

Nov. 19, 1940.

N. H. WATTS

2,222,329

WASHING MACHINE

Filed Jan. 15, 1935

2 Sheets-Sheet 1

Fig. 1.

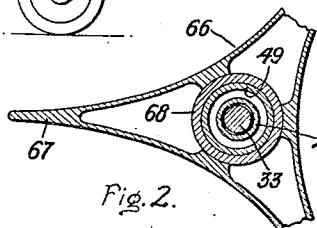
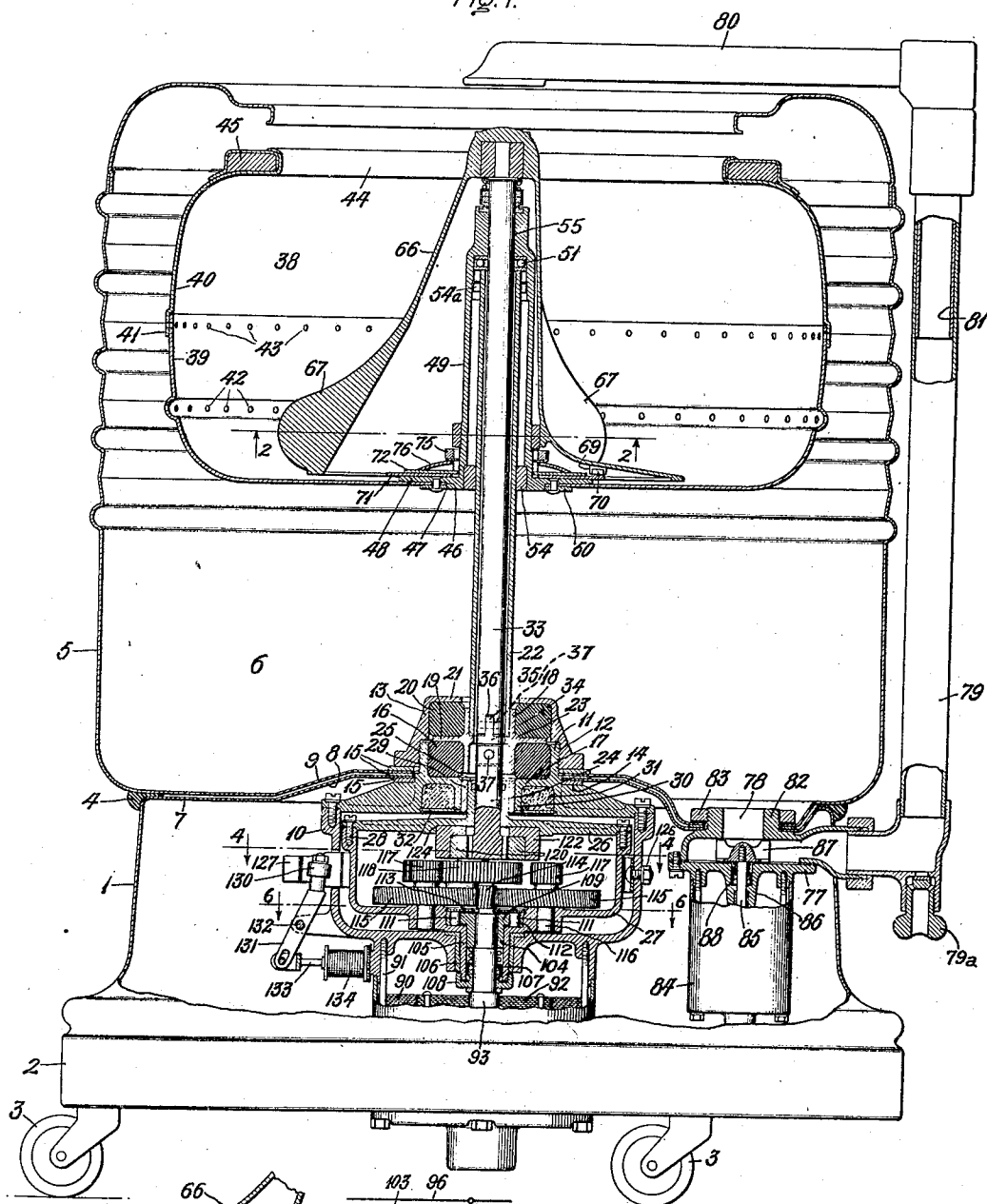


Fig. 2.

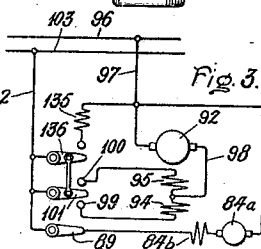


Fig. 3.

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2 Sheets-Sheet 2

Fig. 4.

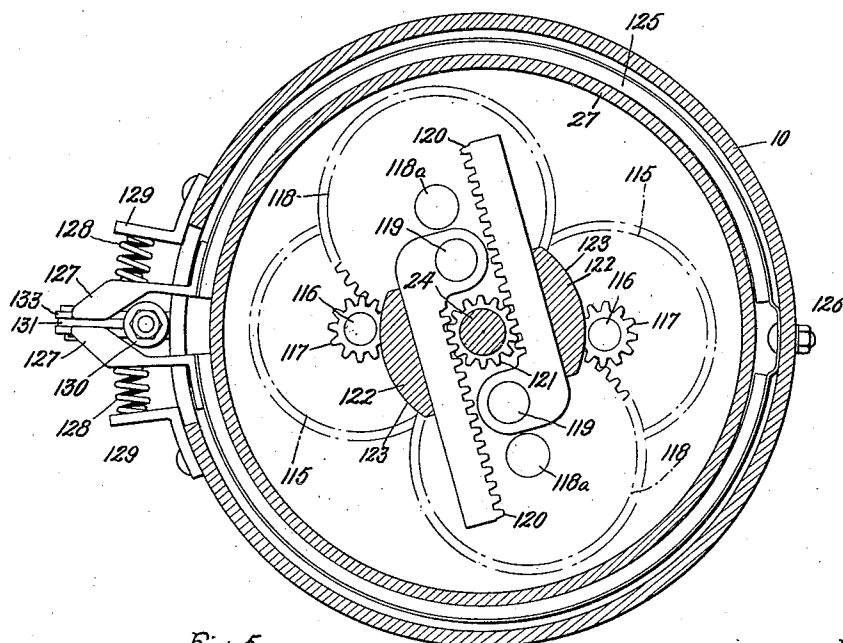


Fig. 5.

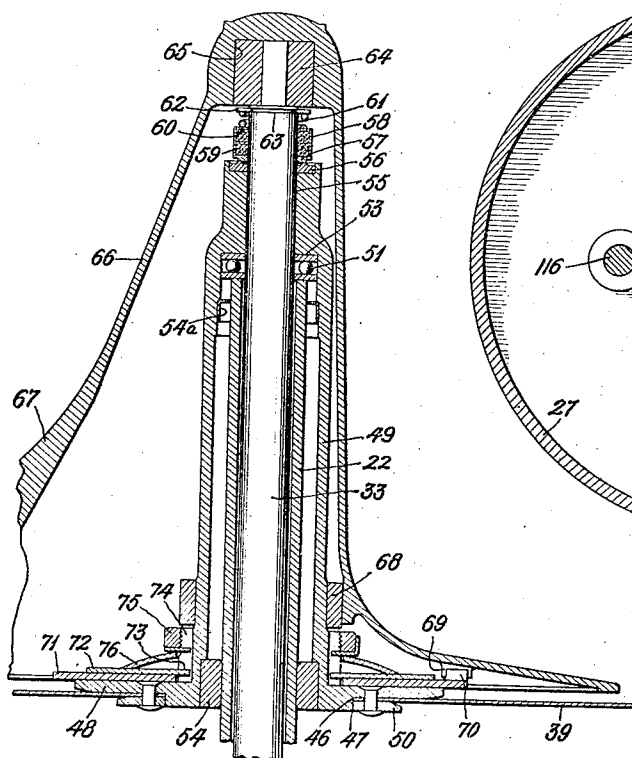
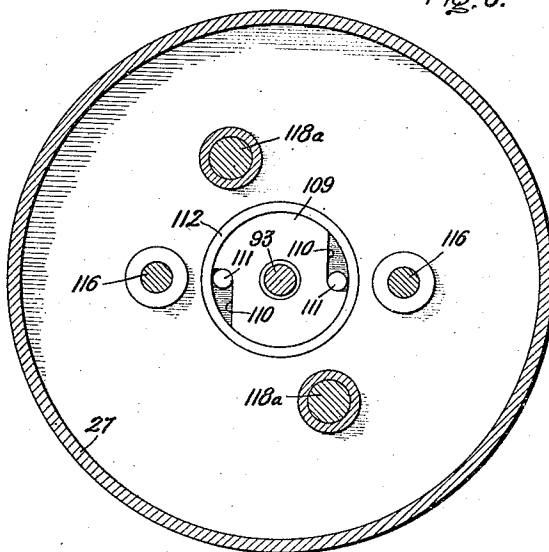


Fig. 6.



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UNITED STATES PATENT OFFICE

2,222,329

WASHING MACHINE

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Application January 15, 1935, Serial No. 1,870

33 Claims. (Cl. 68—23)

My invention relates to washing machines of the type in which washing is effected by the oscillation of an agitating element in a tub and in which the tub is subsequently rotated to centrifugally extract the liquid from the material washed, thereby washing and drying in a single tub.

The object of my invention is to provide an improved construction and arrangement in a washing machine of this type, and particularly to provide an improved arrangement for driving and controlling the washing and extracting operations of the machine.

For a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

In the accompanying drawings, Fig. 1 is a sectional elevation of a washing machine embodying my invention; Fig. 2 is a fragmentary sectional view taken on line 2—2 of Fig. 1; Fig. 3 is a diagram of the control for the washing machine; Fig. 4 is an enlarged sectional view taken on line 4—4 of Fig. 1; Fig. 5 is an enlarged sectional elevation of the agitator and the coupling between the agitator and the tub; and Fig. 6 is an enlarged sectional view taken on line 6—6 of Fig. 1 and showing the over-running clutch between the motor shaft and the rotatable gear housing.

Referring to the drawings, the washing machine embodying my invention is carried on a base 1 provided with a down-turned skirt 2 which is supported by casters 3. On the upper edge of the base is a rubber gasket 4 on which rests the outer edge of a stationary tub 5. The tub 5 acts as the outer casing for the washing machine and the lower portion 6 provides a storage reservoir for the liquid used in washing. The upper wall 7 of the base is provided with a raised portion 8 at the center which fits into a complementary portion 9 in the tub 5 and supports the center of the tub. A housing 10 which contains the driving mechanism for the washing machine is carried on the under side of the wall 7 of the base. This housing is provided with a tubular sleeve 11 having an external threaded portion 12 which projects through a central opening in the walls 8 and 9. A nut 13 which is threaded on the threaded portion 12 clamps the stationary tub 5 and wall 7 of the base between the nut 13 and a surface 14 on the upper side of the housing 10. Gaskets 15 are provided between the nut and the upper side of the tub 5, between the lower side of tub 5 and the base, and

between the base and the surface 14 to prevent leakage. With this arrangement, the tub 5, the base, and the housing 10 are clamped together as a unit.

A rubber ring 16 fits inside the tubular portion 11 and is supported at the bottom by an inwardly extending flange 17 formed on the tubular portion 11. A cylindrical member 18 which extends through the center of the rubber ring 16, has a flange 19 which extends over the upper surface of ring 16. A rubber ring 20, arranged on the upper side of flange 19 and around the cylindrical member 18, is held in place by an inwardly extending flange 21 at the upper end of nut 13. The lower end of a vertical sleeve 22 is fixed to the inner side of cylindrical member 18 and rests against an inwardly extending flange 23. The joint between sleeve 22 and member 18 is liquid-tight. With this arrangement, the sleeve 22 is fixed to the cylindrical member 18, and the rubber rings 16 and 20 provide a resilient support for the lower end of the sleeve. Rubber rings 16 and 20 also act as seals and prevent leakage from the bottom of tub 5. The upper end of sleeve 22 extends above the liquid level in tub 5.

A two-part flexible driving shaft extends from the housing 10 through the sleeve 22. The lower part 24 of this shaft is journaled in a bearing 25 integral with the cover plate 26 of a rotatable gear housing 27. The cover plate 26 is secured to the gear housing 27 by studs 28. The outer surface of bearing 25 is rotatably carried in a bearing 29 which is supported by the down-turned end 30 of flange 17. Bearing 29 is lubricated by an annulus 31 of oil-absorbent material which is held by plate 32 in the annular depression formed by the down-turned end 30 of the flange 17. The upper part 33 of the two-part shaft is connected to the lower part 24 by a universal joint centered opposite the flange 19 on cylindrical member 18. This universal joint comprises a member 34 having tongues 35 at either end which extend at right angles to each other and fit in slots 36, respectively formed in the adjacent ends of shafts 24 and 33. The tongues 35 are pivotally connected to the shafts 24 and 33 by pins 37. The universal joint therefore permits motion in any direction of the adjacent ends of the shafts 24 and 33. Since a small force applied at the upper end of shaft 33 causes a relatively large deflection, the two-part shaft has a low critical speed even though the parts 24 and 33 are relatively stiff. Shafts 24 and 33 provide a flexible shaft which can deflect during its rotation to accommodate unbalance

of the member driven by the shaft. Sleeve 22 is flexible and can accommodate itself to the movement of the flexible shaft. The flexibility of sleeve 22 is increased by the resilient mounting of the lower end of the sleeve.

In the upper part of tub 5 is a tub 38 which is spaced above the liquid level in reservoir 6 and is arranged for rotation about the sleeve 22 and the shaft 33. This tub is made from two cup-shaped members 39 and 40, the open ends of which telescope and are secured together at 41. Holes 42 are provided in the side walls of the lower cup-shaped portion 39, and holes 43 are provided at the joint 41 through which the liquid drains during washing and during rotation of the tub 38 to extract the liquid from the material in the tub. The upper portion 40 of the tub is provided with a central opening 44 at the top through which clothes may be inserted or removed. A ring 45 of steel or other suitable material is mounted around the upper rim of the tub for the purpose of increasing the loading on the driving shaft thereby lowering the speed at which critical vibration of the driving shaft occurs. In the washing machine illustrated, the critical vibration of the shaft occurs at about 100 R. P. M. while the spinning speed is about 1800 R. P. M. The bottom of the tub 38 is provided with a central opening 46, the edge of which rests against a shoulder 47 on the under side of a flange 48 on post 49. A ring 50 on the under side of the tub is riveted to the flange 48 in order to secure the post 49 to the tub. The tub is supported by a ball bearing 51 arranged between the upper end of sleeve 22 and a shoulder 53 formed on the inside of post 49. By supporting the tub at the upper end of shaft 33, the speed at which critical vibration of the shaft occurs is decreased. The lower end of the tub is guided during rotation about sleeve 22 by a bearing 54 which is secured to the inside of post 49 and which bears on sleeve 22. A ring 54a secured to the inside of post 49 below bearing 51, holds the bearing in place when the tub is lifted from the sleeve 22. The upper end of the post 49 is provided with a bearing 55 through which shaft 33 extends. With this arrangement, the tub 38 is removably supported by the sleeve 22 and is free to rotate relative to either the sleeve 22 or the shaft 33. Since sleeve 22 and shaft 33 can deflect laterally, the axis of rotation of tub 38 may shift to accommodate unbalance of the tub.

A seal, shown in Fig. 5, is provided at the upper end of post 49 to prevent leakage between the bearing 55 and the shaft 33. This seal comprises a ring 56 fixed to the upper side of post 49 and a ring 57 which is slidable on shaft 33. Ring 57 is provided with cylindrical side walls 58 which are spaced from shaft 33, and packing rings 59 are arranged between these walls and shaft 33. A metal ring 60 is arranged at the upper end of packing rings 59 and within the walls 58. A coil spring 61 arranged between ring 60 and a snap ring 62, secured in groove 63 in shaft 33, forces the packing rings 59 against shaft 33 and also forces ring 57 against ring 56. The packing rings 59 prevent leakage around the upper end of shaft 33, and the sealing rings 56 and 57 prevent leakage between the shaft 33 and the post 49. Ring 62 also transmits the downward thrust of shaft 33 to the post 49. The downward thrust of the shaft 33 includes the weight of the shaft 24 which is connected thereto by the universal joint 34 and pins 37.

The upper end of shaft 33 has a nut 64 fixed

thereto which fits into a complementary recess 65 in an agitator 66 and couples the agitator to the shaft 33 and also supports the agitator on the shaft 33. The body of the agitator extends downwardly around the post 49 and is provided with three vanes 67 at the lower end, as shown by Fig. 2. A ring 68 fixed to the inside of the agitator at the lower end bears on post 49 and guides the oscillating movement of the agitator. The under side of the agitator is provided with a projection 69 which is adapted to engage a complementary projection 70 formed on a clutch plate 71. The clutch plate 71 is frictionally secured to the upper side of flange 48 by a plate 72 the inner edge of which fits within a groove 73 in bushing 74 fixed to post 49. A nut 75 threaded on bushing 74 forces the outer edge of a concave disk 76 against the upper surface of plate 72 and holds the clutch plate 71 in frictional engagement with the upper side of flange 48. The clutch plate can slip to relieve excessive forces on projection 70. During washing, the agitator 66 is oscillated through an angle of approximately 180 degrees. If during this movement, the projection 69 on the agitator strikes the projection 70, the tub 38 is moved to a position in which the projections 69 and 70 no longer engage, which is the normal position during washing. The inertia of the tub prevents oscillation of the tub during washing. The slipping of clutch plate 71 also assists in preventing oscillation of the tub. The projections 69 and 70 therefore provide a coupling between the agitator and the rotatable tub 38 which permits the agitator to be oscillated in the tub during washing. The tub 38 is rotated to extract the liquid from the material being washed by rotating the agitator 66. During this rotation, the projection 69 engages the projection 70 and forms a coupling between the agitator and the tub through which the tub is rotated. This coupling is within the tub so that there is no sealing problem. Also, this coupling is readily accessible for adjustment and replacement.

During washing, the liquid level in tub 38 is maintained by a pump 77 which has an inlet 78 to the bottom of tub 5 and which discharges into a vertical pipe 79 supported at the side of the washing machine. A drain plug 79a is provided for pipe 79. Pipe 79 discharges through a pipe 80 which has a depending portion 81 telescoped within the upper end of pipe 79. This permits the pipe 80 to be pivoted about the pipe 79 so that the discharge from the pump may be directed either to the tub 38 or to a drain. The pump 77 runs continually during washing and pumps the liquid which leaks through openings 42 and 43 back into the tub 38. The amount of liquid in the washing machine and the capacity of the pump are preferably arranged so that there is a continuous overflow over the upper edge of tub 38 during washing. This allows the lint which collects on the upper surface of the liquid in tub 38 during washing to flow over the upper edge of tub 38 so that it does not collect on the clothes during extraction. The upper end of the pump is provided with a tubular portion 82 around the inlet opening 78 which projects through openings in the upper wall of the base and the lower wall of tub 5. A nut 83 threaded on the outside of tubular portion 82 holds the pump in position. Suitable gaskets are provided between the abutting parts to prevent leakage. At the lower end of the pump is an electric motor 84 having a motor shaft 85 which is journaled in a bearing housing 86. The upper side of the bearing hous-

ing 86 forms the lower side of the pump casing. The pump impeller 87 is secured to the upper end of shaft 85, and a suitable seal 88 is arranged between the impeller and the bearing housing 86 to prevent leakage around the pump shaft. The motor 84 is illustrated as a series motor having an armature 84a and a field 84b. The motor is connected across power conductors 96 and 103 and is controlled by a switch 89, as shown in the control diagram in Fig. 3.

The power for driving the washing machine is obtained from an electric motor, illustrated as a series motor, carried within the lower end of stationary housing 10. This motor comprises a stationary field member 90 fixed within the housing 10 by bolts 91 and a rotating armature 92 which is carried by a shaft 93. The stationary member 90 has two field windings 94 and 95 which are wound so that the direction of rotation of the motor may be controlled by connecting one or the other of the field windings in series with the armature. One arrangement for controlling the direction of rotation of the motor is shown in Fig. 3. In this arrangement, one side of the armature 92 is connected to conductor 96 which forms one side of the power supply by conductor 97. The other side of the armature is connected to one side of field windings 94 and 95 by conductor 98. The other side of field windings 94 and 95 terminates in contacts 99 and 100 respectively, which are alternately engaged by a switch blade 101. The switch blade 101 is connected by conductor 102 to conductor 103 which forms the other side of the power supply. With this arrangement, the direction of rotation of the motor is controlled by moving switch blade 101 into engagement with either contact 99 or contact 100. When switch blade 101 engages contact 99, the motor rotates in a counter-clockwise direction.

A sleeve 104 is keyed on the upper end of shaft 93. This sleeve is rotatable in a bearing formed by the down-turned flanges 105 of rotatable housing 27. The housing 27 at the lower end is rotatably supported on housing 10 by a bearing 106 arranged between flange 105 and housing 10. A seal 107 arranged between sleeve 104 and cap 108 threaded on the lower end of flange 105 prevents leakage of lubricant from the housing 27 around the shaft 93. At the upper end of sleeve 104 is a collar 109 which forms one member of an over-running clutch arranged between the shaft 93 and the housing 27. Collar 109 is provided with inclined notches 110 (see Fig. 6) in which rolls 111 rest. A hardened steel ring 112 surrounds the collar 109 and is secured to the housing 27. When the shaft 93 is rotated in a counter-clockwise direction, as viewed in Fig. 6, the rolls 111 are moved to the position shown in Fig. 6, and relative rotation between the shaft 93 and the housing 27 is permitted. When the shaft 93 is rotated in a clockwise direction, the rolls 111 are wedged between the inclined surface of slots 110 and the steel ring 112, thereby coupling together the housing 27 and the shaft 93. A snap ring 113 is secured in a groove in the housing 27 above rolls 111 and retains the rolls in position.

The shaft 93 projects above collar 109, and a helical gear 114 is cut in the projecting end. This gear meshes with gears 115 on opposite sides of gear 114. Gears 115 are rotatably carried in housing 27 by shafts 116. To the upper side of gears 115 are fixed concentric gears 117 which mesh with gears 118, arranged on opposite sides of shaft 93, and rotatably carried on housing 27

by shafts 118a. Pins 119 are eccentrically fixed to gears 118 and provide cranks to which the opposite ends of racks 120 are pivotally connected. Racks 120 are arranged on opposite sides of a pinion 121 which is fixed to the lower end of shaft 24. The crank pins 119 are arranged so that the racks 120 are reciprocated in opposite directions by the rotation of gears 118. With this arrangement, the oscillating movement of pinion 121 due to the reciprocation of the racks causes no thrust on bearing 25 in which the shaft 24 is journaled. The reciprocating movement of the racks is guided by guides 122 having cylindrical outer surfaces 123 which fit within a circular depression 124 in the under side of cover plate 26. Guides 122 are therefore free to move and maintain the racks 120 in engagement with the pinion 121 at all times.

In order to prevent rotation of the housing 27 when the shaft 93 is rotated in a counter-clockwise direction, as viewed in Fig. 6, a brake band 125 is provided around the outer surface of housing 27. The center of the brake band is fixed to housing 10 by bolts 126, as shown in Figs. 1 and 4. The adjacent ends of brake band 125 are secured to cams 127. The cams 127 are urged toward each other in order to hold brake band 125 against the outer surface of housing 27 by compression springs 128 which are arranged between lugs 129 attached to housing 10 and the outer surface of the cams 127. The cams 127 are moved away from each other in order to move brake band 125 away from the surface of housing 27 by a roller 130 which is rotatably carried on the upper end of a lever 131. The middle of lever 131 is pivotally carried on housing 10 by a pin 132, and the lower end of lever 131 is connected to the movable member 133 of a solenoid 134. When the solenoid is energized, roller 130 is moved between the oppositely inclined inner surfaces of cams 127 moving the cams 127 apart and releasing the brake on housing 27.

The operating coil 135 of the solenoid is connected between conductors 97 and 102. A switch blade 136 which is mechanically interlocked with switch blade 101 controls the energizing of the operating coil of the solenoid. Switch blade 136 is arranged so that when switch blade 101 is moved to contact 99 in order to cause the motor shaft 93 to rotate in a counter-clockwise direction, the solenoid will be deenergized and the springs 128 urge the brake band 125 against casing 27 and prevent rotation of the casing. During this condition, the gear 114 on the shaft 93 causes the gears 115 and 118 to rotate on the housing 27, thereby causing the shaft 24 to be oscillated by racks 120. This will cause the agitator 66 to be oscillated in the tub 38. This driving connection is the driving connection used during washing.

When the switch blade 101 is moved to contact 100, switch blade 136 is moved to close the circuit through the operating coil 135 of the solenoid and the brake on housing 27 is released. When the switch blade 101 is in this position, the motor shaft 93 rotates in a clockwise direction, and the rolls 111 of the over-running clutch are wedged between the inclined surfaces of notches 110 and the ring 112, thus coupling the housing 27 to the motor shaft. During this condition, there will be no rotation of the gears 115 and 118 on the housing 27, and the shaft 24 will be rotated at motor speed. This will cause the projections 69 and 70 to engage and thereby cause the tub 38 to be rotated by agitator 66. This driving

connection is used for extracting liquid from material in the tub 38.

When the switch blade 101 is returned to the neutral position, shown in Fig. 3, the operating coil of the solenoid is deenergized and the brake band 135 is tightened around the surface of housing 27. With this arrangement, the brake is used to retard the rotation of tub 38 after the completion of the extraction of liquid from the material in the tub.

In the use of a washing machine, switch 89 is closed energizing the pump motor 84, and a washing solution is run into tub 38 until the liquid flows over the upper rim of the tub 38. The clothes are then placed in the tub and switch blade 101 is moved to contact 99 causing the motor shaft to rotate in a counter-clockwise direction, as viewed in Fig. 6. As explained above, this will cause the shaft 24 to be oscillated and will thereby cause the agitator 66 to be oscillated in the tub 38. At the start of this oscillating movement, the projection 69 on the agitator may engage projection 70 carried by the tub 38. This will cause the tub 38 to be rotated to a position in which the projections 69 and 70 no longer engage, or will cause clutch plate 71 to slip and move projection 70 to a position in which it will no longer engage projection 69. The oscillating movement of the agitator will not cause any oscillating movement of the tub.

At the completion of the washing operation, switch 89 is opened, stopping the pump, and the liquid in the tub is allowed to drain through openings 42 and 43. The switch blade 101 is next moved to contact 100 causing the motor shaft to be rotated in a clockwise direction, as viewed in Fig. 6. This will cause the rolls 111 of the over-running clutch to be wedged between the inclined surfaces of notches 110 and the steel ring 112, thereby coupling the housing 27 to the motor shaft 93. Due to the mechanical interlock of switch blades 101 and 136, the operating coil 135 of the solenoid 134 will be energized, and the brake on the outer surface of housing 27 will be released. With the switches in this position, the shaft 24 will be rotated, and projections 69 and 70 will engage causing the tub 38 to be rotated by the agitator 66. Due to the resilient mounting provided by rubber rings 16 and 20 and the universal joint between the shafts 24 and 33, the critical vibration of shaft 33 will occur at a very low speed, about 100 R. P. M. and the tub 38 will pass through this critical vibration quickly due to the high accelerating torque of the driving motor. Due to the flexibility of sleeve 22 and the shafts 24 and 33, the axis of rotation of tub 38 can shift to accommodate unbalance of the tub. During rotation of the tub, the liquid in the material will be thrown by centrifugal force to the outside of the tub and will pass through openings 42 and 43 into the reservoir at the bottom of tub 5. At the completion of the extracting operation, the switch blade 101 is returned to the neutral position, shown in Fig. 3, deenergizing the driving motor and also deenergizing the solenoid 134. This causes the brake band 125 to be tightened around the housing 27, thereby retarding the rotation of the tub.

If it is desired to re-use the washing solution which is in the reservoir 6 at the bottom of tub 5, the dried clothes are removed from tub 38, and switch 89 is closed to start the pump which will pump the washing solution into the tub 38. A

similar washing and extracting operation may then be used for another batch of clothing.

If instead it is desired to rinse the clothes which are in the tub 38, the pipe 80 is turned about the pipe 81 so that it will discharge into a drain instead of into the tub 38. The pump is then started and the washing solution in the reservoir 6 is pumped to the drain. The washing and extracting operations outlined above may then be repeated with clear water and, at the completion of these operations, the clothes in the tub 38 will be in a rinsed and dried condition.

What I claim as new and desire to secure by Letters Patent in the United States is:

1. A washing machine comprising a rotatable tub adapted to receive liquid and material to be washed, an agitator in said tub, said agitator having a portion extending adjacent the bottom of the tub, a shaft for driving the agitator, means for selectively oscillating and rotating the agitator shaft, and a coupling between said agitator and said tub, said coupling being enclosed between the bottom of the tub and the portion of the agitator adjacent the bottom of the tub and said coupling having sufficient lost motion to permit oscillation of said agitator relative to said tub and said coupling being effective upon rotation of said agitator to cause rotation of said tub through said agitator.

2. A washing machine comprising a rotatable tub adapted to receive liquid and material to be washed, an agitator in said tub, means extending through the bottom of the tub for oscillating said agitator and for rotating said agitator, the inner surface of said tub and an adjacent portion of said agitator having complementary portions which permit oscillation of the agitator in the tub through a limited angle for washing and which engage upon rotation of the agitator to cause the tub to be rotated when the agitator is rotated for extracting liquid from the material.

3. A washing machine comprising a rotatable tub adapted to receive liquid and material to be washed, washing means in said tub, a power shaft, means effective upon rotation of said shaft in one direction for operating said washing means through said shaft for causing washing in said tub, and means effective upon rotation of said shaft in the reverse direction for rotating said tub through said shaft to extract liquid from the material contained therein.

4. A washing machine comprising a rotatable tub adapted to receive liquid and material to be washed, an agitator in said tub, a power shaft, oscillating mechanism for driving said agitator, means effective upon rotation of said shaft in one direction effecting a driving connection from said shaft to said oscillating mechanism for oscillating said agitator relative to said tub, and means effective upon rotation of said shaft in the reverse direction for effecting a driving connection from said shaft to said tub for rotating said tub to extract liquid from the material contained therein.

5. A washing machine comprising a rotatable tub adapted to receive liquid and material to be washed, a vertical shaft, an agitator in said tub connected to said shaft and rotatable relative to said tub, a power shaft, means effective upon rotation of said power shaft in one direction for effecting a driving connection from said power shaft oscillating said vertical shaft, means effective upon rotation of said power shaft in the reverse direction for effecting a driving connection from said power shaft for rotating said ver-

tical shaft, and a coupling between said vertical shaft and said tub effective to cause rotation of said tub upon rotation of said vertical shaft.

6. A washing machine comprising a rotatable tub, an agitator in said tub, a shaft for driving said agitator, a power shaft driving a sun gear, a planet gear carried by a rotatable carrier and driven by said sun gear, mechanism connecting said planet gear and said agitator shaft for effecting oscillation of said agitator shaft upon rotation of the planet gear on said carrier, said mechanism being effective to hold the agitator shaft in fixed angular relation to the planet gear when the planet gear is stationary on said carrier, means causing rotation of said planet gear on said carrier by said sun gear for causing said agitator shaft to be oscillated, means positively preventing rotation of said planet gear on said carrier for causing rotation of said carrier by said power shaft whereby said agitator shaft is rotated, and means for rotating said tub from said agitator shaft during rotation thereof.

7. A washing machine comprising a rotatable tub, an agitator in said tub, a shaft for driving said agitator, a power shaft driving a sun gear, a planet gear carried by a rotatable carrier and driven by said sun gear, mechanism connecting said planet gear and said agitator shaft for effecting oscillation of said agitator shaft upon rotation of the planet gear on said carrier, said mechanism being effective to hold the agitator shaft in fixed angular relation to the planet gear when the planet gear is stationary on said carrier, means causing rotation of said planet gear on said carrier by said sun gear for causing said agitator shaft to be oscillated, means including an overrunning clutch for preventing rotation of said planet gear on said carrier when said power shaft is reversed whereby said carrier is rotated by said power shaft, and means for rotating said tub from said agitator shaft during rotation thereof.

8. A washing machine comprising a rotatable tub, an agitator in said tub, a shaft for driving said agitator, a power shaft driving a sun gear, a planet gear carried by a carrier rotatable on said power shaft and driven by said sun gear, mechanism connecting said planet gear and said agitator shaft for effecting oscillation of said agitator shaft upon rotation of the planet gear on said carrier, said mechanism being effective to hold the agitator shaft in fixed angular relation to the planet gear when the planet gear is stationary on said carrier, means causing rotation of said planet gear on said carrier by said sun gear for causing said agitator shaft to be oscillated while the shaft is rotating in one direction, means including an overrunning clutch between said carrier and said power shaft for coupling said carrier to said power shaft when said power shaft is reversed thereby causing rotation of said agitator shaft through said mechanism, and means for rotating said tub from said agitator shaft during rotation thereof.

9. A washing machine comprising a rotatable tub adapted to receive liquid and material to be washed, an agitator in said tub, a shaft for driving said agitator, a power shaft driving a sun gear, a planet gear carried by a rotatable carrier and driven by said sun gear, means preventing rotation of said carrier for causing rotation of said planet gear on said carrier by said sun gear, mechanism connecting said planet gear and said agitator shaft for effecting oscillation of said agitator shaft upon rotation of the planet gear

on said carrier, said mechanism being effective to hold the agitator shaft in fixed angular relation to the planet gear when the planet gear is stationary on said carrier, means coupling said carrier to said power shaft for rotating said agitator shaft through said mechanism, and means for rotating said tub from said agitator shaft during rotation thereof.

10. A washing machine comprising a rotatable tub, an agitator in said tub, a shaft for driving said agitator having a pinion thereon, racks on opposite sides of said pinion meshing therewith, opposite ends of said racks being connected to cranks, a rotatable carrier, means including gears carried by said carrier for rotating said cranks, means causing rotation of said gears on said carrier in the same direction for reciprocating said racks in opposite directions to oscillate the agitator, means for holding said racks in mesh with said pinion, means rotating said carrier and positively preventing rotation of said gears on said carrier for causing rotation of said agitator shaft, and means for rotating said tub from said agitator shaft during rotation thereof.

11. A washing machine comprising a rotatable tub, an agitator in said tub, a shaft for driving said agitator, a power shaft driving a sun gear thereon, a planet gear carried by a rotatable carrier and driven by said sun gear, means including a brake preventing rotation of said carrier for causing rotation of said planet gear or said carrier, mechanism connecting said planet gear and said agitator shaft for effecting oscillation of said agitator shaft upon rotation of the planet gear on said carrier, said mechanism being effective to hold the agitator shaft in fixed angular relation to the planet gear when the planet gear is stationary on said carrier, means releasing said brake and coupling said power shaft to said carrier for rotating said agitator shaft by said power shaft through said mechanism, means for rotating said tub from said agitator shaft during rotation thereof, and means including said brake for retarding the rotation of said tub.

12. A washing machine comprising a rotatable tub, an agitator in said tub, a shaft for driving said agitator, a power shaft driving a sun gear, a planet gear carried by a rotatable carrier and driven by said sun gear, means including a brake preventing rotation of said carrier for causing rotation of said planet gear or said carrier, mechanism connecting said planet gear and said agitator shaft for effecting oscillation of said agitator shaft upon rotation of the planet gear on said carrier, said mechanism being effective to hold the agitator shaft in fixed angular relation to the planet gear when the planet gear is stationary on said carrier, means controlled by reversal of said power shaft for releasing said brake and coupling said power shaft to said carrier to rotate said agitator shaft by said power shaft through said mechanism, and means for rotating said tub from said agitator shaft during rotation thereof.

13. A washing machine comprising a rotatable tub adapted to receive liquid and material to be washed, an agitator in said tub, said tub and said agitator comprising relatively rotatable members, said members having complementary portions which permit oscillation of the agitator in the tub through a limited angle and which engage upon rotation of the agitator to cause the tub to be rotated, means including a slip clutch between one of said members and its complementary portion for decreasing the shock

upon engagement of said complementary portions, means for oscillating said agitator, and means for rotating said agitator.

14. In a washing and drying machine, a rotatable tub adapted to receive liquid and material to be washed, washing means in said tub of the type operable by oscillation, shaft means for oscillating said washing means and for rotating said tub to extract liquid from the material contained therein, a sun gear, a rotatable carrier having a planet gear driven by said sun gear, oscillating mechanism for oscillating said shaft means, a driving connection between said planet gear and said oscillating mechanism for effecting oscillation of said shaft means upon rotation of the planet gear on said carrier, said driving connection being effective to hold said shaft means and said planet gear in fixed angular relation when the planet gear is stationary on said carrier, means preventing rotation of said carrier for causing rotation of said planet gear on said carrier by said sun gear for effecting oscillation of said shaft means, and means for positively preventing rotation of said housing by said carrier for causing rotation of said housing by said sun gear whereby said shaft means is rotated.

15. In a washing and drying machine, a rotatable tub adapted to receive liquid and material to be washed, washing means in said tub of the type operable by oscillation, shaft means for oscillating said washing means and for rotating said tub to extract liquid from the material contained therein, a sun gear, a rotatable carrier having a planet gear driven by said sun gear, oscillating mechanism for oscillating said shaft means, a driving connection between said planet gear and said oscillating mechanism for effecting oscillation of said shaft means upon rotation of the planet gear on said carrier, said driving connection being effective to hold said shaft means and said planet gear in fixed angular relation when the planet gear is stationary on said carrier, means preventing rotation of said housing for causing rotation of said planet gear on said carrier by said sun gear for effecting oscillation of said shaft means while the sun gear is rotating in one direction, means for rotating said sun gear in the reverse direction, and means including an over-running clutch for preventing rotation of said planet gear on said carrier when said sun gear rotates in said reverse direction for causing rotation of said carrier by said sun gear whereby said shaft means is rotated.

16. In a washing and drying machine, a rotatable tub adapted to receive liquid and material to be washed, washing means in said tub of the type operable by oscillation, shaft means for oscillating said washing means and for rotating said tub to extract liquid from the material contained therein, a sun gear, a rotatable carrier having a planet gear driven by said sun gear, oscillating mechanism for oscillating said shaft means, a driving connection between said planet gear and said oscillating mechanism for effecting oscillation of said shaft means upon rotation of the planet gear on said carrier, said driving connection being effective to hold said shaft means and said planet gear in fixed angular relation when the planet gear is stationary on said carrier, means preventing rotation of said carrier for causing rotation of said planet gear on said carrier by said sun gear for effecting oscillation of said shaft means, and a coupling for causing

said sun gear and said carrier to rotate in unison whereby said shaft means is rotated.

17. In a washing and drying machine comprising a rotatable tub adapted to receive liquid and material to be washed, washing means in said tub of the type operable by oscillation, a shaft for driving said washing means having a pinion thereon, racks on opposite sides of said pinion meshing therewith, opposite ends of said racks being connected to cranks, means for holding said racks in mesh with said pinion, means including gears carried by a rotatable carrier for rotating said cranks, means causing rotation of said gears on said carrier in the same direction for reciprocating said racks in opposite directions, means for rotating said carrier positively preventing rotation of said gears on said carrier for causing rotation of said shaft, and means for rotating said tub from said shaft to extract during rotation thereof liquid from the material contained therein.

18. In a washing and drying machine comprising a rotatable tub adapted to receive liquid and material to be washed, washing means in said tub of the type operable by oscillation, a shaft for driving said washing means, a sun gear, a planet gear carried by a rotatable carrier and driven by said sun gear, means including a brake for preventing rotation of said carrier and thereby causing rotation of said planet gear on said carrier by said sun gear, oscillating mechanism for oscillating said shaft means, a driving connection between said planet gear and said oscillating mechanism for effecting oscillation of said shaft means upon rotation of the planet gear on said carrier, said driving connection being effective to hold said shaft means and said planet gear in fixed angular relation when the planet gear is stationary on said carrier, means releasing said brake and coupling said sun gear to said carrier for causing rotation of said shaft, and means for rotating said tub from said shaft.

19. In a washing machine, a rotatable tub adapted to receive liquid and material to be washed, said tub having a hub projecting from the bottom thereof, an agitator in said tub having a portion depending around said hub to a point adjacent the bottom of the receptacle, means extending through said hub for selectively oscillating and rotating said agitator, said tub and said depending portion of the agitator having complementary portions within the tub which have sufficient lost motion therebetween to permit oscillation of the agitator in the tub through a limited angle for washing which engage upon rotation of the agitator when the agitator is rotated for extracting liquid from the material.

20. In a washing machine, a rotatable tub and an agitator therein, said agitator extending closely adjacent the bottom of the tub, means operable at different times to rotate and oscillate said agitator, said means operating through the bottom of said tub, the top of said tub being open and free from obstructions, the adjacent portions of the tub and agitator within the tub having complementary portions which have sufficient lost motion therebetween to permit oscillation of the agitator in the tub through a limited angle and which engage upon rotation of the agitator and cause the tub to be rotated by the agitator.

21. In a washing and drying machine, a rotatable tub adapted to receive liquid and material to be washed, washing means in said tub, a power

shaft, a driving connection between said power shaft and said washing means effective upon rotation of said shaft in one direction for causing washing in said tub, and a driving connection between said shaft and said tub effective upon rotation of said shaft in the reverse direction for rotating the tub to extract liquid from the material contained therein.

22. In a washing and drying machine, a rotatable tub adapted to receive liquid and material to be washed, washing means in said tub, a power shaft and driving connections between said power shaft and said tub and said washing means for effecting washing in said tub and for rotating said tub to extract liquid from the material contained therein, means for selectively rotating the power shaft in opposite directions, one of said driving connections including an over-running clutch whereby it is effective only during one direction of rotation of said power shaft and the other of said connections being effective only during the rotation of the power shaft in the reverse direction.

23. In a washing machine, a rotatable tub adapted to receive liquid and material to be washed, an agitator in the tub having a hollow portion extending adjacent the bottom of the tub, means for selectively oscillating and rotating the agitator, and a coupling between the agitator and the tub located within said hollow portion and between it and the inside of the tub, said coupling having sufficient lost motion to permit oscillation of the agitator relative to the tub upon oscillation of the agitator and being effective upon rotation of the agitator to cause rotation of the tub through the agitator.

24. In a washing machine, a rotatable tub adapted to receive liquid and material to be washed, said tub having a hollow hub extending upward above the bottom of the tub, an agitator in the tub having a hollow portion depending around said hub, a shaft projecting upward through said hub and connected to said agitator, means for selectively oscillating and rotating said shaft, and a coupling between the shaft and the tub located within said hollow portion and between it and the inside of the tub, said coupling having sufficient lost motion to permit oscillation of the agitator relative to the tub upon oscillation of the shaft and being effective upon rotation of the shaft to cause rotation of the tub.

25. In a washing machine, a rotatable tub adapted to receive liquid and material to be washed, an agitator in the tub, a shaft connected to said agitator, means for selectively oscillating and rotating the shaft, a coupling between the shaft and the tub comprising relatively rotatable members, said members having complementary portions which permit oscillation of the shaft through a limited angle without oscillating the tub and which engage upon rotation of the shaft to cause the tub to be rotated, and means including a slip clutch on one of said members for decreasing the shock on engagement of said complementary portions.

26. In a washing and drying machine having a rotatable tub adapted to receive liquid and material to be washed and washing means for agitating the liquid for washing purposes, a power shaft, a sun gear driven thereby, a rotatable carrier having a planet gear driven by said sun gear, a driving connection from said planet gear to said washing means operable upon rotation of the planet gear on said carrier, a driving

connection from said carrier to said tub operable upon rotation of the carrier, means preventing rotation of the carrier whereby the planet gear will be rotated thereon, and means for effecting a positive driving connection between said carrier and said power shaft whereby the carrier will be rotated.

27. In a washing and drying machine having a rotatable tub adapted to receive liquid and material to be washed and washing means for agitating the liquid for washing purposes, a power shaft, a sun gear driven thereby, a rotatable carrier having a planet gear driven by said sun gear, a driving connection from said planet gear to said washing means operable upon rotation of the planet gear on said carrier, a driving connection from said carrier to said tub operable upon rotation of the carrier, means operable during rotation of the power shaft in one direction for preventing rotation of the carrier whereby the planet gear will be rotated thereon, and means operable during rotation of the power shaft in the reverse direction for effecting a positive driving connection between said carrier and said power shaft whereby the carrier will be rotated.

28. In a combined washing and centrifugal drying machine, a receptacle for receiving material to be washed adapted for rotation on its axis to centrifugally extract liquid from the material contained therein, a casing surrounding the receptacle and spaced therefrom to permit gyratory movement of the receptacle therein, an oscillatory washing element in the receptacle for agitating the liquid and material therein, a driven shaft having one end extending within the casing and provided with driving connections to the washing element and to the receptacle whereby during oscillation it oscillates the washing element for washing and during rotation it rotates the receptacle for extracting, a driving shaft at the other end of the driven shaft, a universal joint connecting the shafts, means for selectively oscillating and rotating the driving shaft, and means resiliently supporting the driven shaft and the receptacle for gyratory movement relative to the casing and to the driving shaft.

29. In a combined washing and centrifugal drying machine, a receptacle for receiving material to be washed adapted for rotation on its axis to centrifugally extract liquid from the material contained therein, a casing surrounding the receptacle and spaced therefrom to permit gyratory movement of the receptacle therein, an oscillatory washing element in the receptacle for agitating the liquid and material therein, a driven shaft having one end extending within the casing and provided with driving connections to the washing element and to the receptacle whereby during oscillation it oscillates the washing element for washing and during rotation it rotates the receptacle for extracting, a frame at the other end of the driven shaft having a driving shaft journaled therein, a universal joint connecting the shafts, means resiliently supporting the driven shaft and the receptacle for gyratory movement relative to the casing and to the driving shaft, and mechanism carried by the frame for selectively oscillating and rotating the driving shaft.

30. In a combined washing and centrifugal drying machine, a receptacle for receiving material to be washed adapted for rotation on its axis to centrifugally extract liquid from the ma-

terial contained therein, a casing surrounding the receptacle and spaced therefrom to permit gyratory movement of the receptacle therein, a washing element in the receptacle for agitating the liquid and material therein, a shaft having one end extending within the casing and provided with driving connections to the washing element and to the receptacle whereby it selectively operates the washing element for washing and rotates the receptacle for extracting, driving means for the shaft, a universal connection between the driving means and the shaft, and means resiliently supporting the shaft and the receptacle for gyratory movement relative to the casing and to the driving means.

31. In a combined washing and centrifugal drying machine, a receptacle for receiving material to be washed adapted for rotation on its axis to centrifugally extract liquid from the material contained therein, a casing surrounding the receptacle and spaced therefrom to permit gyratory movement of the receptacle therein, said casing having a bottom wall below the receptacle, an oscillatory washing element in the receptacle for agitating the liquid and material therein, a driven shaft having its upper end extending within the casing and provided with driving connections to the washing element and to the receptacle whereby during oscillation it oscillates the washing element for washing and during rotation it rotates the receptacle for extracting, a driving shaft at the lower end of the driven shaft, a universal joint connecting the shafts, means for selectively oscillating and rotating the driving shaft, and means resiliently supporting the driven shaft and the receptacle for gyratory movement relative to the casing and to the driving shaft, said supporting means being of such stiffness that the critical speed of the receptacle during extracting occurs substantially below the normal extracting speed.

32. In a combined washing and centrifugal drying machine, a receptacle for receiving material to be washed adapted for rotation on its axis to centrifugally extract liquid from the material contained therein, a casing surrounding the receptacle and spaced therefrom to permit

gyratory movement of the receptacle therein, washing means for agitating the liquid and material in the receptacle, vertical driven shaft means having the upper end thereof extending within the casing and provided with driving connections to the washing means and to the receptacle whereby it selectively operates the washing means for washing and rotates the receptacle for extracting, a frame at the lower end of the driven shaft means having a driving shaft means journaled therein, a universal connection between the driving and driven shaft means, means resiliently supporting the driven shaft means and the receptacle for gyratory movement relative to the casing and to the driving shaft means, said supporting means being of such stiffness that the critical speed of the receptacle during extracting occurs substantially below the normal extracting speed, and mechanism carried by the frame for operating the driving shaft means.

33. In a combined washing and centrifugal drying machine, a receptacle for receiving material to be washed adapted for rotation on its axis to centrifugally extract liquid from the material contained therein, a casing surrounding the receptacle and spaced therefrom to permit gyratory movement of the receptacle therein, said casing having a bottom wall below the receptacle, a washing element in the receptacle for agitating the liquid and material therein, a vertical shaft having its upper end extending within the casing and provided with driving connections to the washing element and to the receptacle whereby it selectively operates the washing element for washing and rotates the receptacle for extracting, driving means for the shaft, a universal connection between the driving means and the lower end of said shaft, and means resiliently supporting the shaft and the receptacle for gyratory movement relative to the casing and to the driving means, said supporting means being of such stiffness that the critical speed of the receptacle during extracting occurs substantially below the normal operating speed.

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