

June 15, 1943.

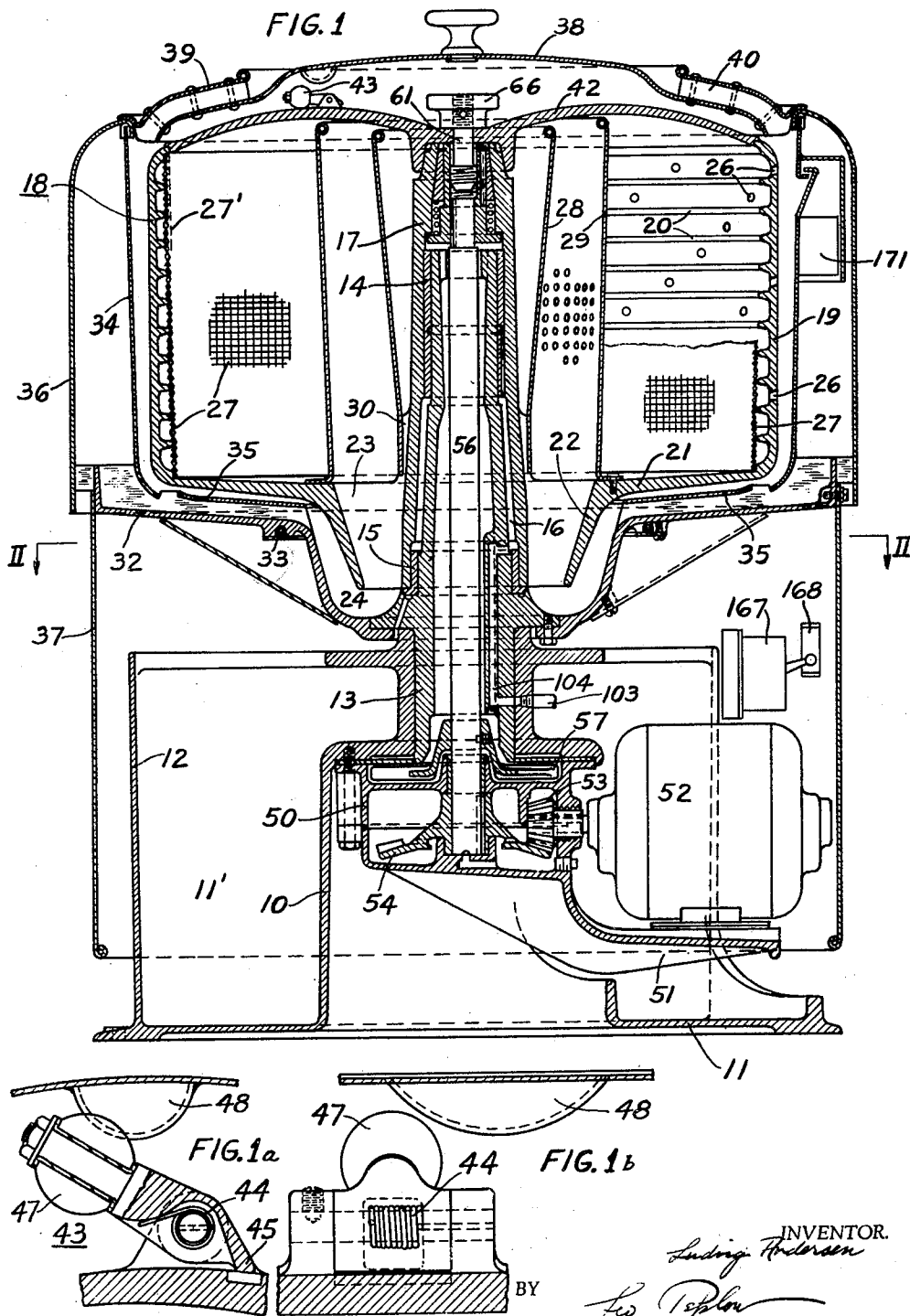
L. ANDERSEN

2,321,641

WASHING MACHINE

Filed April 22, 1940

8 Sheets-Sheet 1



June 15, 1943.

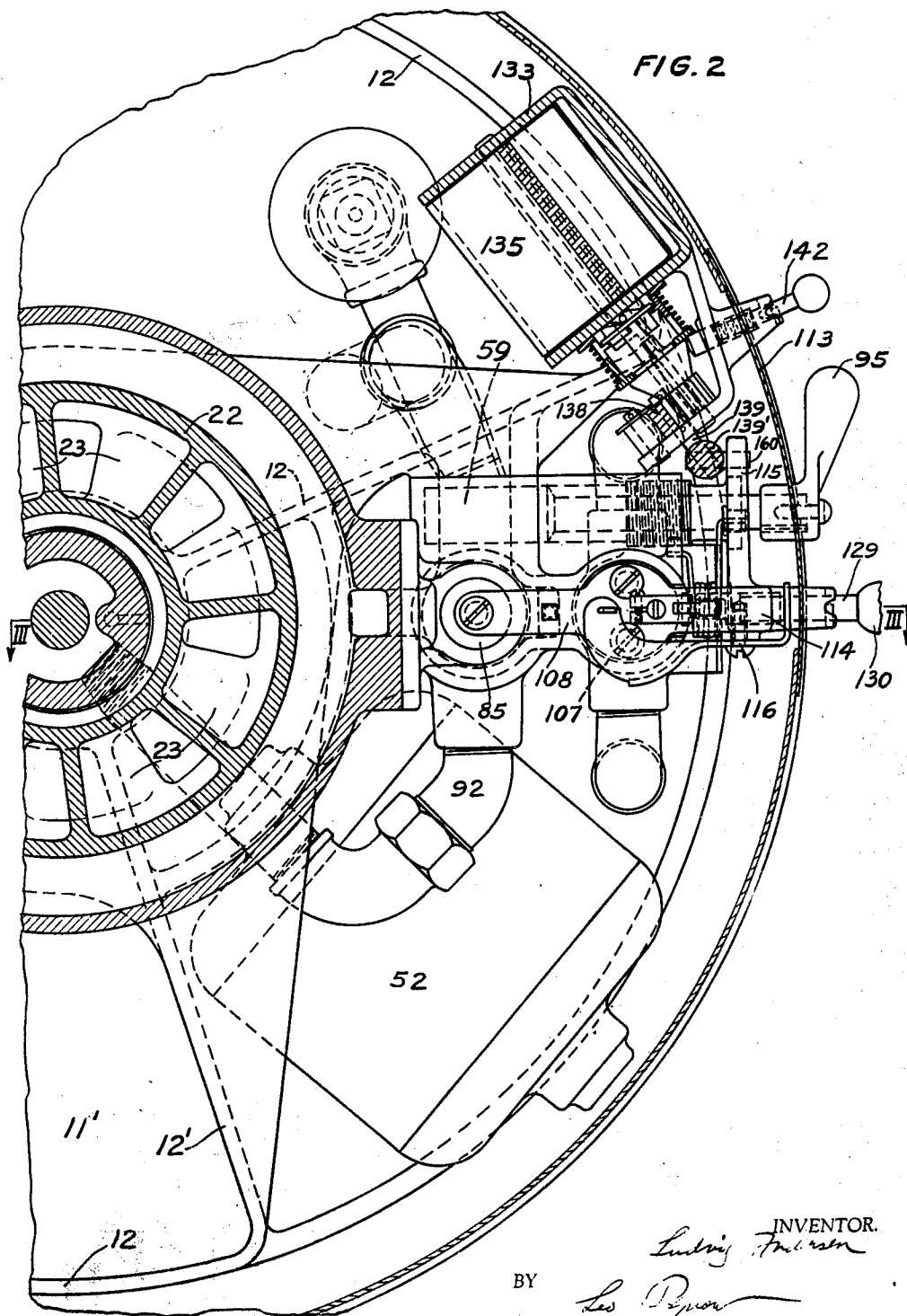
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WASHING MACHINE

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8 Sheets-Sheet 2



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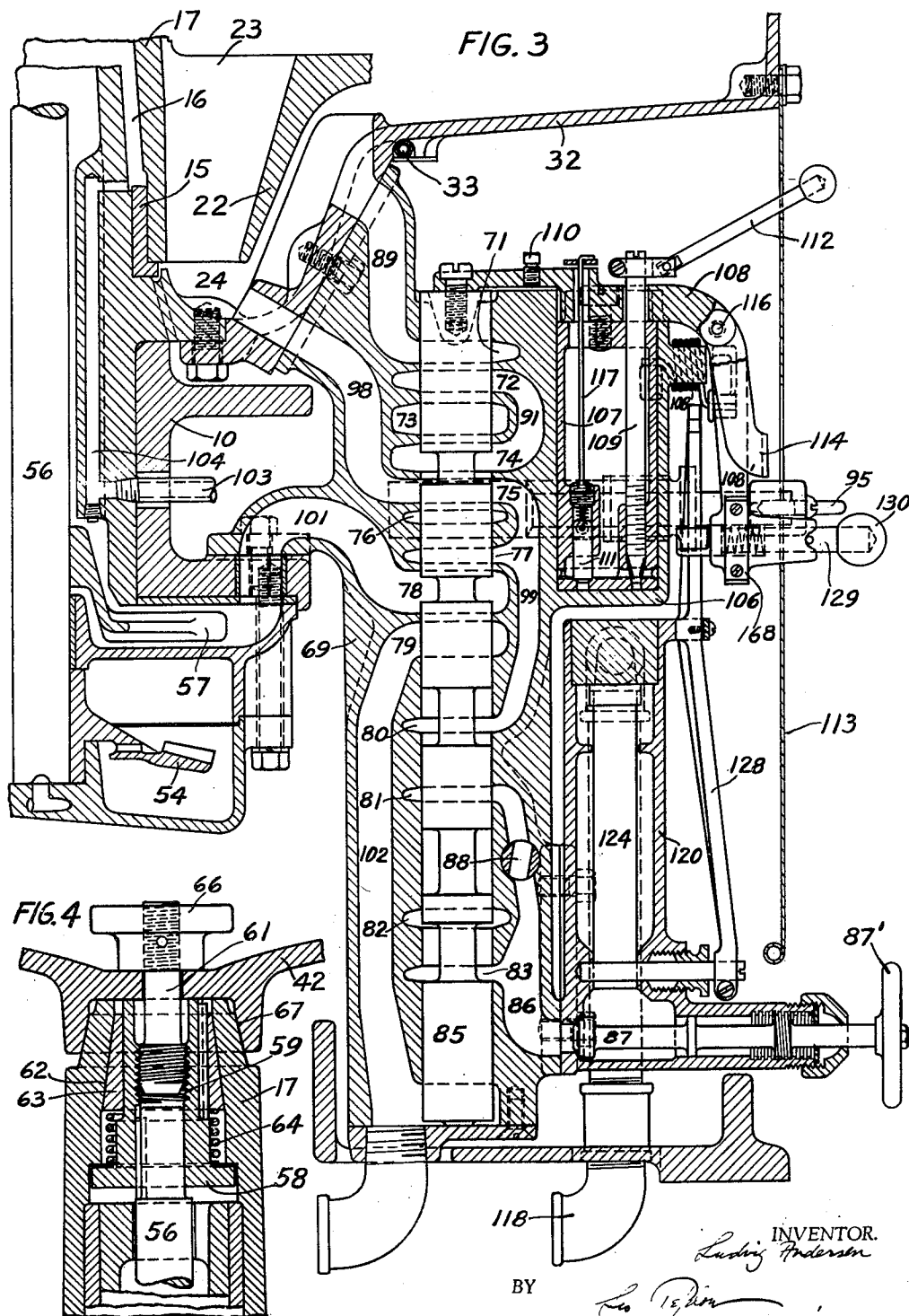
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WASHING MACHINE

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8 Sheets-Sheet 3



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8 Sheets-Sheet 4

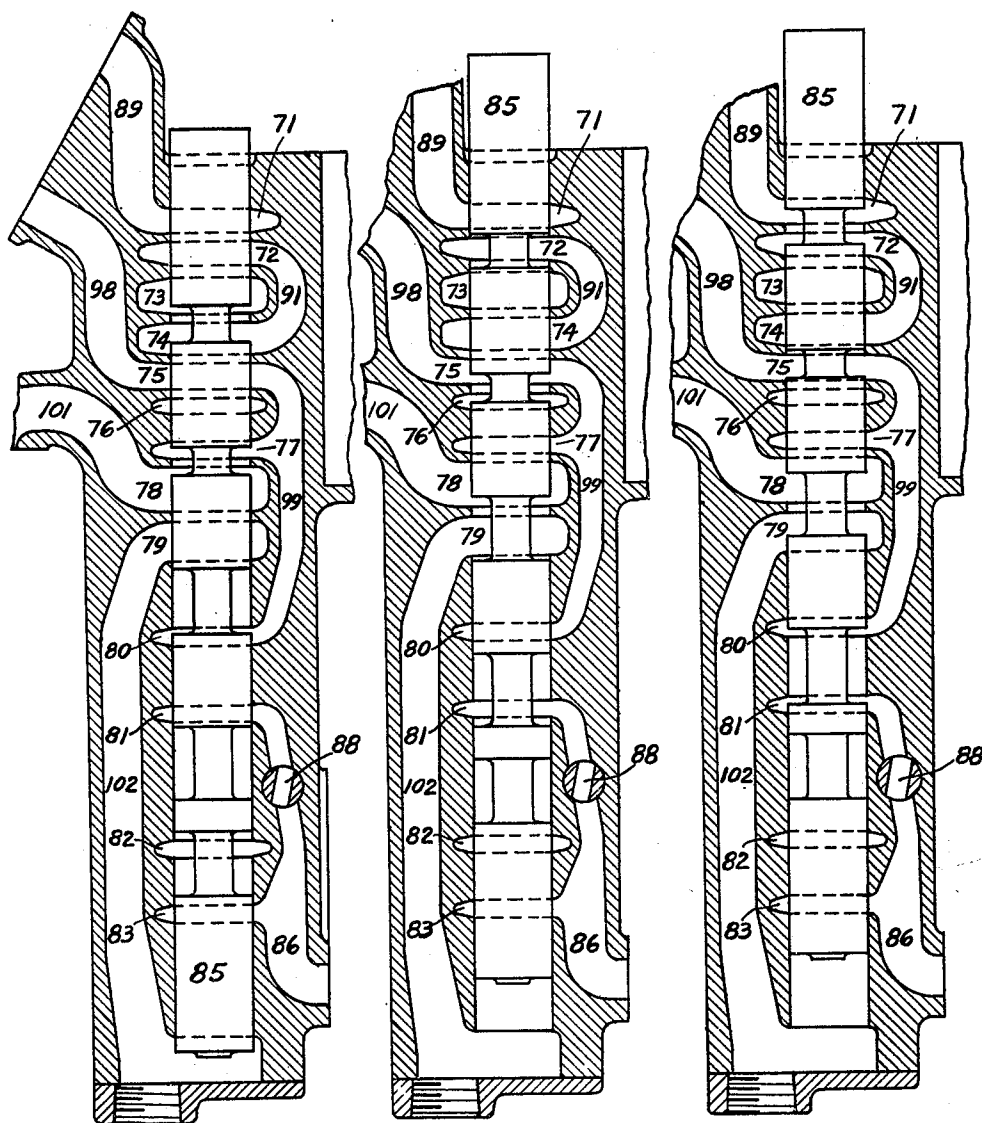


FIG. 5

FIG. 6

FIG. 7

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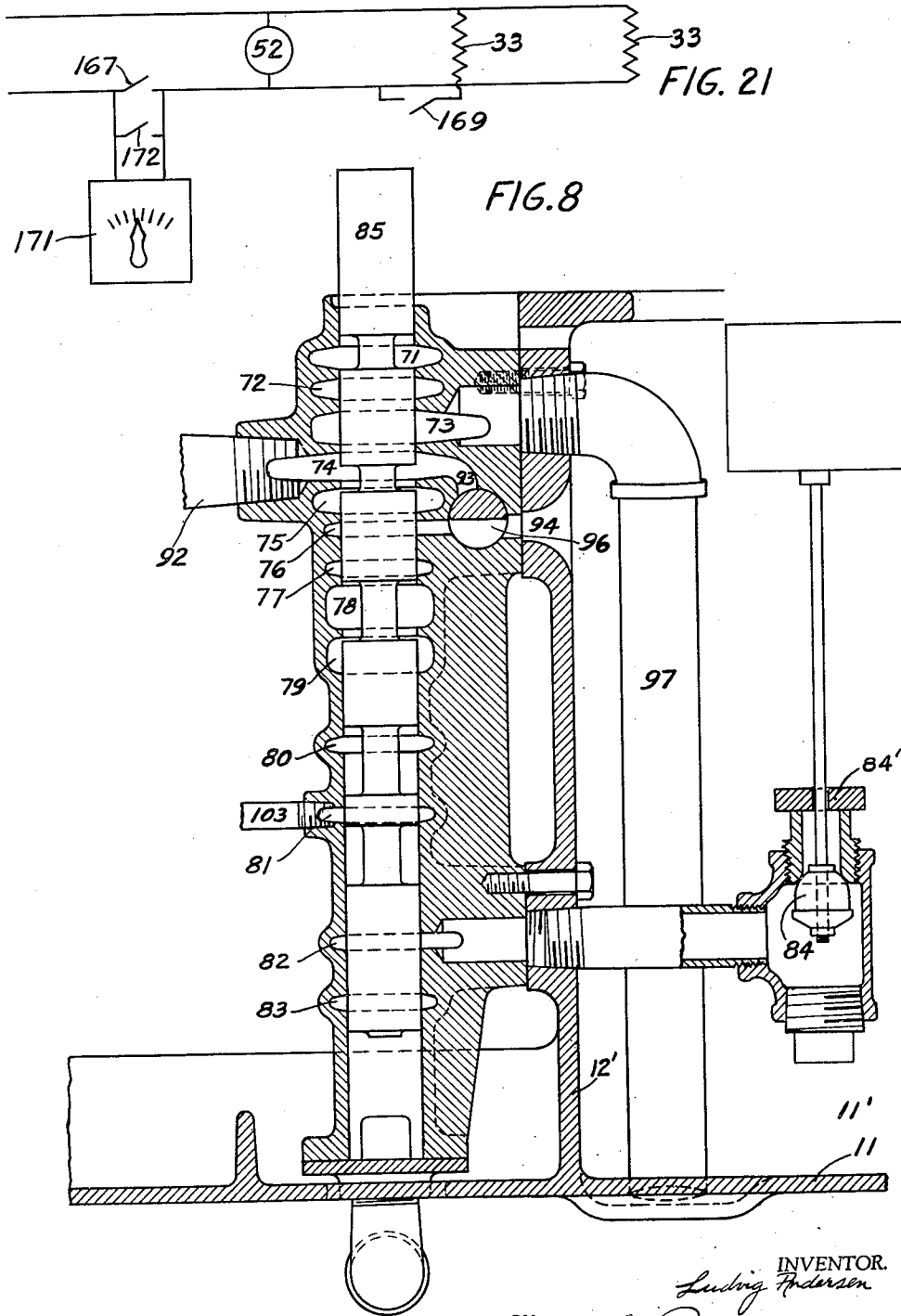
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WASHING MACHINE

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8 Sheets-Sheet 5



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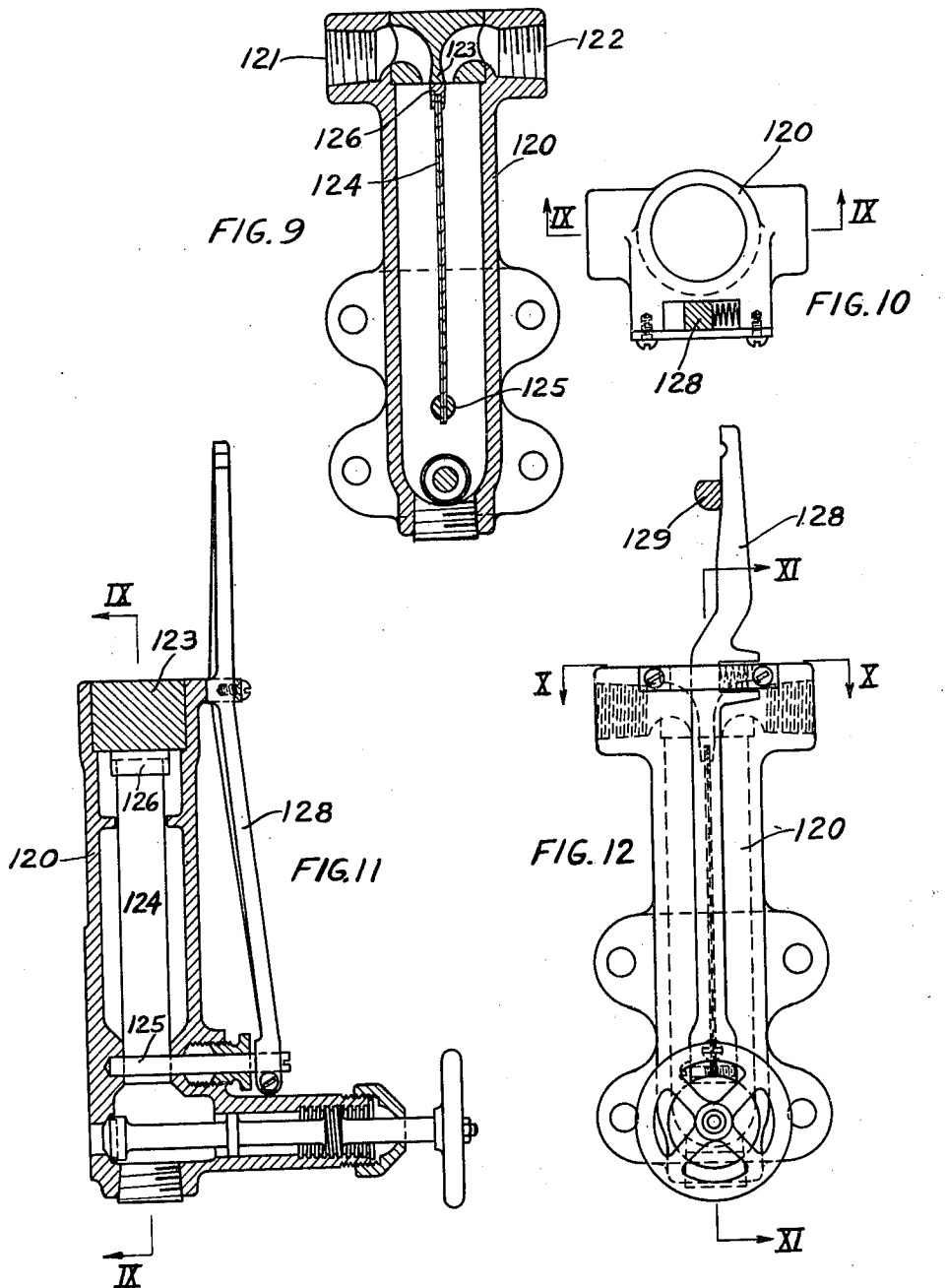
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WASHING MACHINE

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8 Sheets-Sheet 6



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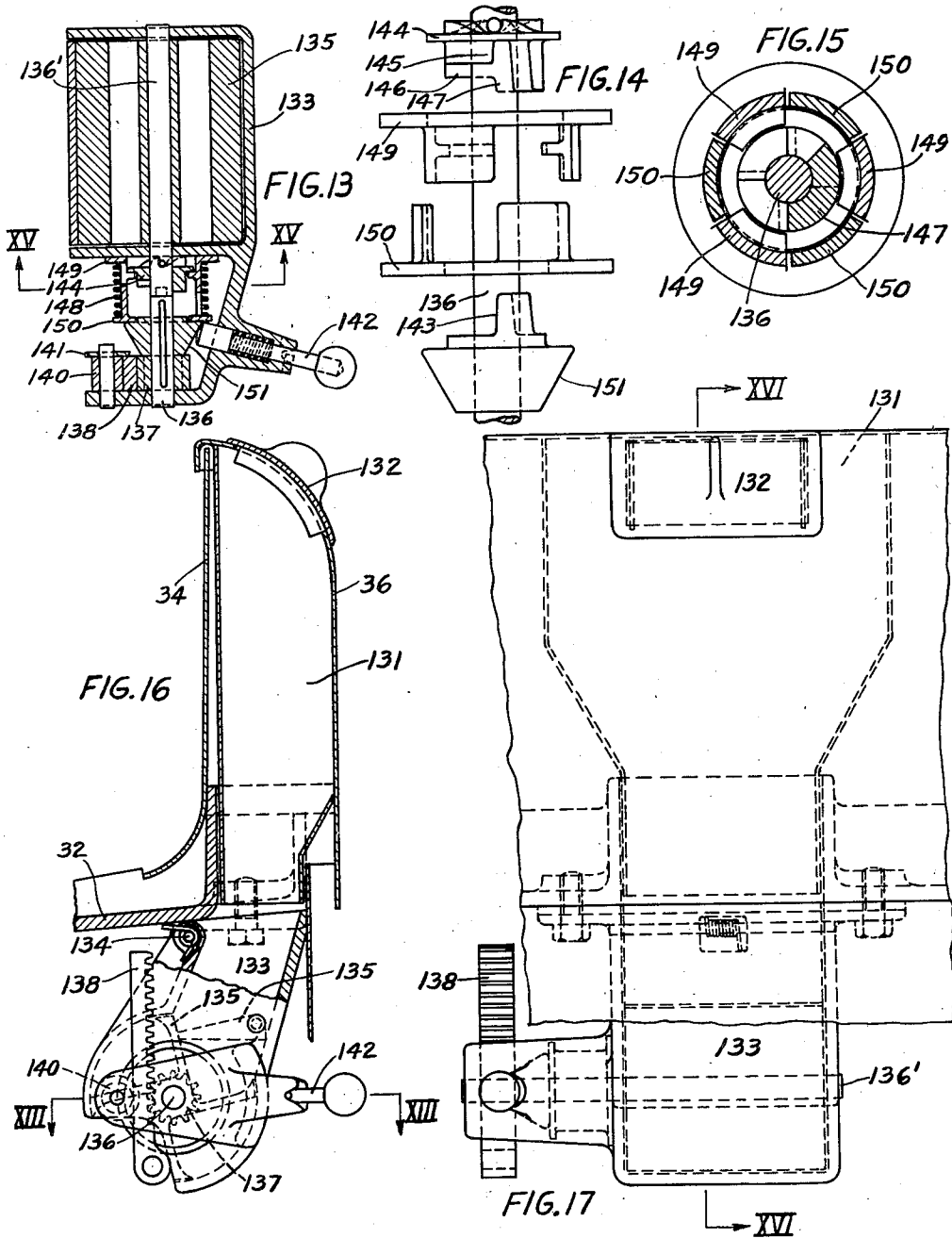
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WASHING MACHINE

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8 Sheets-Sheet 7



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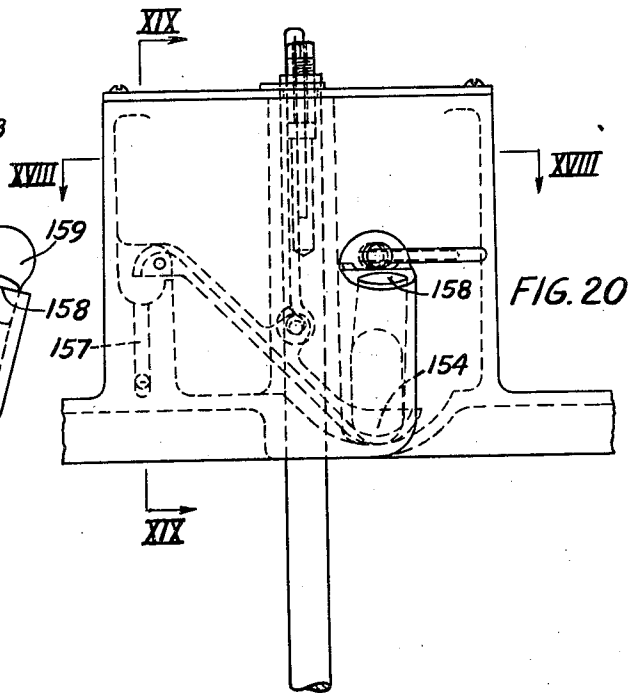
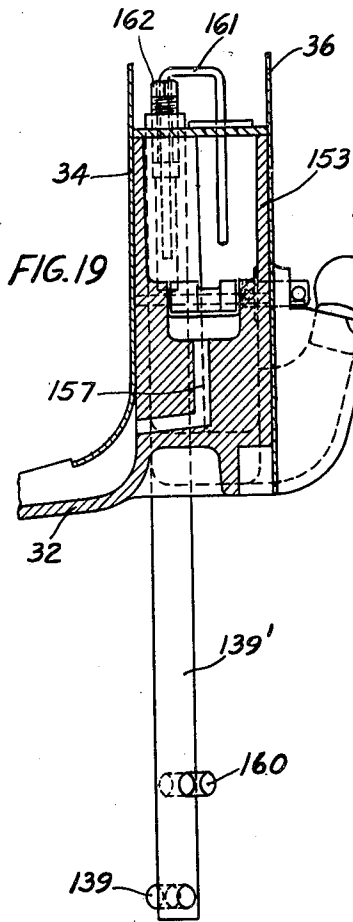
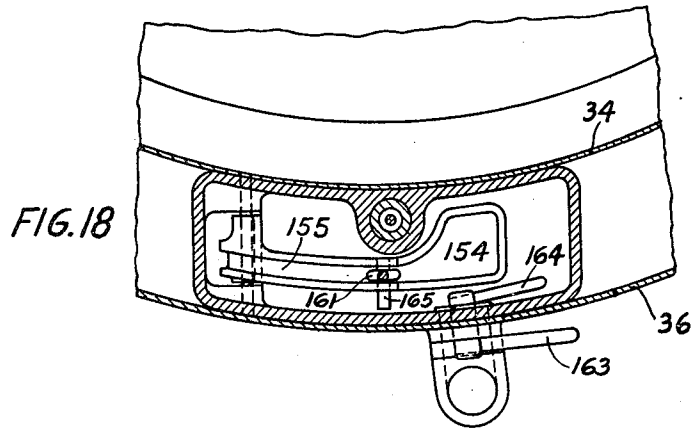
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WASHING MACHINE

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8 Sheets-Sheet 8



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UNITED STATES PATENT OFFICE

2,321,641

WASHING MACHINE

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Application April 22, 1940, Serial No. 330,938

16 Claims. (Cl. 68—12)

This invention relates to an improved washing machine; and more particularly to a washing machine in which the various steps ordinarily involved in the washing of clothes may be predetermined and preset, involving no attention on the part of the operator from the time the machine is started until the clothes have been cleansed and brought to the desired degree of minimum moisture content.

It is of one of the objects of this invention to provide a fully automatic washing machine. It is another object of this invention to provide a washing machine which may automatically cleanse soiled clothing, rinse out the soapy water, with or without the addition of bluing to the rinsing water, and then dry the washed clothes to a predetermined degree of moisture, all these steps being sequentially performed automatically.

It is a further object of this invention to provide a rotary washing machine having an improved friction clutch transmission therein, whereby the rotation of the drum may be started gradually and uniformly with a single-speed motor without requiring an unduly large starting current.

It is a further object of this invention to provide, in a washing machine, a rotary drum driven by a power shaft thru a clutch mechanism which is rendered operative only when the closure for the drum is fastened in place, whereby said drum cannot be rotated unless the closure is fastened in place.

It is a further object of this invention to provide a washing machine comprising a rotary drum provided with a central tapered water admission chamber and substantially radial vanes for maintaining a positive head of water in the rotary drum during operation thereof.

It is a further object of this invention to provide a washing machine of the rotary drum type equipped with an alarm for notifying the operator when rotation of the drum begins and ends.

It is a further object of this invention to provide a washing machine equipped with an auxiliary fluid tank, whereby the same fluid may be used therein repeatedly.

It is a further object of this invention to provide a washing machine in which material may be dried by centrifugal action combined with passage of air, preheated or not, thru said material; a further object of the invention being to provide humidity-sensitive control means for stopping the drying action when the material being dried has reached a desired minimum moisture content.

It is a further object of this invention to pro-

vide a clothes washing machine in which part of the mechanism is water-lubricated; a further object being to provide a transmission for a washing machine in which lubricating oil is prevented from contaminating the washing fluid, and vice versa.

It is a further object of this invention to provide, in an automatic clothes washing machine, means for predetermining the length of the cycle of operations performed by said machine.

It is a further object of this invention to provide, in a clothes washing machine, a compound valve arranged so that continuous movement of an element of said valve results in successively directing fluid to and from said washing machine as required to perform the various steps of a washing cycle; a further object being to provide means for directing fluid discharged from said machine alternatively to a drain or to an auxiliary storage tank.

Other objects of this invention are: to provide thermostatic hot and cold water proportioning means; bluing (or other chemical) dispensing means; predetermined volume soap dispensing means; automatically and manually controllable heating means; all particularly adapted for use in an automatic clothes washing machine.

Various other objects will become apparent from the following description of this invention, taken in conjunction with the drawings and the claims appended hereto.

In the drawings:

Fig. 1 is a vertical sectional view of the improved washing machine, showing more particularly the construction of the rotatable drum, the transmission for rotating same, and the auxiliary tank.

Figs. 1a and 1b are enlarged detail views of the sound alarm mechanism indicated at the top of the rotatable drum of Fig. 1.

Fig. 2 is a fragmental plan view of the washing machine taken on section line II—II of Fig. 1.

Fig. 3 is a vertical section detail view taken on the line III—III of Fig. 2, and more particularly illustrating the operating levers and associated mechanism, as well as the compound valve, of this invention.

Fig. 4 is a vertical sectional view of a detail of the transmission clutch elements generally shown near the top of Fig. 1.

Figs. 5, 6 and 7 are fragmental vertical sectional views showing the compound valve in different successive positions.

Fig. 8 is also a sectional view of the valve and shows the piping system associated with the valve.

Fig. 9 is a vertical sectional view of the thermostatic fluid proportioning means, taken on line IX—IX of Figs. 10 and 11.

Fig. 10 is a plan view of same, taken on line X—X of Fig. 12.

Fig. 11 is a vertical sectional view of same taken on the line XI—XI of Fig. 12.

Fig. 12 is an elevation view of same.

Fig. 13 is a plan sectional view of the lower portion of the soap dispensing means, taken on the line XIII—XIII of Fig. 16.

Fig. 14 is an exploded view of the clutch shown in Fig. 13.

Fig. 15 is a vertical sectional view taken on line XV—XV of Fig. 13.

Fig. 16 is a vertical sectional view of the soap dispenser, taken on lines XVI—XVI of Fig. 17.

Fig. 17 is an elevation view of the soap dispenser.

Fig. 18 is a sectional plan view of the bluing dispenser, taken on line XVIII—XVIII of Fig. 20.

Fig. 19 is an elevation sectional view of same, taken on line XIX—XIX of Fig. 20.

Fig. 20 is an elevation view of same.

Fig. 21 is a circuit diagram illustrating the electrical circuit of the automatic washing machine of this invention.

Rotary drum

Referring to the figures in detail, and with particular reference to Fig. 1, the washing machine of the invention is supported by means of a base or frame 10 of which the bottom 11 and peripheral wall 12 form a fluid containing tank 11'. Fixed to the base is a stationary standard or post 13, which carries upper and lower bearings 14 and 15, for supporting a rotatable sleeve 17, which is the hub of rotary drum or clothes container 18. An annular chamber 16 located between rotary sleeve 17 and stationary standard 13, has water admitted thereto by means of pipe 103 and channel 104, thus providing water lubrication for bearings 14 and 15, which are made of material such as a phenol condensation product suited for water lubrication. This avoids the necessity for using lubricating oil adjacent the cleansing water.

Rotary drum 18 comprises outer wall 19, provided with ribs 20, bottom member 21, inner depending skirt 22, and a plurality of substantially radial vanes 23, these vanes being slanted forward at the lower portions thereof, as shown in Fig. 2, in the direction of rotation of the drum, in order to lift water from bowl or well 24 upward. The rotation of these slanted radial vanes, together with the centrifugal force of water raised by said vanes, creates a positive head of water inside the drum during rotation thereof.

As shown in Fig. 1, outer wall 19 of drum 18 is provided with a plurality of internal ribs 20, preferably horizontal, and a plurality of upwardly directed apertures 26. A cylindrical coarse mesh screen 27, for retaining the clothes being washed from contact with wall 19 of the drum, is mounted adjacent said wall and supported by ribs 20, a fine mesh screen 27' being located inward of screen 27. Centrally of the drum are two members 28 and 29, preferably frusto-conical, supported on sleeve 17 and bottom 21, respectively. The annular space between frusto-conical members 28 and 29 forms a fluid admission chamber which, together with frusto-conical skirt 22, during rotation of the drum, retains a positive head of water lifted therein by vanes 23. Because the diameter of this fluid admission cham-

ber increase in an upward direction, water received in this chamber is urged upwardly by centrifugal force to the top of drum 18, aiding in the maintenance of a definite head of water available for treatment of the material in the drum. It will be understood that inner member 28 is imperforate, while outer member 29 is perforated to permit water from the fluid admission chamber to pass into the clothes containing portion of the drum. Member 29 need not extend thru the full length of the drum. Passages 30 are provided to permit any water which may have entered inside of member 28 to drain down into well 24.

Stationary bottom plate 32 is suitably supported, as by attachment to the lower portion of standard 13, the inner part of bottom plate 32 co-acting with standard 13 to form the well or bowl 24. The under side of plate 32 carries heating elements 33 in intimate thermal contact therewith, for maintaining the temperature of washing or rinsing water or of drying air passing thru the drum. Plate 32, by means of suitable ribs, supports drum enclosing baffle wall 34, and deflector plate 35, as well as outer casing 36 and skirt 37. An auxiliary cover or closure for the machine comprises inner disk 38 and outer annulus 39 which fits the upper edge of casing 36, the two portions of the outer cover being spaced from each other by spacers 40 to provide an annular air passage therebetween.

The drum is closed at the top by means of main cover 42 which closely fits the upper edge of wall 19. Cover 42 carries a pivotally supported flyweight 43, best shown in Figs. 1a and 1b, which is retained in a raised position by means of spring 44, a stop lug 45 limiting the upward movement of flyweight 43. A roller 47 may be provided near the end of the flyweight, said roller being adapted to impact against a boss 48 carried by cover 38 when the flyweight is in its raised position. This occurs when the drum is being started from standstill, or is being brought to a stop, the sound produced by these impacts notifying the operator that the drum is being started or stopped. When the drum is rotating at normal operating speed, however, centrifugal force, acting in opposition to spring 44, causes the flyweight to fly outward and downward into the position shown in Fig. 1, so that impacts with boss 48 do not take place.

Mounted centrally of the machine and attached to the frame 10 is a pump and gear casing 50 and motor support bracket 51. The latter carries an electric motor 52 which, thru bevel gears 53 and 54, rotates drive shaft 56 which is supported on a step bearing in gear case 50. It will be understood that the motor and control means described below are located at one side of the central axis of the drum at the approximate elevation of the tank 11' formed by wall 12, the fluid containing portion of said tank being closed by radial walls 12'. The drive shaft 56 carries a centrifugal pump 57. It will be noted that the gear chamber is entirely closed and separate from other parts of the mechanism, so that there is no possibility of lubricating oil from the gear chamber contaminating the washing fluid, or of water getting into the gear chamber.

Drive shaft 56 drives rotary drum 18 thru a clutch best shown in Fig. 4. The reduced upper end of drive shaft 56 carries splined thereto a vertically movable follower 58, which is internally threaded at 59, and is operable by actuating screw 61. A conical internal friction surface 62

is provided near the top of sleeve 17, this surface being engageable by the outer surface of conical clutch member 63, which is splined on follower 57 to rotate therewith. A compression spring 64 is located between clutch cone 63 and a flange of follower 58. Actuating screw 61 is provided with an operating knob 66, the bottom of which bears against main cover 42, which may be provided with a friction surface 67 to engage with a complementary surface of sleeve 17. Should the upward pressure of the water in drum 18 exert a force on cover 42 sufficient to tend to raise the cover, it will be noted that the bottom flange of follower 58 will abut an internal shoulder of sleeve 17, preventing appreciable upward movement of cover 42.

From the above description, it will be noted that when closure 42 is removed from the drum, the main shaft cannot rotate the drum, since the follower 58, being in its lowest position, does not cause driving engagement between clutch cone 63 and hub 17. This is a safety feature of importance. When, however, cover 42 is tightened in place by means of actuating screw 61 and knob 66, follower 58 is moved upward and forces clutch cone 63 into engagement with sleeve 17, so that sleeve 17 and drum 18 are in frictional driving engagement with drive shaft 56.

Valve construction

The following is a description of the novel valve mechanism of this invention, reference being made particularly to Figs. 3 and 5 to 8.

Valve block 69 is mounted on frame 10 beneath rotating drum 18. The valve block is provided with a plurality of valve chambers 71—83 inclusive, and valve piston 85, slidable in a closely fitting bore passing thru said valve chambers 71—83.

Water at a desired temperature is admitted to valve block 69 thru port 86, which is controlled by manually operated inlet valve 87. A restriction valve 88 is located in port 86, said port connecting inlet valve 87 with valve chamber 83 and, thru restriction valve 88, valve chamber 81. Upper valve chamber 71 connects with port 89 which connects with bowl 24. Valve chambers 72 and 74 are connected by port 91, chamber 74 being connected by means of pipe 92 (Fig. 8) with the inlet end of centrifugal pump 57. Port 93 (Fig. 8) connects valve chamber 74 with valve chamber 76 and drain connection 94 to the tank 11', diversion valve 96, operable by means of handle 95, being inserted to divert the water from valve chamber 76 either to the tank 11' or to the pump 57 by way of valve chamber 74.

Valve chamber 73 is adapted to receive water from tank 11' by way of intake pipe 97 (Fig. 8). Port 98 connects the bottom of well 24 with valve chamber 75, the latter being connected with valve chambers 77 and 80 by means of port 99. A port 101 leads from the outlet of centrifugal pump 57 to valve chamber 78. Valve chamber 79 is connected with a drain by means of port 102. Valve chamber 81 is connected by pipe 103 and port 104 with annular water lubricating chamber 16 (see Fig. 3).

Dash pot

Still referring to Fig. 3, mounted on valve block 69 is dash pot cylinder 106, which may be filled with oil or other fluid. Dash pot piston 107 fits closely in cylinder 106, piston 107 and valve piston 85 being connected by operating arm 108 to move up and down together. Operating arm 108 is pressed downward against the tension of heli-

cal spring 108', mounted on an abutment on dash pot cylinder 107. Upon releasing the arm after pressing it down, the spring urges the operating arm 108 upward, thereby causing the cycle of operations to be described later. An adjustable stop screw 110 is provided at the upper portion of operating arm 108, to determine the upper limit of movement of operating arm 108 when stop screw 110 abuts bottom plate 32.

The bottom of dash pot piston 107 is provided with two ports, one being adjustably closed by needle-valve 109, while the other is normally closed by spring pressed valve 111. Needle valve 109 is threaded in a suitable bore in piston 107, and adjustment of the valve is effected by means of an operating handle 112 which is pivotally mounted on needle valve 109 and passes thru a lateral slot in operating panel 113. Handle 112 is pivotally mounted so that it can remain accessible to an operator outside panel 113 while pistons 85 and 107 move up or down with operating arm 108. It will be understood that movement of handle 112 circumferentially about needle valve 109 changes the setting of the needle valve and therefore determines the speed of movement of pistons 85 and 107 upward under the influence of spring 108'.

Spring pressed valve 111 may be manually opened whenever desired by the operator by pressing inward on dash pot release lever 114, pivoted at 116, thereby raising connecting link 117, which raises valve 111 against the pressure of its spring. Upon downward movement of operating arm 108, valve 111 is pressed upward against its spring by the pressure of the fluid in the dash pot, permitting the rapid descent of dash pot piston 107 and valve piston 85.

Water proportioning chamber

Water is admitted to the washing machine thru hot and cold water pipes 118, which admit water into thermostatic proportioning chamber 120, which is suitably attached to valve block 69, the bottom opening of the proportioning chamber communicating with port 86 of the valve block and being regulable by manual valve 87.

As shown more particularly in Figures 9 to 12, thermostatic proportioning chamber 120 is provided with inlets 121 and 122 for hot and cold water, respectively. A wall 123 intermediate these inlets directs both streams of water downward into the proportioning chamber. A bimetallic thermostat element 124 is carried by means of pivoted pin 125, which is suitably supported in chamber 120. Carried on the free end of thermostat element 124 is a proportioning element 126, which is adapted, upon deflection of the free end of thermostat element 124, to proportion the amount of cold and hot water entering proportioning chamber 120 by restricting one or the other of the water inlets.

Thermostat element 124 may be preset for any desired water temperature, as for washing clothes of different materials. To accomplish this, thermostat lever 128 is fastened to pin 125. It will be seen that movement of lever 128 circumferentially about pin 125 will determine the original position of thermostat 124. Operating arm 108 carries thermostat cam actuator 129 which is adapted to contact a cam surface on one side of thermostat lever 128, which is spring biased into contact with cam actuator 129. The latter may be rotated by means of knob 130 (Fig. 3) to obtain the desired setting of lever 128 and therefore of proportioning ele-

ment 126. A suitable spring-pressed pin and groove retaining means may be provided to maintain cam actuator 129 in any set position.

Soap dispenser

Automatic means for depositing predetermined amounts of soap is provided in accordance with this invention. As best shown in Figs. 2 and 13-17, the soap dispenser comprises a soap container 131 which is suitably fastened to an edge of bottom plate 32, and is provided with removable cover 132. At the bottom of container 131 is a hopper 133, having one wall thereof hinged at 134, the hopper being suitably mounted on bottom plate 32, and carrying a rotary metering feeder element 135 fixed on rotary shaft 136'. Hopper 133 is arranged over tank 11', as shown in Fig. 2, so that soap leaving feeder 135 drops into the tank 11'. A pinion 137, carried by shaft 136, meshes with a rack 138, which is carried by a pin 139 passing thru a suitable aperture in rack 138, the rack being retained in engagement with pinion 137 by a backing roller 140 and retaining plate 141. Pin 139, which carries rack 138, is carried by a rod 139' (see Fig. 19) and moves up and down with operating arm 108, as described below.

Rotary feeder element 135 is shown as comprising four radial pockets, and is fixed on shaft 136'. A selective clutch mechanism is provided between shafts 136 and 136' to rotate feeder element 135 by a predetermined amount depending upon the setting of feeder handle 142. This clutch mechanism comprises driving clutch element 143 and driven clutch element 144. The latter has, in this case, three clutch fingers 145, 146, 147 of different lengths. Clutch members 143 and 144 are normally kept out of engagement by spring 148 acting thru collars 149 and 150. The axial position of driving clutch element 143 is determined by the position of axially adjustable spring pressed feeder regulator 142. Driven clutch element 144 is connected by a pin and ratchet with shaft 136' so that, when the clutch elements 143 and 144 are in engagement and rack 138 is moved downward (Fig. 16), shaft 136' and feeder 135 are rotated in a counter-clockwise direction by an amount depending on the relative axial position of feeder regulator 142 and clutch driving element 143.

If driving clutch element 143 is in position to engage clutch finger 147, complete downward movement of rack 138 will result in a 180° movement of feeder 135, emptying two pockets of soap into tank 11'. Similarly, if driving clutch element 143 is set to engage driven clutch finger 146, full downward movement of rack 138 will result in 270° rotation of feeder 135, emptying three pockets of soap into tank 11'; while engagement of driving element 143 with finger 145 will result in emptying four pockets of soap into tank 11' upon a single downward movement of rack 138. A pin and ratchet connection between driven clutch element 144 and feeder shaft 136' permits upward movement of rack 138 with no resultant movement of feeder 135, which is retained against reverse rotation by means of pawl 135'. A conical bearing surface 151 is provided on driving clutch element 143, to provide a bearing surface for the inner end of feeder regulator 142. It is obvious that more than three settings of the soap feeder may be arranged, if desired. It will be noted that an inner wall of hopper 133 is pivotally mounted at 134 on said hopper, and is spring biased to-

ward feeder 135. This permits said wall being swung away from feeder element 135 for accessibility to the feeder element, and to make the feeder self-clearing.

Bluing dispenser

In order to add bluing to the rinse water at a desired stage of the washing cycle, a preferred construction of bluing dispenser is provided, as illustrated in Figs. 18, 19 and 20. The bluing dispenser comprises a casing 153 carried by or integral with bottom plate 32 and located between baffle wall 34 and outer casing 36. Pivotaly mounted in casing 153 is a ladle 154 provided with a discharge channel 155. A port 157 leads from the depending rear lip of ladle 154 to conduct bluing onto the upper surface of bottom plate 32, where it mixes with the rinse water. Any desired amount of bluing may be poured into container 153 thru opening 158 provided with stopper 159. Ladle 154 is raised to discharge its load of bluing by means of link 161, the starting elevation of which is determined by the setting of hollow screw 162 carried by rod 139', which connects with abutment 115 provided on operating arm 108 by means of pin 160, so that as the operating arm 108 rises under the influence of spring 108', it will raise link 161 with it, thereby discharging ladle 154. Link 161 is loosely carried in the bore of screw 162, so that lost motion between rod 139' and link 161 is provided. It will be noted that rod 139' also actuates the soap dispenser, as previously described.

If it is not desired to use bluing during the cycle, the ladle 154 may be locked in its upper position, above the level of bluing in container 153, by means of stop member 164, operable by handle 163. When, with ladle 154 in its raised position, handle 163 and stop member 164 are turned counter-clockwise 180° from the position shown in Fig. 20, upon releasing ladle 154 it will descend only until abutment 165 strikes and rests on the end of stop member 164, thereby preventing descent of ladle 154 into the bluing. Handle 163 is accessible outside outer casing 36.

Electrical circuit

Referring now to Figs. 1 and 21, the motor 52 is energized by a switch 167 which is operable by a forked arm 168 carried by operating arm 108. Upon descent of operating arm 108, switch 167 is actuated to energize motor 52. In parallel with the motor are two or more heating elements 33, one or more of which is or are in series with switch 169, as shown. Switch 169 may be operated thermostatically or by hand.

Mounted between baffle wall 34 and outer casing 36 is a humidity sensitive control 171 which actuates a second motor switch 172. Humidity sensitive element 171 is shown only diagrammatically, since a number of such controls are known and are available. Switch 172 is closed by humidostat 171 as soon as water is introduced into drum 18, and remains closed until the contents of the drum have attained a predetermined minimum degree of moisture, when the humidostat opens switch 172. Humidostat 171 may be adjustable to shut off the motor when any desired minimum moisture content of clothes being dried has been reached. As shown in Fig. 1, humidostat 171 is mounted on baffle wall 34 in such manner that air leaving drum 18 passes about said humidity sensitive element thru a tortuous passage which prevents water

from the drum from reaching said humidity sensitive element.

Cycle of operation

To start the machine in operation, with covers 42 and 38 removed, soiled clothes are placed in drum 18, between screen 27' and frusto-conical wall 29, to fill the clothes-containing chamber, if desired. Cover 42 is then fastened in place by means of operating knob 66, thereby clutching drive shaft 56 to the sleeve 17, which forms a hub for drum 18. Cover 38 is then put in place, as shown in Fig. 1.

Inlet valve 87 is now opened by means of valve wheel 87', to admit hot and cold water to the machine. The timing of the washing cycle is determined by moving needle-valve operating handle 112 inward or outward, as seen in Fig. 3, to determine the effective size of the orifice controlled by needle valve 109. This will determine the speed with which dashpot piston 107, and therefore starting arm 108 and compound valve piston 85 will rise under the action of spring 108'. It will be noted that the speed of operation may be altered during operation by moving timing handle 112.

Knob 130 is then moved to the radial position which will give the desired water temperature by setting cam actuator 129, which determines the neutral position of thermostat element 124. This will control the temperature of both soap water and rinse water.

Valve handle 95 is then set in a horizontal position, as shown in Fig. 3, if it is desired to discharge the soap water from drum 18 into storage tank 11', for use over again later; or the handle 95 is turned downward to a vertical position if it be desired to discharge the soap water into the drain.

Soap dispenser feeder handle 142 is then set at the desired axial position to dump the desired amount of soap into the tank 11', such setting providing for no soap, minimum, medium, or maximum amounts of soap, as desired.

Bluing dispenser lock handle 163 is then set to the right, as shown in Fig. 20, if bluing is desired, or to the left if no bluing is to be used.

With the various adjustments thus set, the machine is ready for operation, and is started by pushing operating arm 108 against the pressure of spring 108' down as far as it will go, to the position shown in Fig. 3. As operating arm 108 is brought down, the pressure of the liquid in dashpot 106 forces valve 111 upward against the pressure of its spring, permitting rapid descent of dashpot piston 107. On its downward path, operating arm 108 performs the following operations:

1. Bluing ladle 154 is lowered into the bluing, assuming that lock handle 163 is turned to the position shown in Figs. 18 and 20, by means of abutment 115 of operating arm 108 acting on bluing dispenser rod 139' thru pin 160.

2. Soap dispenser feeder 135 is rotated to dump into tank 11' an amount of soap predetermined by the setting of feeder handle 142 (unless feeder handle 142 is set in the "no soap" position, in which case clutch members 143 and 144 will not engage, and the soap feeder will not be operated). Operating arm 108, thru abutment 115 and pin 160 actuates rod 139', which, thru pin 139, carries rack 138 downward, thereby actuating feeder 135 thru pinion 137 and clutch members 143 and 144.

3. Near the lower terminus of its downward

movement, operating arm 108, which carries fork 168 mounted thereon, closes switch 167, thereby energizing motor 52. The latter drives shaft 56 thru bevel gears 53 and 54, thereby operating centrifugal pump 57. Since cover 42 is fastened down by means of operating knob 66, drive shaft 56 is frictionally clutched to hub 17, so that the drum 18 rotates with shaft 56. It should be noted, however, that friction clutch 62, 63 permits enough slippage between shaft 56 and hub 17 to permit the drum to start slowly, thereby preventing overloading of motor 52 at starting. While motor 52 may reach full speed almost instantly, drum 18 starts slowly and gradually builds up to full speed. When the drum starts to rotate, the operator is advised of that fact by the repeated impact of flyweight 43 against cover boss 48, this sound alarm ceasing when the drum attains its normal speed.

When starting arm 108 has reached the bottom of its starting stroke, compound valve piston 85 is in the position shown in Fig. 3. With the valve in this position, water enters the machine thru pipes 118, passes thru proportioning chamber 120, where the proportions of hot and cold water are determined by thermostatic element 124, and is admitted by valve 87 thru port 86 into valve chamber 83 and, thru restriction valve 88, into valve chamber 81, as in Fig. 3. It will be noted that, with restriction valve 88 always open, water is admitted to valve chamber 81, regardless of the position of valve piston 85. Since valve chamber 81 is connected by pipe 103 (Fig. 8) with water lubricating chamber 16, lubrication for bearings 14 and 15 is assured thruout the cycle.

As soon as operating arm 108 is released at the bottom of its movement, it begins to rise under the action of spring 108', the speed of its upward movement depending upon the setting of needle-valve 109, which is operable by handle 112. While operating arm 108 is in the position shown in Fig. 3, and during the first part of its upward movement, it will be seen that water is admitted to valve chamber 82 from chamber 83. Referring now to Fig. 8, it will be seen that water which is admitted to chamber 82 passes into storage tank 11'; admission into said tank 11' being also regulated by float valve 84, which prevents overflow of tank 11'. Water continues to be admitted to tank 11', under control of float valve 84, until valve chamber 83 is closed by valve piston 85, as shown in Fig. 5. It will be noted that valve 84 is so constructed that, once the valve has been raised to closed position by its float, it remains in closed position so long as water pressure is maintained in chamber 82. A loose washer 84' is provided to guard the float from water streaming upward thru the valve.

In this position of valve stem 85, water can no longer be admitted to tank 11', since valve chamber 82 is now shut off from valve chamber 83. It will be noted (Fig. 8) that pipe 92, leading to suction end of pump 57, is connected to valve chamber 74. In the valve position of Fig. 5, chamber 74 is connected to chamber 73 after chamber 83 is isolated from chamber 82, and pump suction draws soap water from tank 11' thru intake pipe 97, chambers 73, 74, pipe 92, and pump 57, forcing it under pressure thru pipe 101 into valve chamber 78, from which it flows into valve chambers 77 and 75, thru port 98 into the bottom of well 24. It will be noted that in the first position of valve 85 (Fig. 3), centrifugal pump 57 was inoperative, since it empties into valve chamber 78 from which there is no exit.

In the position of the valve of Fig. 5, however, pump 57 forces water in chamber 78, from which it enters chamber 77 which is connected with chamber 75.

Soap water which reaches well 24 is picked up by rotating drum vanes 23 (Fig. 1), which, together with the centrifugal force of the water, carry the water upward into the space between frusto-conical members 28, 29, the frusto-conical shape of the members, when the drum is rotating, also urging the water level upward, creating a positive head of water available to the drum. The centrifugal action of the rotating drum and its contents urges the water outward thru perforated wall 29, thru the contents of the drum, thoroughly cleansing same, thru screens 27', 27 and apertures 26 of drum 18. The water thus expelled from rotating drum 18 runs down baffle wall 34 and onto bottom plate 32 back into well 24, to be again picked up by vanes 23 and forced thru the contents of the drum. As the water runs over bottom plate 32, its temperature is maintained by heating elements 33. This process is continued until all the soap water has been drawn from container 11' by pump 57, and circulated repeatedly in cleansing the contents of drum 18.

When valve piston 85 reaches the position of Fig. 6, sufficient time has elapsed to cleanse the contents of drum 18. In the valve position of Fig. 6, pump 57 is inoperative since inlet chamber 73 is isolated from pump inlet chamber 74. In this position of the valve, water drains from the bottom of well 24 thru port 98 into chamber 75 and thence into chamber 76. If it is desired to save the soap water to be used again, diversion valve 96 has been turned to the horizontal position shown in Fig. 8, and the soap water drains from chamber 76 thru drain connection 94 into tank 11'. If, however, it is not desired to save the soap water for further use, valve 96 is turned to the vertical position connecting valve chamber 76 with pump intake chamber 74, and the course of the water in this case will be from well 24 thru port 98 to chambers 75, 76 and 74, pump intake pipe 92, pump 57, pump discharge port 101, chambers 78 and 79, and drain port 102. This continues until all of the soap water is discharged either to tank 11' or to a drain.

The valve next assumes the position shown in Fig. 7. In this position water from the proportioning chamber is admitted thru valve 87 into valve chamber 81 thru restriction valve 88, which is set to limit the flow of rinse water. Chamber 81 is now connected with valve chamber 80 and the water passes from there thru port 99 to valve chamber 75 and port 98 into well 24. Here this clean water is picked up by vanes 23 and forced thru rotating drum 18 and its contents in the same manner as was the soap water previously. At a desired point in the rinsing step, operating handle abutment 115 actuates pin 160 to raise rod 139', tipping bluing ladle 154 onto bottom plate 32, where it mixes with the incoming rinse water.

Water which has passed thru the rotating drum and its contents runs down port 89 into chamber 71, thru chamber 72 into pump intake chamber 74, thru pump 57, and is discharged thru port 101, chambers 78 and 79 to drain 102.

It will be noted that throughout the soaping and rinsing steps, drum 18 rotates above the water level in well 24, so that little energy need be used to rotate the drum, and high speed rotation thereof is possible.

Operating arm 108 and valve piston 85 reach the end of their upward movement in the position shown in Fig. 8. In this position of the valve, no water can be admitted to the drum or pump either from proportioning chamber 120 or tank 11'. This is the drying step. Whatever water is discharged by rotating drum 18 drains off thru port 98, chambers 75 and 74, pump 57 and out thru chambers 78 and 79 to drain port 102.

During this drying step, while water is removed from the drum contents by centrifugal force, air is admitted thru the annular space between outer casing 36 and skirt 37, passes over bottom plate 32, where it is heated by means of heaters 33, one or more of which is or are energized by thermostatic switch 169 which is responsive to the temperature of plate 32. If preferred, switch 169 may be actuated manually. The air passes upward between vanes 23 and thru the contents of the rotating drum, the rotating drum 18 and its contents acting as a centrifugal pump to force the air outward and up between drum 18 and baffle wall 34 and out thru the annular passage in cover 38, 39. As the air leaves the drum, it is directed upward by upwardly slanted apertures 26. Part of the air leaving drum 18 passes thru a tortuous passage (which prevents the entrance of water particles expelled from drum 18) into intimate contact with humidity sensitive element 171. Deflector plate 35 is arranged to provide an annular aperture between plate 35 and baffle wall 34. Deflector plate 35 prevents the rotational velocity of bottom 21 of drum 18 from interfering with air entering from the bottom of outer casing 36 into the well 24. It will be noted that the outer edge of deflector plate 35 is turned upward toward the drum, forming an annular throat at this point. The low pressure at this point is instrumental in inducing flow of air downward around humidity-sensitive element 171. When the air leaving drum 18 has reached a desired minimum degree of moisture, humidity sensitive element 171 operates to open switch 172, switch 167 having been opened by fork 168 when arm 108 reached the upper terminus of its movement. Switch 172 may be opened manually, if it is not desired to operate the drier in response to humidostat 171. This deenergizes the motor, and the drum is brought to a stop, the slowing down of the drum being indicated acoustically by the impacts of flyweight 43 against cover boss 48. This notifies the operator that the washing cycle is completed and the clothes are clean and have reached the desired minimum moisture content.

While a specific embodiment of the invention has been described and illustrated, it will be clear to those skilled in the art that various modifications and variations are possible within the scope of the invention and of the claims appended hereto. While the invention has been described with particular reference to clothes washing, it is contemplated that the invention may be utilized for the treatment of material for various other purposes. For example, in view of the provisions described above for saving the cleaning fluid for reuse later, it will be understood that this invention lends itself for use as a dry-cleaning machine.

It will also be understood that various features of this invention are adapted for general use other than in combination with a washing machine.

It is desired to claim and secure by Letters Patent:

1. In a washing machine, a stationary support comprising a hollow standard; a drum comprising a hub mounted for rotation on bearings on said standard, a substantially cylindrical wall and a bottom provided with an annular central aperture surrounding said hub; an annular chamber between said standard and said hub and extending between said bearings; an annular skirt surrounding said aperture and depending from said bottom; a plurality of radial vanes connecting said skirt and said hub; and means for introducing washing fluid into said annular chamber for lubricating said bearings.

2. A washing machine comprising a base provided with a housing, a stationary central hollow standard within said housing, a drum having a hub rotatably supported on said standard, said base comprising a storage tank located beneath said housing and rotatable drum, a pump communicating with said housing and said storage tank, a pump casing and a gear casing located beneath said hub and standard and within the confines of said tank, a drive shaft within said gear and pump casings and hollow standard, and means for connecting said drive shaft in driving engagement with said hub.

3. A washing machine comprising a support, a perforated drum provided with a fluid admission aperture centrally of its lower end and mounted on said support for rotation about a vertical axis, a cylindrical baffle wall surrounding said drum and providing an annular space between said wall and said drum, a stationary bottom plate carried by said support adjacent the lower end of said drum and spaced from said baffle wall to provide an annular air admission aperture between said bottom plate and said baffle wall, and a closure member for the upper end of said baffle wall provided with an annular aperture communicating with said annular space between said baffle wall and said drum.

4. An automatic washing machine comprising a storage tank and a clothes container, valve means for admitting tap water to said tank, means operable in conjunction with said valve means for admitting water from said tank to said clothes container, means for circulating said water repeatedly thru said container, means for draining said water back to the tank, means for continuously admitting tap water to said container and continuously draining it therefrom for a predetermined period of time, and means for discontinuing admission of water to said container upon the termination of said predetermined period.

5. A washing machine comprising a frame provided with a tank and a vertical standard, a drum mounted on said standard, a drive shaft passing thru said standard, means for connecting said shaft in driving engagement with said drum, a pump operable by said drive shaft, hot and cold water inlets, a proportioning chamber for thermostatically proportioning the amount of hot and cold water admitted to said drum, a compound valve, means for sequentially urging said compound valve thru a plurality of positions, in the first position said valve connecting said proportioning chamber to said tank, in the second position said valve connecting said tank to the pump inlet and connecting the pump outlet to said drum, in the third position said valve connecting said drum to a drain, in the fourth position said valve connecting said proportioning chamber to

said drum, said pump inlet to said drum, and said pump outlet to a drain, and in a fifth position said valve connecting said drum to said pump inlet and said pump outlet to a drain.

6. A washing machine as defined in claim 5, adjustable dashpot means being provided for adjustably determining the speed of movement of said valve.

7. A washing machine as defined in claim 5, soap dispensing means for depositing variable, predetermined quantities of soap within said tank, bluing dispensing means, adjustable to operative and inoperative position, for depositing a predetermined quantity of bluing in said drum, and means, movable with said compound valve, for actuating said soap dispensing means and said bluing dispensing means at predetermined positions of said valve.

8. A washing machine comprising a frame provided with a hollow standard and a tank having an inlet and an outlet port, an annular well carried by said frame and provided with upper and lower ports, a rotatable apertured drum provided with a hub supported on bearings on said standard, an annular chamber between said hub and standard communicating with said bearings and provided with a fluid inlet, a drive shaft passing thru said standard for driving said hub, a pump having a fluid inlet and a fluid outlet; a source of water; a compound slide valve comprising a cylinder provided with a plurality of chambers and a compound piston movable thru said chambers; means for connecting certain of said valve chambers with said water source, said tank inlet and outlet ports, said upper and lower well ports, said pump inlet and outlet, said fluid inlet to said bearing chamber, and a drain.

9. A washing machine as defined in claim 8, wherein one valve chamber is connected to said upper well port, a second valve chamber is connected to a third valve chamber which is connected to said pump inlet, a fourth valve chamber is connected to the tank outlet port, a fifth valve chamber is connected to said lower well port, a sixth valve chamber, a diversion valve for alternatively connecting said sixth valve chamber to said third valve chamber or to a second inlet to said tank, a seventh valve chamber connected to said fifth chamber, an eighth chamber connected with the outlet of said pump, a ninth valve chamber connected with said drain, a tenth chamber connected with said fifth and seventh chambers, an eleventh valve chamber connected with said source of water and with said bearing chamber fluid inlet, a twelfth valve chamber connected with said first tank inlet port, and a thirteenth valve chamber connected to said source of water and said eleventh valve chamber.

10. In an automatic washing machine comprising a clothes container, a compound slide valve comprising a valve cylinder comprising a plurality of valve chambers, a compound piston passing thru said valve chambers and having a starting and a final position; means connecting said valve with said clothes container, a drain and a source of water; an operating member for moving said valve piston to its starting position; resilient means urging said member and valve piston from starting to final position; a dashpot cylinder supported on said valve cylinder; and a dashpot piston rigidly connected with said operating member and fitting within said dashpot cylinder.

11. An automatic washing machine as defined in claim 10, said dashpot piston being provided

with a needle valve, and means for adjusting said needle valve to vary the rate of movement of said operating member under the influence of said resilient means.

12. An automatic washing machine as defined in claim 10, said dashpot piston being provided with a spring-pressed valve, and means for opening said valve to permit rapid movement of said operating member and its associated valve and dashpot pistons.

13. A washing machine comprising a support, a vertical, perforated drum provided with a bottom wall having a fluid admission aperture centrally thereof and mounted on said support for rotation about a vertical axis, a cylindrical baffle wall surrounding said drum and providing an annular space between said wall and said drum, a stationary bottom plate on said support spaced from the bottom wall of said drum and providing an annular fluid admission aperture between said bottom plate and the lower end of said baffle wall, and a stationary annular deflecting plate between said drum and bottom plate and closely adjacent said bottom wall of said drum, the outer edge of said deflecting plate being turned up to form a restricted throat between said deflecting plate and said drum.

14. In a washing machine, a rotary apertured drum comprising a substantially cylindrical wall and a bottom wall provided with an annular central aperture adjacent the central axis thereof,

an annular skirt depending from said bottom wall adjacent said central aperture, a plurality of radial vanes within said skirt, said vanes being downwardly and forwardly inclined in the direction of rotation of said drum, and a plurality of circumferential ribs internally of said cylindrical wall.

15. In a washing machine, a stationary support comprising a hollow standard, a drum comprising a hub mounted for rotation on bearings on said standard; an annular chamber between said standard and said hub and extending between said bearings; and means for introducing washing fluid into said annular chamber for lubricating said bearings.

16. A washing machine comprising a support, a vertical, perforated drum provided with a bottom wall having a fluid admission aperture centrally thereof and mounted on said support for rotation about a vertical axis, a cylindrical baffle wall surrounding said drum and providing an annular space between said wall and said drum, a stationary bottom plate on said support spaced from the bottom wall of said drum and providing an annular fluid admission aperture between said bottom plate and the lower end of said baffle wall, and a heating element intimately contacting said bottom plate for heating the fluid passing thereover.

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