit has been selected by the switch 140. It will be seen that the nozzle 92, being directed toward the central portion of the tub, will direct the stream of water toward the rotating agitator 20. Since the tub will be spinning at a speed of 860 R. P. M., the blades of the agitator will interrupt such stream, diffusing the water within the tub 18 so as, to evenly distribute the same upon the mass of laundry compacted centrifugally upon the side wall 82 of the tub 18. The spray rinse water will continue to flow for the period as indicated, and after the flow is discontinued, the tub will continue to rotate at centrifuge speed to extract the water and damp dry the laundry. The timer motor will continue the operation of the cam until the motor contact 134' is open, whereupon the tub 18 decelerates and the cycle is complete.

In Figure 6, an alternative circuit is shown for converting oscillatory motion to rotary motion without using a starting winding. In the form shown, upon opening switch 111, the contacts 104 merely open the stator field circuit upon rotation in one direction. This biases the oscillations sufficiently to cause conversion to rotary motion.

While various embodiments of the invention have been illustrated and described, it is to be understood that the invention is not limited thereto. As various changes in the construction and arrangement may be made without departing from the spirit of the invention, as will be apparent to those skilled in the art, reference will be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. A washing machine comprising, in combination, a centrifuging tub, an oscillatable agitator concentrically arranged therein and rotatable relative thereto, a reversible induction motor, a resilient coupling having its ends connected between said motor and tub, means drivably connecting said agitator to said coupling at a point intermediate the ends thereof, and means for converting oscillatory rotation of said motor to continuous rotation thereof.

2. A washing machine comprising, in combination, a centrifuging tub, an oscillatable agitator concentrically arranged therein and rotatable relative thereto, a reversible induction motor, a resilient coupling having its ends connected between said motor and tub, means drivably connecting said agitator to said coupling at a point intermediate the ends thereof, means for initially establishing rotation of said motor, and means for converting oscillatory rotation of said motor to continuous rotation thereof.

3. A washing machine comprising, in combination, a base, an upstanding tubular sleeve projecting therefrom, a reversible motor in said base having its rotor arranged coaxially with respect to and below said sleeve, a centrifuging tub journaled on said sleeve, an oscillatable agitator rotatable relative to said tub and therewithin, a resilient connecting link between said tub and rotor extending through said sleeve, a driving connection between said agitator and a point intermediate the ends of said resilient link, a stator flux producing winding in said motor, and a unidirectional switch actuated by rotor rotation in circuit with said winding to break the circuit upon rotation in one direction.

4. A washing machine comprising, in combination, a base, an upstanding tubular sleeve projecting therefrom, a reversible motor in said base having its rotor arranged coaxially with respect to and below said sleeve, a centrifuging tub journaled on said sleeve, an oscillatable agitator rotatable relative to said tub and therewithin, a resilient connecting link between said tub and rotor extending through said sleeve, a driving connection between said agitator and a point intermediate the ends of said resilient link, a stator flux producing winding in said motor, a unidirectional switch actuated by rotor rotation adapted to be placed in circuit with said winding to break the current flow in said winding upon rotation in one direction, and time controlled means for rendering said circuit effective to control current flow in said winding.

5. A washing machine comprising, in combination, a centrifuging tub, an oscillatable agitator concentrically arranged therein and rotatable relative thereto, a reversible induction motor, a resilient coupling having its ends connected between said motor and tub, means drivably connecting said agitator to said coupling at a point intermediate the ends thereof, means for converting oscillatory rotation of said motor to continuous rotation thereof, means for supplying wash water to said tub, means for draining centrifuged liquid discharged from said tub, and time controlled means actuating said supply means, and subsequently rendering said converting means effective to establish continuous rotation.

6. A washing machine comprising, in combination, a centrifuging tub, an oscillatable agitator concentrically arranged therein and rotatable relative thereto, a reversible induction motor, a resilient coupling having its ends connected between said motor and tub, means drivably connecting said agitator to said coupling at a point intermediate the ends thereof, means for initially establishing rotation of said motor, means for converting oscillatory rotation of said motor to continuous rotation thereof, means for supplying wash water to said tub, means for

draining centrifugal liquid discharged from said tub, and time controlled means for sequentially activating said supply means, said initial rotation establishing means, and said converting means effective to establish continuous rotation.

7. In an oscillating drive, a rotatable device having inertia resistance to rotation, an induction motor having a field winding, a starting winding, and a rotor, the latter rotatable in either direction with substantially equal torques for any given speed when said field winding only is energized, the direction of rotation depending on the direction of initial rotation, a torsionally resilient link connecting said rotor to said inertia device and normally maintaining opposed oscillatory movement of said device and rotor when said field winding alone is energized for driving said device, means for closing a circuit to said field winding, and means energized by the closing of said circuit independent of motor rotation to momentarily close a circuit through said starting winding to momentarily create a starting torque in one direction.

8. In an oscillating drive, a rotatable device having inertia resistance to rotation, an induction motor having a field winding, a starting winding and a rotor, the latter rotatable in either direction with substantially equal torques for any given speed when said field winding only is energized, the direction of rotation depending on the direction of initial rotation, a torsionally resilient link connecting said rotor to said inertia device and normally maintaining opposed oscillatory movement of said device and rotor when said field winding alone is energized for driving said device, means for closing a circuit to said field winding, and means energized by the closing of said circuit independent of motor rotation to momentarily close a circuit through said starting winding to momentarily create a starting torque in one direction, said last-named means comprising a solenoid having a plunger, and contacts in said circuit, and means carried by said plunger for closing said contacts by movement of said plunger.

9. In an oscillating drive, a rotatable device having inertia resistance to rotation, an induction motor having a field winding, a starting winding, and a rotor, the latter rotatable in either direction with substantially equal torques for any given speed when said field winding only is energized, and unequal torques biased in one direction when said field winding and starting winding are both energized depending on the direction of initial rotation, a torsionally resilient link connecting said rotor to said inertia device and normally maintaining opposed oscillatory movement of said device and rotor when said field winding alone is energized for driving said device, means for establishing oscillatory movement of said rotor by energization of said field winding and initial momentary energization of said starting winding, means associated with said rotor adapted to close a circuit upon rotation of said rotor in one direction only, and open and hold said circuit open upon reverse

rotation, and means for causing said rotor to discontinue oscillatory motion and commence continuous rotation comprising means to energize said starting winding through said circuit.

10. In an oscillating drive, a rotatable device having inertia resistance to rotation, an induction motor having a field winding, a starting winding, and a rotor, the latter rotatable in either direction with substantially equal torques for any given speed when said field winding only is energized, the direction of rotation depending on the direction of initial rotation, a torsionally resilient link connecting said rotor to said inertia device for driving said device, means for energizing said field winding and momentarily said starting winding adapted to initiate rotation of said rotor in one direction, switch means associated with said rotor, adapted to open during rotation in said one direction and close during rotation in the other direction, and means for placing said switch means in circuit with said starting winding to energize said starting winding during all rotation in one direction to cause said rotor to discontinue oscillatory rotation and commence continuous rotation.

11. In an oscillating drive, a rotatable device having inertia resistance to rotation, an induction motor having a field winding, a starting winding, and a rotor, the latter rotatable in either direction with substantially equal torques for any given speed when said field winding only is energized, the direction of rotation depending on the direction of initial rotation, a torsionally resilient link connecting said rotor to said inertia device for driving said device, means for energizing said field winding and momentarily said starting winding adapted to initiate rotation of said rotor in one direction, switch means associated with said rotor, adapted to open during rotation in said one direction and close during rotation in the other direction, and means for placing said switch means in circuit with said starting winding to energize said starting winding during all rotation in one direction to cause said rotor to discontinue oscillatory rotation and commerce continuous rotation, said switch means opening during rotation in the direction of ultimate continuous rotation, whereby said starting winding when energized resists rotation in a direction opposite to ultimate rotation, and remains open once continuous rotation is established.

EARL C. WILLIAMS.

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