

Aug. 4, 1953

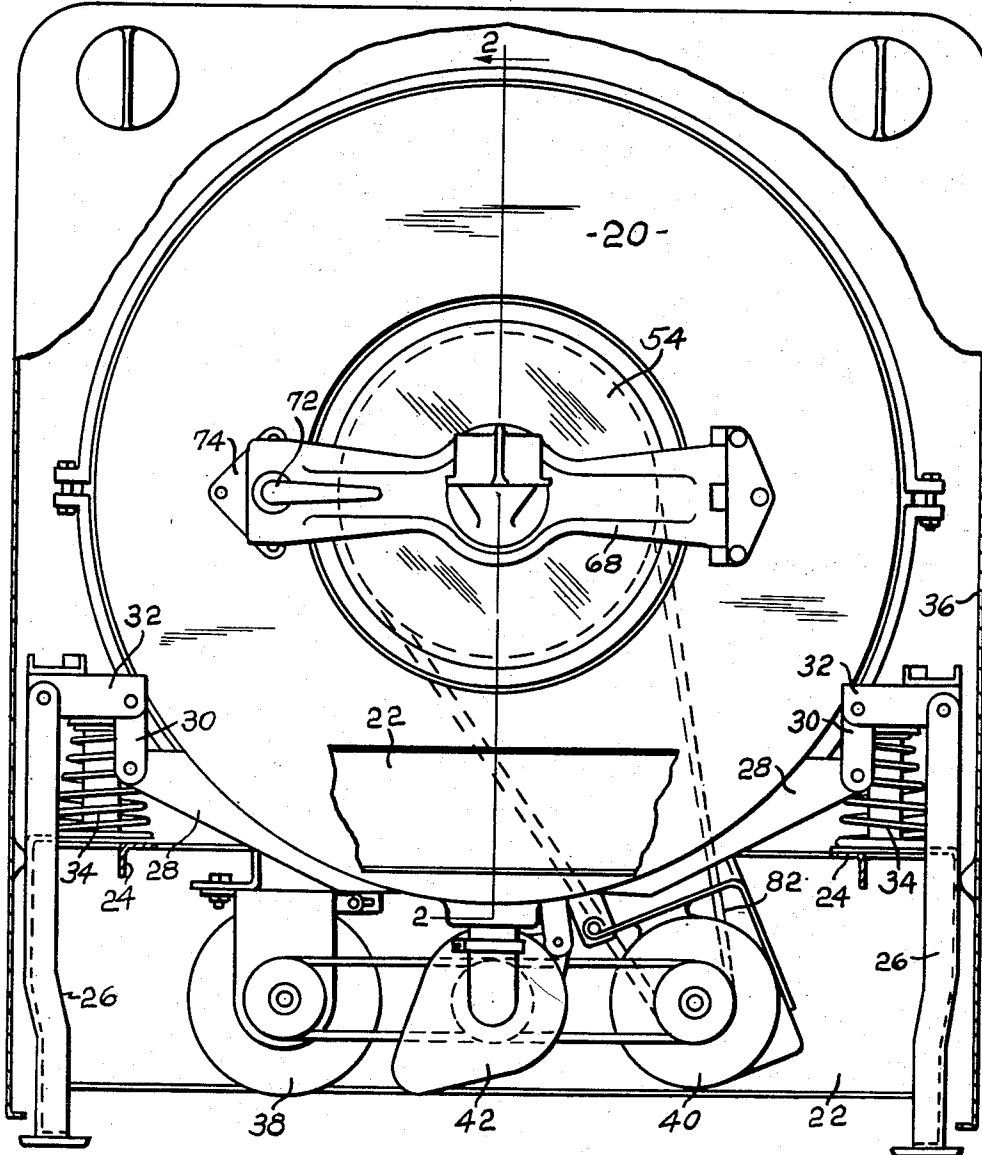
F. P. KEIPER
WASHING MACHINE

2,647,386

Filed April 3, 1948

5 Sheets-Sheet 1

FIG. 1.

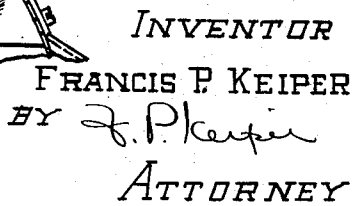


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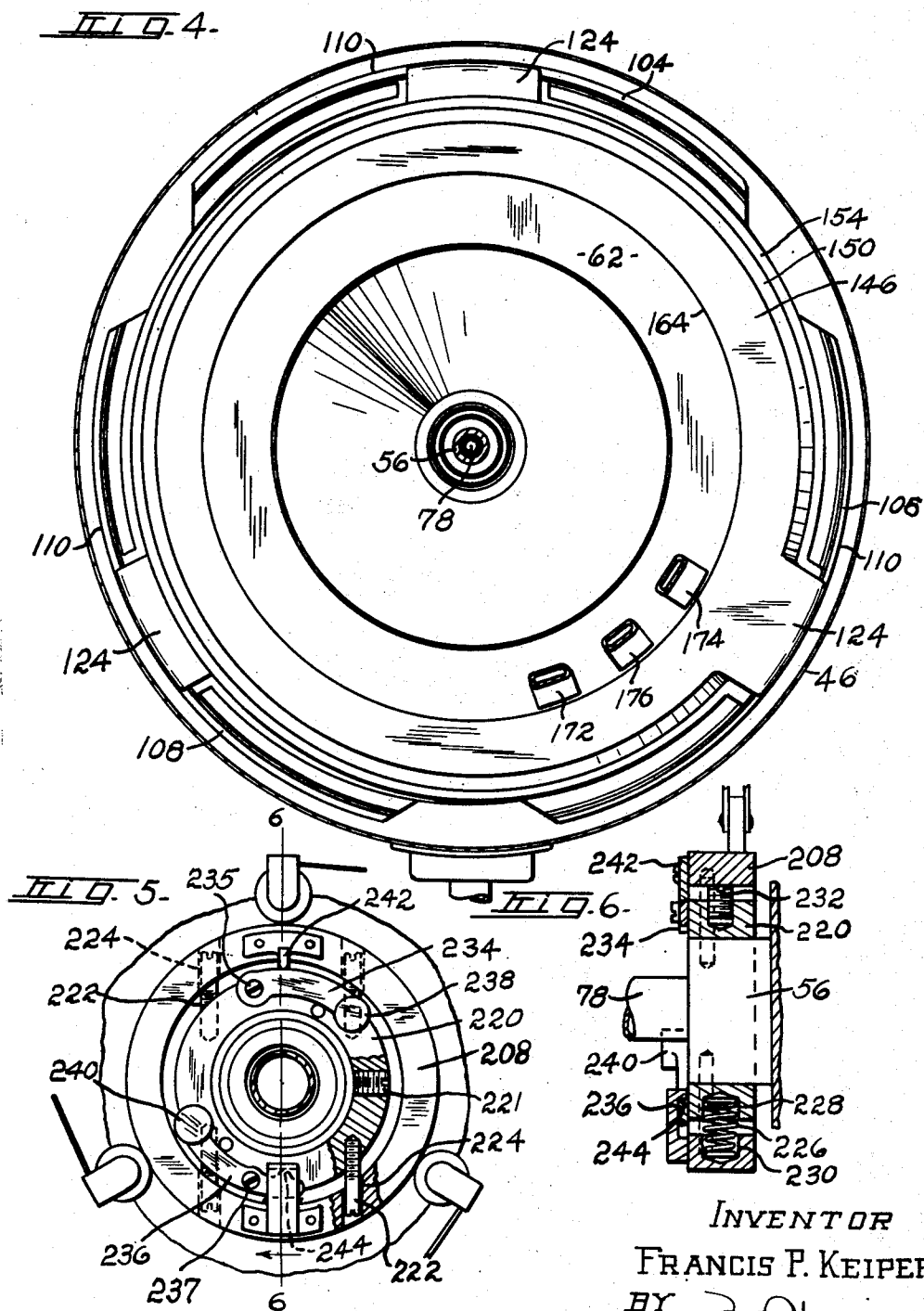
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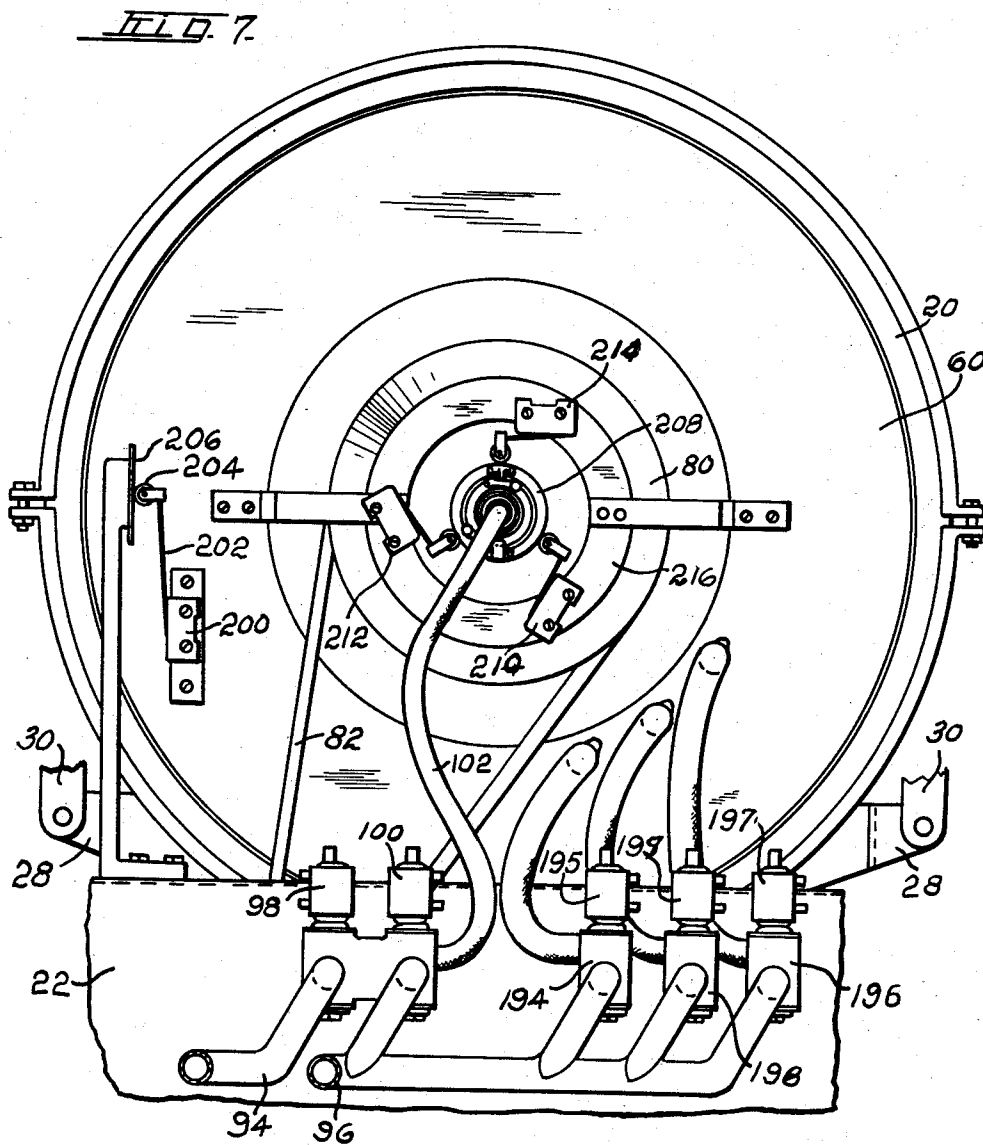
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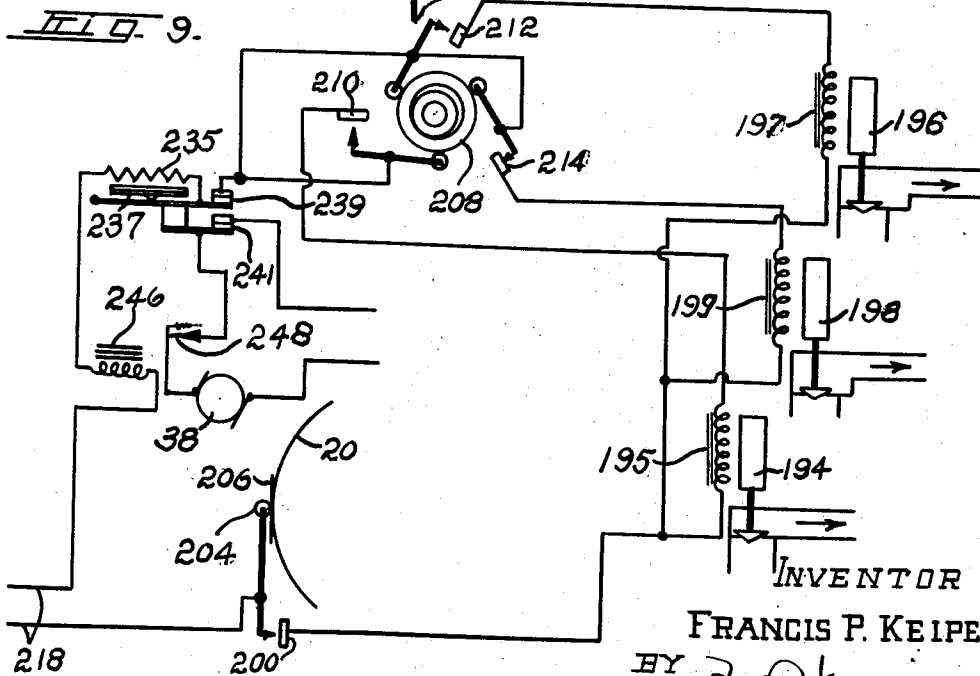
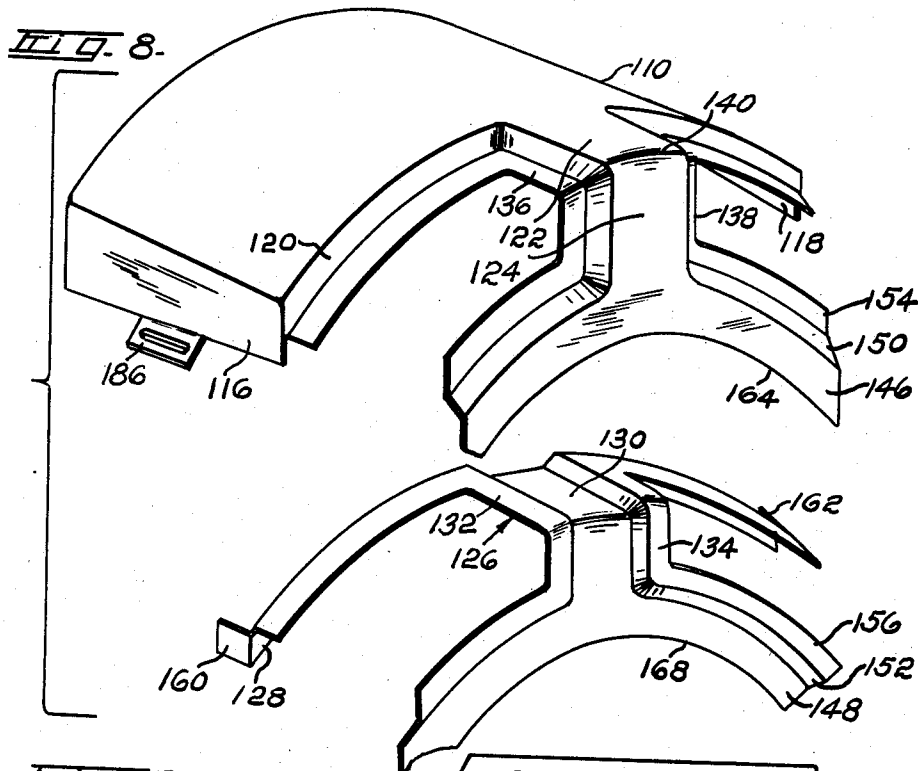
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UNITED STATES PATENT OFFICE

2,647,386

WASHING MACHINE

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Application April 3, 1948, Serial No. 18,790

9 Claims. (Cl. 68—23)

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This invention relates to washing machines, and more particularly to washing machines in which centrifugal extraction is employed.

In washing machines having centrifugal extractors, considerable difficulty is had in loading the clothes-containing basket or drum in balanced relation, with the result that, at high speed rotation thereof, vibration is present. Such vibration consumes power and tends to fatigue the parts, aside from its disturbing aspect.

In manually loaded machines of the vertical axis type, it is possible with considerable skill to load the centrifuge in approximate balance, so that such vibration is minimized. However, in automatic washing machines, where washing and extraction are sequentially carried out in the same container, it is undesirable for the operator to be required to handle the laundry for the purpose of distributing it properly. Particularly in horizontal axis machines, it is impossible for the operator to distribute the clothes manually.

The present invention is directed toward balancing an unbalanced loaded centrifugal extractor by application of counterbalance liquid about the periphery of the extractor in automatically selected peripherally spaced locations as the need therefor appears. The invention has to do further with the construction and application of liquid containing pockets for receiving counterbalance liquid to a centrifugal extractor. Additionally, the invention is directed to suitable controls for restricting the application of such balancing liquid to a suitable range of speed, normally lower than the maximum speed at which final extraction is had and above a preset minimum. The invention still further relates to apparatus for causing the balancing operation to be cyclically repeated in the event of failure to establish a balance within a reasonable time.

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

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

Figure 1 is a front elevation of a centrifugal extractor type washing machine with cabinet portions broken away, to which the invention is applied;

Figure 2 is a vertical section taken through the

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axis of the machine substantially on the line 2—2 of Figure 1;

Figure 3 is a fragmentary section taken on the line 3—3 of Figure 2;

Figure 4 is a transverse section through the machine taken substantially on the line 4—4 of Figure 2;

Figure 5 is an enlarged end view taken on the line 5—5 of Figure 2;

Figure 6 is a section taken on the line 6—6 of Figure 5;

Figure 7 is a rear view of the machine illustrating the hydraulic and electrical control devices;

Figure 8 is an exploded perspective detail view of one of the balancing pockets; and

Figure 9 is a schematic electrical hydraulic control circuit.

Referring to Figures 1 and 2, there will appear a tub or splash guard 20 resiliently suspended from a stationary frame 22, the latter having a horizontal open framework 24 supported on corner posts or legs 26. The tub 20 is provided with a saddle 28 which is suspended at either side and at the front and rear from upwardly extending links 30 hanging from horizontally extending links 32 pivoted to the upper end of the posts 26. The horizontal links 32 are resiliently supported in the position shown by conical springs 34 extending between the stationary frame and suitable brackets, not shown, but rigidly connected to the links 32. A suitable housing 36 supported upon the frame 22 surrounds the tub, there being provided sufficient clearance for limited lateral and upward movement of the tub.

Suspended from the tub and beneath it are a main drive motor 38, which is connected by a belt to a transmission 40, and a suitable drain pump 42. Within the tub 20 is a wash drum or container 44 having a slightly tapered circular outer wall 46, a rear wall 48, and a front wall 50, the latter being provided with a circular door opening 52 with a rotatable circular door 54 cooperating therewith for providing access to the drum for loading and unloading, as well as a seal therefor during washing. The drum 44 is supported at its rear upon a shaft 56 mounted on bearings 58 carried by a back wall 62 spaced to the rear of the back wall 48 and a central hub member 64 mounted upon the shaft 56 and supporting the walls 48 and 62 of the drum 44.

The revolvable door 54 is mounted upon a bearing 66 carried upon a transverse hinged bar 68 hinged to the forward wall 70 of the tub 20. The

bar is provided with a suitable latch 72 cooperating with a latch plate 74, the latter being mounted upon the forward wall 70. The hinged bar 68 is provided with a hollow trunnion 76 on which the bearing 66 is supported. The hollow trunnion affords a means for supplying detergent to the drum 44. The shaft 56 is hollow to accommodate a supply pipe 78 for introducing wash water into the drum 44. The shaft 56 extends to the rear of the bearings 48 and has keyed thereon a sheave 80 adapted to be belt driven as at 82 from the transmission 40. Wash water is removed from the drum 44 by means of a pair of diametrically oppositely disposed arcuate peripheral passages 83 arranged between the rear wall 48 and outer wall 62. In practice, each passage is substantially 180° in length and is provided with an inlet opening 84 entering into the compartment 86 between the walls 48 and 62 and has a discharge opening 88 at its opposite end for discharge into the tub or splash guard 20. The rear wall 48 is provided with a plurality of spaced peripheral ports 90 which permit flow of wash water from the drum 44 into the compartment 86. It will be seen from the foregoing description that the drum 44 is supported for rotation on front and rear bearings which are in turn carried by the tub 20, previously described as suspended for limited movement with respect to the frame 22. The drum 44 is provided with a number of baffles or vanes 92 arranged in staggered relation and in spaced planes upon the internal surface of the slightly tapered drum wall 46.

Hot and cold water supply lines 94 and 96, respectively, are connected to temperature control valves 98 and 100, and a flexible conduit 102 connects the output of such valves to the conduit 78 extending through hollow shaft 56. The structure thus far described is described in more complete detail in the pending applications of Peyton W. Douglas, Serial No. 775,237, filed September 20, 1947, and Serial No. 787,445, filed November 21, 1947, issued February 26, 1952, as Patent No. 2,586,794.

In the apparatus described, a wash load is introduced through the door 54, and detergent is introduced through the soap channel in the hollow trunnion 66. Suitable wash water in proper quantity and temperature is introduced through the conduit 78. Washing is effected by rotation of the drum in a clockwise direction, it appearing that with rotation in such direction, the conduits 83 are ineffective to permit wash water to escape through the inlet and outlet ports 84 and 88 of the conduits 83. Upon completion of the washing operation, rotation is reversed, whereupon the conduits 83 act in a bailing or scooping capacity and remove wash water from the drum 44. Thereafter, rinsing of laundry contained within the drum may be effected by the introduction of rinse water and rotation in a clockwise direction followed by draining of the rinse water by rotation in a counterclockwise direction, the latter being effected through the same conduits 83 in the manner described in connection with the elimination of wash water. If desired, rotation may be effected following a washing operation in a counterclockwise direction during which there is continuously supplied rinse water through the conduits 78. For such purposes, a spray rosette 79 may be provided for effective distribution of the rinse water through the internal drum surfaces. Various combinations of rinsing procedure as described may be employed as is desired. It will be understood that the transmission 40

may provide for the clockwise and counterclockwise rotation previously described, or a reversible motor may be employed. Upon completion of the rinsing operation, however, the transmission will cause the drum to speed up for extraction of moisture from the laundry contained within the drum. The laundry contained within the drum will be distributed about the inner wall thereof as the speed is increased. It will be understood that there will be a certain amount of tumbling action of the laundry initially during this acceleration stage, during which the various articles will tend to uniformly distribute themselves about the inner surface of the wall 46.

In practice, the uniform distribution sought by such tumbling action and gradually increasing speed is often unsatisfactory in that a severe unbalanced condition may result. The unbalanced condition may be aggravated by the type of laundry placed within the drum, for example, a chenille rug or a heavy bath towel containing a large amount of water may position itself on one side of the drum, and insufficient laundry may dispose itself opposite thereto to establish satisfactory conditions. In fact, automatic laundries of the type described are often subjected to washing of a single heavy piece of the character described, which cannot distribute itself uniformly about the internal wall and therefore establishes an extremely severe unbalanced condition. Where a severe unbalanced condition occurs, acceleration of the drum causes the center of the drum to be carried in the direction of unbalance, and until a critical speed is reached and passed, the motion of the drum may be extremely severe causing violent vibration and excessive strain on the bearings and parts. The surrounding tub, under such conditions, may move through distances beyond the clearance provided within the surrounding cabinet 36 and severe vibration will be transmitted to the supporting floor upon which the machine rests.

In order to obviate the conditions respecting unbalance, which may occur in a machine of the type described, a counterbalancing apparatus is employed, together with mechanism for rendering the counterbalancing effective and responsive to the uneven load distribution within the drum causing the unbalance. In Figures 2 and 4, there is shown, arranged about the outer surface of the tapered drum wall 46, a plurality of balancing fluid receiving pockets 104, 106 and 108. The pockets are in the form of shallow arcuate chambers each having an outer wall 110 extending fore and aft parallel to the axis of the drum 44, and cylindrically about the drum. Each of the pockets is less than 120° in length and is suitably secured to the outer wall 46 of the drum 44 by fastening means such as, for example, the threaded bolts 112 which secure the vanes 92 within the drum. Each of the pockets may comprise a shallow pan-like element having the outer wall 110 as described, a front wall 114 and side walls 116 and 118. The rear wall may be formed in part integral with the wall 110 as at 120, and the outer wall 110 may be extended to the rear of the drum 44 as at 122 to form a conduit 124 of shallow hat-shaped section through which balancing fluid may be introduced into the balancing pockets.

The conduit 124 may be completed by a complementary member 126 (see Figure 8) terminating in a wall 128 adapted to cooperate with the wall 120 in the forming of a rear wall of each of the pockets 104, 106 and 108. The channel

portion 130 of the complementary member 126 may be of hat-shape section with flanges 132 and 134 adapted for engagement with flanges 136 and 138 similarly bounding the channel portion 122 of the member 110. It will appear that the channel 124 formed by the complementary members extends around a 90° bend as at 140 to form a radial conduit 142. It will further appear that the radial conduit 142 flows into an annular arcuate channel 144 formed by the complementary shape of each of the members. The annular channel thus formed comprises annular side wall portions 146 and 148, offset portions 150 and 152 and attachment flanges 154 and 156, the latter actually being extensions of the flanges 138 and 136 and the flanges 134 and 132 of the complementary members. It will also appear that the flanges 132 and 134 and 136 and 138 may extend arcuately along the seam between the back portions 120 and 128 of the back wall of the pocket. The flanges thus described upon the complementary members will mate when the members are in assembled relation and may be secured together by any convenient means such as rivets, spot or seam welding, or other means as will be readily understood in the art. The wall 120 and 128 may be further completed by the provision of tabs 160 and 162 which may overlap the side walls 116 and 118 of the outer pocket member, and be secured thereto by suitable means such as riveting or spot welding.

The annular channel 144 formed by the spaced annular walls 146 and 148 provides an internally facing channel the inner edges 164 and 168 of which are circular, and concentric with the axis of rotation of the drum. The edges may be outwardly as at 178 to facilitate the entry of balancing fluid thereinto from stationary flat jets such as 172, 174 and 176 supported in the back wall 60 of the tub 20. The jets may be arranged in the position shown or may be positioned so as to project fluid upward into the rings as may be desired. The channels vary in depth, the outer wall actually being eccentric, with the point of greatest eccentricity being at the radial conduit leading therefrom. By such construction, fluid is caused to flow toward the conduit by centrifugal force, and the liquid reaches the balancing pocket more quickly.

From the structure thus far described, it will appear that three annular channels 178, 180, and 182 are provided for cooperation with the jets 172, 174 and 176. The side walls 148 and 146 of each of these channels are secured to the adjacent corresponding side walls of the adjoining channels in any suitable manner as by spot welding, so that the pockets 104, 106 and 108 and the channels 178, 180 and 182 provide what may be termed as a balancing harness for positioning about the drum 44. In the structure thus described, the interconnection between the side walls of the annular channels serves to connect the pockets structurally across the rear of the drum so as to provide a relatively rigid structure well able to withstand the centrifugal force of balancing fluid which may be distributed to any one or more of the pockets. In practice, the axial width of the annular channels may be in the order of 3/8 inch so that the entire stack of channels will require a minimum of axial space behind the drum. Where such dimensions are employed, each of the pockets may be identical to one another. The pockets thus in their arrangement about the drum may be slightly staggered axially. The fastening ears 164

and 186 attached to the side walls 116 and 118, and the ears 188 attached to the forward wall 114, may be provided with slotted apertures 190 in order to be secured by the vane attachment bolts 112 in such slightly staggered relation as may appear necessary. The side walls 116 and 118 of each of the pockets may preferably extend to and form relatively tight engagement with the outer surface of the tapered wall 46, whereas the forward wall 114 may be spaced from the wall 46 to provide a drainage aperture 192 effective for dumping any fluid contained within the pockets whenever the speed of rotation of the drum is insufficient to maintain such fluid arcuately distributed by centrifugal force over the outer cylindrical wall 110 of each of the pockets.

The jets 172, 174 and 176 are connected through electrically operated valves 194, 196 and 198 to the cold water supply line 96. In practice, it is preferable that the conduits be of substantial size to permit rapid flow of liquid through the valve when opened into the jets 172, 174 and 176 so that balancing fluid may be quickly distributed to the respective channels when the need for counterbalancing is ascertained.

To determine the state of unbalance and the disposition of the force causing the unbalanced condition, a vibration sensitive switch 200 is provided, the switch being mounted upon the rear wall 60 of the tub 20. The switch is provided with a resilient arm 202 having a follower 204 adapted to engage and roll upon a stationary vertical surface 206 rigidly supported from the frame 22. The switch 200 is adapted to be closed during displacement of the tub structure to the left (as seen in Figure 7) of the position which it normally would occupy with all the moving parts stationary. The switch is thus closed during nearly 180° of each complete rotation when a certain degree of unbalance is in evidence, and senses the angular position of the center of mass producing vibration of the tub 20. To properly distribute balancing fluid to the correct pocket or pockets, the eccentric 208 is positioned upon the rear end of the shaft 56, and three switches 210, 212 and 214 are mounted about the eccentric and supported upon a ring bracket 216 affixed to the rear tub wall 60. The switches 210, 212 and 214 are adapted to be sequentially closed with rotation of the drum 44, each switch being closed for 120° of a complete revolution, each successive switch being closed approximately upon the opening of the previous switch.

A reference to Figure 9 may be had wherein the switch 214 is shown as closed while the switches 212 and 210 are open. One contact of each of the switches 210, 212 and 214 is connected to one side of the solenoids 195, 197 and 199 of the valves 194, 196 and 198, respectively, and the other sides of the solenoids are connected together to a common lead extending to a contact of the vibration responsive switch 200. The switches 210, 212 and 214 have one terminal of each connected together and the common lead therefrom and a lead from the other contact of switch 200 are connected to a source of electrical energy as at 218.

The eccentric 208 is so oriented on the shaft and with respect to the valves 194, 196 and 198, and the respective jets controlled thereby, and the corresponding balancing pockets, as to complete a circuit through one or two of the solenoids of the valves during closure of the vibration responsive switch 200. The particular valve or

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valves actuated will correspond to the pockets positioned opposite a radial extending through the center of mass within the drum creating the unbalance. Thus, as the tub and drum structure of Figure 7 move to the left and periodically close switch 200 in response to the normal acceleration force of the center of mass, the valves which will be actuated will be those supplying balancing fluid to the pocket or pockets which are located at that time to the right of the drum axis (as seen in Figure 7).

It will appear that movement of the tub may take place in response to an unbalanced condition at speeds below that sufficient to provide adequate centrifugal force to cause balancing fluid to be retained in or flow from the annular channels 178, 180 and 182 into the balancing pockets 104, 106 and 108. In order to prevent the flow of balancing fluid prior to sufficient speed to render such centrifugal flow effective, a speed governor may be provided. To constitute such a governor, the eccentric 208 may be supported upon a hub collar 220 and be readily shiftable from a concentric position to eccentric position in response to a predetermined centrifugal force or speed of rotation. As shown in Figure 5, the eccentric 208 appears in a concentric position and when so positioned, none of the switches 210, 212 or 214 will be closed, as will be readily understood. The eccentric ring 208 is radially slidable upon a plurality of parallelly arranged pins 222 threaded or otherwise secured in the collar 220, the pins projecting into guide apertures 224 in the eccentric ring. Concentricity of the ring is normally maintained by a compression spring 226, the ends of which are positioned in oppositely facing recesses 228 and 230 in the collar and ring, respectively. An adjusting screw 232 provides an effective stop for determining the concentric position.

A pair of levers 234 and 236, pivoted to the collar 220 at 235 and 237, respectively, are suitably weighted as at 238 and 240 as to be sensitive to centrifugal force. The lever arms are adapted to bear against eccentric ring carried bearing points 242 and 244, so that upon the attainment of a predetermined speed, the ring 208 will be shifted against the radial force of the spring 226 to move the ring 208 to an eccentric position, the eccentricity being limited upon the compression of the spring 226 sufficient to permit the ring 208 to bear against the collar 220 adjacent the spring 226. In practice, the spring 226 may be under residual compressive stress and the actual eccentric movement substantially limited so that complete eccentricity of the ring 208 is established upon a change of speed of a few R. P. M. at the speed determined suitable to commence the introduction of counterbalancing fluid into one or more of the pockets 104, 106 and 108. It will appear that the collar 220 may be angularly adjusted on the shaft 56 and secured by set screw 221, so as to compensate for such lag as may be manifested by the centrifugal and other forces acting.

In practice, the selected speed will preferably be below the critical speed for the rotating unbalanced drum so that severe forces and vibration will not be encountered. As the speed, however, is gradually increased, the introduction of balancing fluid in the proper pockets will counterbalance the unbalanced arrangement of laundry within the drum. So long as there is any substantial or appreciable lateral movement of the tub structure due to an unbalanced condition,

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flow of balancing fluid into the proper pocket will be effected and only after lateral movement has terminated will switch 200 remain open and the flow of balancing fluid to the pockets be discontinued. Since the current flow is periodic, as determined by the opening and closing of switch 200, the action of the valves will likewise be periodic. By balancing at slow speed, such periodic action will effect introduction of balancing fluid in fixed increments. However, such valves may be damped mechanically or electrically directly or by the use of relays, so as to remain open for a period approximately equal to the time of one revolution at the predetermined speed for governor operation.

As a substantially balanced condition is established, the speed continues to increase and extraction of water from the laundry within the drum continues at an accelerated rate. It will be appreciated that with a greater amount of laundry on one side of the drum than the other, with the increase of speed, a greater amount of water will be extracted from that side of the drum. Thus, as speed is increased, a new unbalanced condition will result, since the loss of water extracted from the laundry will result in lightening the load on that side of the axis so that the counterbalancing fluid introduced to the pockets in effect now creates an unbalanced condition. As soon as any lateral motion of the tub again takes place, however, it will respond to the new center of mass of the rotating body and balancing fluid will be introduced into the pocket or pockets substantially opposite to the pockets into which balancing fluid was previously introduced. The introduction of fluid will continue until lateral movement and vibration discontinues such that the switch 200 remains open.

Through the apparatus described, it will be appreciated that a minimum of power is required to accelerate the mass since the unbalanced forces are eliminated at a relatively low speed and balancing is continuously effected as required as the speed increases. It will also be appreciated that since the drum will be balanced, considerably higher extraction speeds may be employed with a consequent removal of greater amounts of water from the laundry than has hitherto been considered practical. Full advantage is taken of the higher extraction speed by utilizing a drum 44 having an imperforate tapered wall 46 such that the laundry is continuously supported over its entire area by the tapered drum wall. The extracted liquid is caused to travel to the rear of the tapered wall and through the ports 90 into the chamber 86, whence it is discharged through the arcuate conduits 83, it being appreciated that the direction of rotation employed for extraction is counterclockwise as viewed from the front of the machine. Thus, the laundry is not stressed or strained as would be the case were the drum wall perforate and the fabrics in effect stretched against the perforations and caused to stretch or dimple into the perforations under centrifugal force.

In order to prevent too rapid acceleration of the drum during the initial counterbalancing operation, it may be desirable to interrupt the flow of current to the driving motor 38 in the event unbalance occurs. This may be conveniently effected by inserting a relay 246 in series with the source of power 218, which upon flow of current through one or more of the valves 194, 196 or 198, may momentarily open the switch contacts 248 in series with the drive motor 38. In

such an arrangement, further acceleration is arrested until a balance is obtained or unless the speed of the drum drops below the predetermined speed as determined by the centrifugal or speed responsive device effecting eccentricity of the eccentric ring 202, in which event the circuit is opened and the relay contacts 243 are then allowed to close. The relay 246 may be electrically or mechanically damped if desired, to delay its closing for a fraction of a second, so as to remain open so long as subjected to current impulses resulting from periodic closing of switch 200. With such an arrangement, balancing may be effected substantially at a constant speed selected between the critical speed and the predetermined speed for which the speed responsive device is set. By counterbalancing the drum at the lowest speed permissible, a relatively long period of time may be employed for effecting balance and substantially perfect balance may be attained before accelerating the drum to the higher speed desirable for efficient extraction. Again, should unbalance occur at higher speeds due to the loss of a greater quantity of water extracted from one portion of the laundry contained within the drum, the power may again be momentarily cut off by the relay 246 so as to prevent further acceleration until balance is re-established.

Under certain circumstances, the out of balance distribution may be so bad that the counterbalancing pockets will fail to effect a balance before one or more of the pockets becomes filled completely. When this occurs, it is desirable to repeat the cycle. Time sensitive mechanism may be employed to effectuate repetition, the same being constituted by a heater resistance 235 acting upon a dished snap action bimetallic element 237, operating two pairs of switch contacts 239 and 241. The resistance 235 and contacts 239 are in circuit with the switch 200, and upon the periodic intermittent flow of current for a sufficient length of time, for example a minute, enough heat is generated in the resistance to operate the heat sensitive element 237 to open contacts 239 and 241. Contacts 241 are in circuit with the motor 33. The drum is thus allowed to slow down to rest, the pockets permitted to spill, and after a second period during which the element 237 cools, and snaps back to normal, the contacts 239 and 241 are again closed. The cycle is thus repeated. During acceleration to the predetermined governor speed, the laundry can redistribute itself and thereafter any unbalance will be counterbalanced by the introduction of proper amounts of balancing fluid in the automatically selected pockets.

Since actually the drive motor is not permitted to drive the drum, except at a speed slightly above the predetermined speed determined by the governor, the motor may be of small horsepower because its sole load is the acceleration of the drum, which may be effected gradually. Practically no energy is wasted shaking or vibrating the apparatus over any substantial period of time. A high rate of acceleration is not required to get the speed of the drum above the critical, quickly to minimize vibrations and the severe amplitude thereof in evidence as a badly balanced drum acceleration through the critical.

After rotating the drum at extracting speed for a sufficient length of time, the power to the motor 33 may be cut off and the drum allowed to decelerate to rest. As the drum decreases speed below that sufficient to hold balancing fluid

against the outer walls of the pockets 104, 106 and 108, the water will drop out of each pocket as it reaches the top position by gravity against the outer surface of the drum wall 46, and will then flow forward over the tapered surface thereof into the splash guard or tub and drain therefrom through the drain outlet 42 through the pump 42, which is the same drainage channel through which wash water, rinse water and extracted water drains after discharge from the ports 43 in the rear of the drum 44.

From the foregoing description, it will appear that an apparatus is provided comprising a counterbalance fluid receiving harness construction which may be easily fabricated and applied to a washing and extractor drum. The elements thereof may be reinforced in any suitable manner as may be required to withstand the degree of centrifugal force to be imposed thereupon. Also, control mechanism is provided so as to render the apparatus particularly applicable to automatic operation of the machine.

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

What is claimed is:

1. In a washing machine, a washing and extracting drum mounted for rotation and having an imperforate outer wall, means for accelerating said drum to an extracting speed, a plurality of radially inwardly open pockets uniformly arranged around and beyond the periphery of said drum, means for centrifugally delivering balancing fluid to one or more of said pockets, comprising radially inwardly open channel annuli, one for each of said pockets and including a fluid connection between each channel and a corresponding pocket, non-rotating means for delivering fluid under pressure selectively into one or more of said annuli, means sensitive to rotational unbalance of said drum and the angular position of the mass creating unbalance for controlling said delivering means, and selecting the annulus or annuli for receiving fluid to compensate for rotational unbalance, and shaft-driven speed-responsive means for rendering said sensitive means inoperative at all rotational speeds below that necessary to cause flow of said fluid under centrifugal force from said annuli to said pockets.

2. In a washing machine, a washing and extracting drum mounted for rotation and having an imperforate outer wall, power means for accelerating said drum to an extracting speed, a plurality of radially inwardly open pockets uniformly arranged around and beyond the periphery of said drum, means for centrifugally delivering balancing fluid to one or more of said pockets, comprising radially inwardly open channel annuli, one for each of said pockets and including a fluid connection between each channel and a corresponding pocket, non-rotating means for delivering fluid under pressure selectively into one or more of said annuli, means sensitive to rotational unbalance of said drum and the angular position of the mass creating unbalance for controlling said delivering means, and selecting the annulus or annuli for receiving

ing balancing fluid to compensate for rotational unbalance, shaft-driven speed responsive means for rendering said last named means effective only above a predetermined speed, and means responsive to vibration due to unbalance for interrupting said power means, said last named means being effective at speeds above said predetermined speed only.

3. In a substantially imperforate washing machine, a washing and extracting drum mounted for rotation, means for rotating said drum at extracting speed, a plurality of counterbalance liquid receiving pockets secured in spaced relation about the outside surface of said drum, each of said pockets being inwardly open and comprising a shallow liquid containing compartment having an outer wall cylindrical with respect to the drum rotation axis and located exteriorly of the drum, said compartment having side walls extending generally radially to said outside surface, one end wall of said compartment being discontinuous, and said outer wall having a portion extending parallel to the drum axis beyond one end of the drum from the region of the end wall discontinuance and thence radially inward adjacent an end of said drum, a complemental member secured to said extending portion to form an axial and radial conduit with said extending portion, and annular inwardly directed channel means secured to the inner end of said radial conduit, said complemental member and extending portion terminating in annular disks, with their outer edges secured together and their inner portions spaced to form an annular inwardly directed channel, said channel being in communication with said radial conduit.

4. In a washing machine having an imperforate washing and centrifuging drum, a liquid counterbalance retaining pocket for mounting on said drum comprising a radially shallow arcuate receptacle having a cylindrical outer wall, and inwardly extending side walls and end walls, one of said end walls having a port adjacent said outer wall, and an axial conduit extending therefrom, said receptacle being mounted on said drum exteriorly thereof, said axial conduit being radially flat and circumferentially wide, and having a radially inwardly directed axially shallow portion, said conduit being formed of a pair of complementary members joined together along the shallow side walls formed thereby, said members terminating in substantially annular disks having inner circular edges coaxial with the axis of said cylindrical wall, and said disks being joined together about their outer peripheral edges, said joined edges being discontinuous at said conduit, and the ends thereof blending with the said joined side walls.

5. In a washing machine, an extracting drum, power means to accelerate and rotate said drum, counterbalance liquid receiving pockets arranged in spaced relation about the drum and open in a radially inward direction, and means responsive to load unbalance to introduce balance liquid into one or more appropriate pockets to counterbalance load unbalance, said means including a vibration responsive device, drum speed responsive means to prevent operation of said load unbalance responsive means at all speeds below a predetermined speed in excess of that essential to centrifugally retain liquid in said pockets, means responsive to vibration to discontinue rotation acceleration of said drum, means responsive to a persistent unbalance vibration over a predetermined period of time to discontinue

operation of said power means and said load unbalance responsive means, for a period of time to provide sufficient deceleration of said drum, to reduce the speed thereof below said predetermined speed and below that required to retain counterbalance liquid centrifugally within said pockets.

6. In a washing machine, an extracting drum, power means to accelerate and rotate said drum, counterbalance liquid receiving pockets arranged in spaced relation about the drum and open in a radially inward direction, and means responsive to load unbalance to introduce balance liquid into one or more appropriate pockets to counterbalance load unbalance, said means including a vibration responsive device, drum speed responsive means responsive solely to the rotation speed of the drum to prevent operation of said load unbalance responsive means at all speeds below a predetermined speed in excess of that essential to centrifugally retain liquid in said pockets, means responsive to vibration to discontinue rotation acceleration of said drum, means responsive to a persistent unbalance vibration over a predetermined period of time to discontinue operation of said power means and said load unbalance responsive means, for a period of time to provide sufficient deceleration of said drum, to reduce the speed thereof below said predetermined speed and below that required to retain counterbalance liquid centrifugally within said pockets, said last named means being adapted to restore operation of said power means after said last named period of time, to initiate a second balancing cycle.

7. In a washing machine, a washing and extracting drum mounted for rotation and having an imperforate outer wall, power means for accelerating said drum to an extracting speed, a plurality of radially inwardly open pockets uniformly arranged around the periphery of said drum, means for centrifugally delivering balancing fluid to one or more of said pockets, comprising radially inwardly open channel annuli, one for each of said pockets and including a fluid connection between each channel and a corresponding pocket, non-rotating means for delivering fluid under pressure selectively into one or more of said annuli, means sensitive to rotational unbalance of said drum and the angular position of the mass creating unbalance for controlling said delivering means, and selecting the annulus or annuli for receiving balancing fluid to compensate for rotational unbalance, shaft-driven speed responsive means for rendering said last named means effective only above a predetermined speed, and means responsive to a continuous predetermined period of unbalance to cut off said power means for a period sufficient to permit said drum to substantially stop rotation, and thereafter restore said power means to repeat the balancing cycle.

8. In a washing machine, a washing and extracting drum mounted for rotation and having an imperforate outer wall, power means for accelerating said drum to an extracting speed, a plurality of radially inwardly open pockets uniformly arranged around the periphery of said drum, means for centrifugally delivering balancing fluid to one or more of said pockets, comprising radially inwardly open channel annuli, one for each of said pockets and including a fluid connection between each channel and a corresponding pocket, non-rotating means for delivering fluid under pressure selectively into one or

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more of said annuli, means sensitive to rotational unbalance of said drum and the angular position of the mass creating unbalance for controlling said delivering means, and selecting the annulus or annuli for receiving balancing fluid to compensate for rotational unbalance, drum shaft speed-responsive means for rendering said sensitive means inoperative at all rotational speeds below that necessary to cause flow of said fluid under centrifugal force from said annuli to said pockets, and means responsive to a continuous predetermined period of unbalance to cut off said power means for a period sufficient to permit said drum to substantially stop rotation, and thereafter restore said power means to repeat the balancing cycle.

9. In a washing machine, a washing and extracting drum mounted for rotation and having an imperforate outer wall, power means for accelerating said drum to an extracting speed, a plurality of radially inwardly open pockets uniformly arranged around the periphery of said drum, means for centrifugally delivering balancing fluid to one or more of said pockets, comprising radially inwardly open channel annuli, one for each of said pockets and including a fluid connection between each channel and a corresponding pocket, non-rotating means for delivering fluid under pressure selectively into one or

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more of said annuli, means sensitive to rotational unbalance of said drum and the angular position of the mass creating unbalance for controlling said delivering means, and selecting the annulus or annuli for receiving balancing fluid to compensate for rotational unbalance, and means responsive to a continuous predetermined period of unbalance to cut off said power means for a period sufficient to permit said drum to substantially stop rotation, and thereafter restore said power means to repeat the balancing cycle.

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