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T. R. SMITH

2,836,046

TUMBLER TYPE WASHING MACHINES

Filed May 8, 1952

3 Sheets-Sheet 1

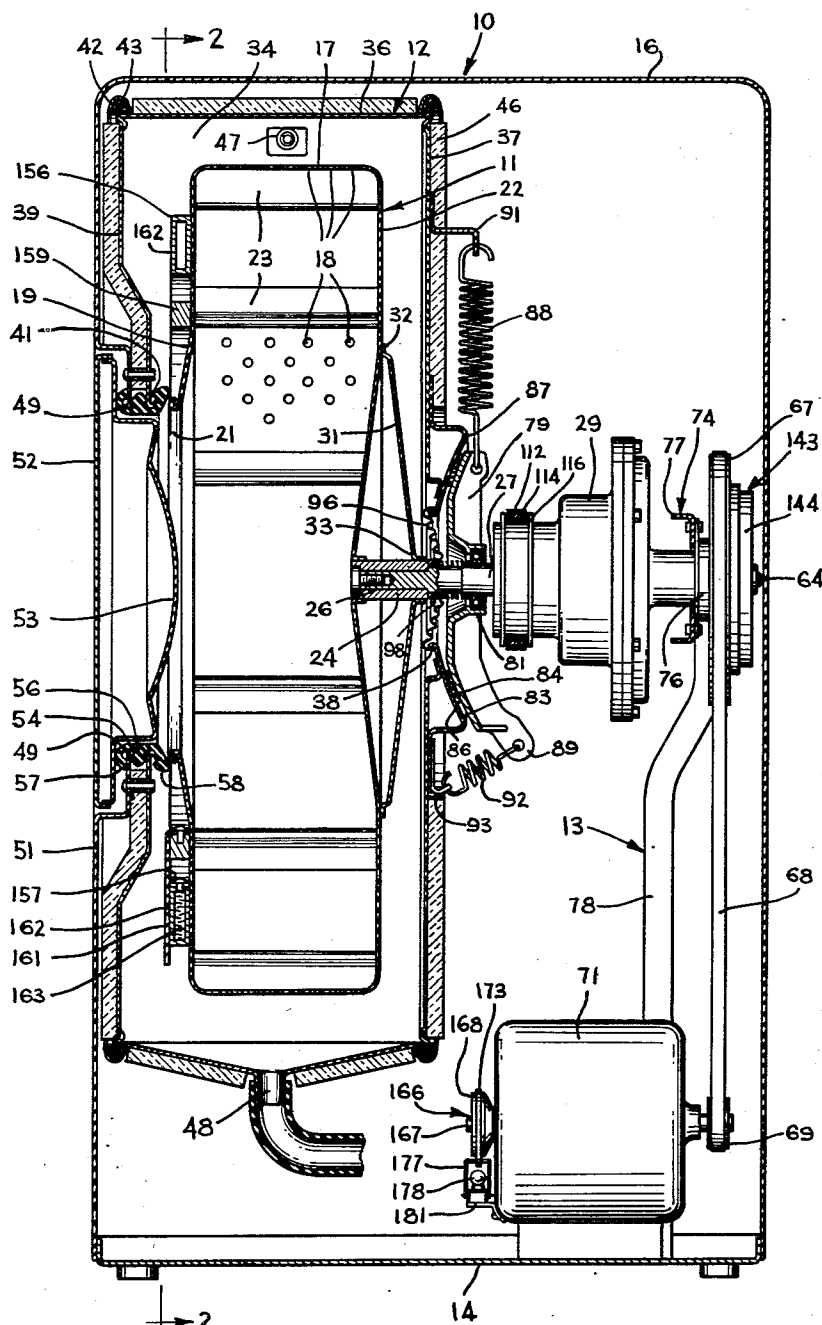


FIG. 1

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3 Sheets-Sheet 2

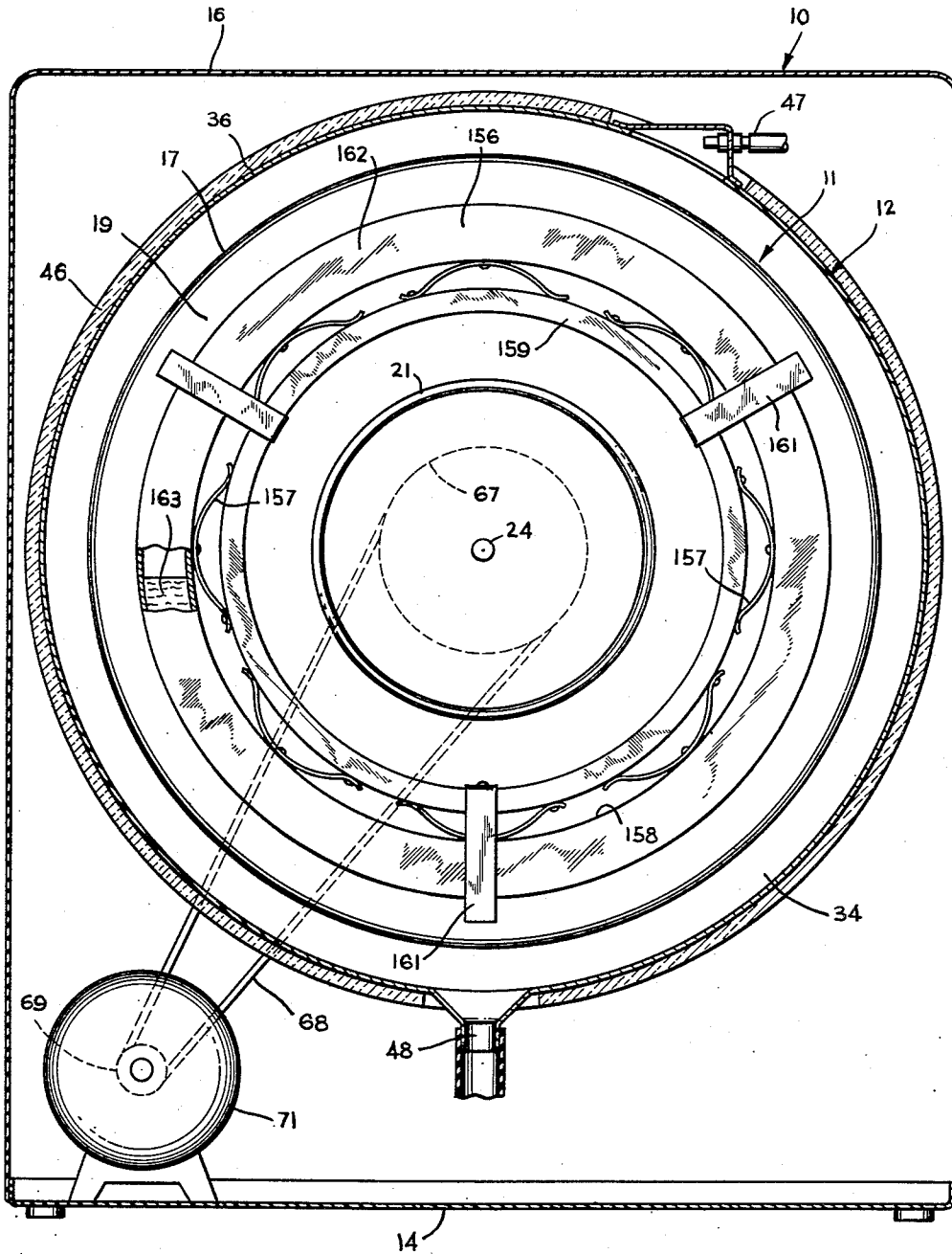


FIG. 2

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2,836,046

TUMBLER TYPE WASHING MACHINES

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5 Claims. (Cl. 68—24)

The invention relates to washing machines and more particularly to clothes washing machines of the tumbler type.

In accordance with the present invention, a tumbler type washing machine has a rotatable drum for receiving the clothing to be treated which is resiliently mounted to rotate about a substantially horizontal axis within a liquid containing chamber. Upon completion of the washing operation, the liquid is removed from the chamber and the tub is accelerated to a relatively high speed through torque limiting mechanism by suitable co-axial gearing to extract the major portion of the liquid from the clothing. Since unequal load distribution is a problem in washing machines of this type, the horizontal drum is resiliently mounted to pivot about a rear bearing through shaft means so that the drum is free to gyrate about its center of mass. In addition, fluid balancing means are mounted on the forward end of the drum which is effective, above the critical speed of the drum, to tend to counterbalance the unequal load distribution of the clothing and to act to return the center of mass of the rotating drum and clothing toward the geometrical center of the drum.

Accordingly, it is an object of the invention to provide a tumbler type washing machine with a resiliently mounted horizontally rotatable drum which is permitted to gyrate about its center of mass during the liquid extraction operation.

It is another object of the invention to provide a resiliently mounted horizontally rotatable drum with a confined liquid balancing means for counteracting unbalanced load distribution during the extraction operation.

It is yet another object of the invention to provide a pivotally mounted horizontally rotatable drum with dampening means for reducing the amplitude of gyration of the drum when rotated at relatively high speeds.

It is still another object of the invention to provide a horizontally rotatable drum for a washing machine with gear reduction mechanism which is mounted concentric to the axis of rotation of the drum.

It is another object of the invention to mount a horizontally rotatable clothes receiving drum on a coaxial shaft having concentric speed reduction mechanism thereon for rotating the drum at variable speeds which is pivotally mounted to permit the drum to gyrate about its horizontal axis.

It is still another object of the invention to provide a tumbler type washing machine with a pivotally mounted horizontally rotatable drum which has a concentric drive shaft having variable speed reduction mechanism secured thereto with mechanism for limiting or controlling the torque transmitted to the drum during the acceleration of the same.

It is another object of the invention to provide a tumbler type washing machine with a horizontally rotatable drum which is resiliently mounted to rotate about its center of mass and is restrained by dampening means and

counterbalanced by a confined liquid carried on the forward portion of the drum.

It is yet another object of the invention to provide a pivotally and resiliently mounted generally horizontally rotatable clothes receiving drum with a container having a confined balancing liquid therein, both of which are laterally shiftable to move the center of mass of the rotating drum toward the geometrical center of the same when it is rotated at relatively high speeds.

It is still another object of the invention to provide a tumbler type clothes washing machine with a relatively simple construction which will permit substantially vibrationless operation without the necessity of special bolting or rigid holding means.

It is yet another object of the invention to provide a tumbler type clothes washing machine which is rotated at a low washing speed and a high extraction speed with a condition responsive device which prevents actuation of the mechanism for rotating the drum at its extraction speed until the drum has substantially attained its washing speed.

It is still another object of the invention to provide a resiliently mounted horizontally rotatable drum with a balancing ring which is laterally shiftable with respect to the drum above its critical speed to shift the center of mass of the rotating drum toward the geometrical center of the same.

It is another object of the invention to provide a tumbler type washing machine with a generally horizontally rotatable drum which is relatively large in diameter and relatively narrow in width.

It is yet another object of the invention to provide a pivotally and resiliently mounted horizontally rotatable drum which has resilient centering means for holding the drum in a generally horizontal position and dampening means for opposing lateral forces tending to shift the drum from the horizontal.

Other objects, features, capabilities and advantages are comprehended by the invention, as will later appear and as are inherently possessed thereby.

Referring to the drawings:

Figure 1 is a diagrammatic longitudinal vertical partial sectional view of the improved tumbler type washing machine showing the improved drive and supporting construction;

Figure 2 is a transverse vertical sectional view taken generally on the line 2—2 of Figure 1 and showing the improved balancing means;

Figure 3 is an enlarged longitudinal vertical sectional view of the change speed gear mechanism shown in elevation in Figure 1;

Figure 4 is a transverse vertical sectional view taken generally on lines 4—4 of Figure 3 showing a braking means for the gear housing and a speed responsive control means for the braking means; and,

Figure 5 is a transverse vertical sectional view taken along the line 5—5 of Figure 3 and showing a centrifugally operated braking means for the rotatable drum.

Referring now to the drawings for a detailed description of the improved tumbler type clothes washing machine, there is indicated at 10 a clothes washing machine comprising a generally horizontally rotatable drum or tumbler 11 encompassed by a substantially imperforate stationary liquid holding casing or container 12, both of which may be supported through suitable structure 13, part of which is not shown, on a base construction 14, and the entire mechanism is enclosed by a suitable cover or cabinet 16 to present a pleasing appearance.

The rotatable drum includes an outer cylindrical wall 17 provided with a plurality of perforations or openings 18 through which the cleaning liquid flows during the washing and extraction operations, a substantially vertical front

wall 19, having a centrally located access opening 21 therein and an imperforate rear wall 22 which is substantially parallel with the front wall 19. A plurality of spaced clothes elevating vanes 23 are secured adjacent the inner periphery of the perforate cylindrical wall 17 to provide the means for elevating the clothing from the bottom of the drum to adjacent the top thereof during the washing operation, whereby they fall toward the bottom of the drum in a tumbling manner.

As more clearly shown in Figure 1, the diameter of the cylindrical wall 17 is relatively large with respect to its depth and the front and rear walls 19 and 22, respectively, cooperate with the outer cylindrical wall to provide a clothes treating drum which is relatively narrow. In the embodiment shown, the diameter of the drum is slightly greater than four times its axial depth. It can be seen that with a construction of this type, the clothing is elevated to a considerably greater height when compared to other domestic horizontal axis tumbler type washing machines, and, since gravity acts on the clothing for a greater distance, the increased velocity of the falling wet clothing increases its agitation upon striking the bottom of the tub and this results in a considerably better washing action in a given length of time. While the diameter of the drum is increased considerably, the depth has been reduced and the surrounding liquid holding container 12 need not contain an excessive quantity of liquid during the washing and rinsing operations.

Concentric with the axis of the rotatable drum is a splined boss or hub 24 for receiving the forward splined end 26 of a rotatable generally horizontal supporting drum shaft 27, which projects backwardly through an opening in the rear wall of the container 12 and terminates in a rearwardly projecting end 28 journaled in a speed change or gear housing 29 in a manner to be hereinafter more fully described.

In order to provide a rigid connection between the drum shaft 27 and the drum 11, so that both elements must move together, the rear wall 22 of the drum is preferably dished forwardly about the central hub 24 and a backwardly projecting frusto-conical disc shaped web 31 has its outer periphery 32 welded to the outer face of the rear wall 22 and its central backwardly projecting portion 33 secured to the hub 24 to provide a box structure.

The casing 12 surrounding the rotatable drum 11 and defining the washing or treating chamber 34 includes an outer substantially imperforate horizontal cylindrical wall 36 spaced from the cylindrical wall 17 of the drum, a rear end wall 37, having a centrally located opening 38 therein through which the drum shaft 27 projects, and a front end wall 39 having a centrally located access opening 41 therein in alignment with the access opening 21 in the rotatable drum 11. The rear, front and cylindrical walls 37, 39 and 36, respectively, are all secured together at their marginal edges to provide a leak proof and rigid unit. In the example shown, the opposite edges of the cylindrical wall 36 are flared radially outwardly and mate with similar flange portions on the end walls, and the entire assembly is clamped together through suitable gasket material 42 covering the ends of the flanges by means of V-shaped circular clamping channels 43. The container 12 is secured on the base construction 14 by any suitable supporting means, not shown. In addition, under some conditions, it may be desirable to entirely or partially insulate the container to conserve the heat in the washing liquid by lagging its exterior walls with suitable heat insulating material 46.

In addition to the access opening in the container, liquid supply means 47 for directing treating liquid into the chamber for the washing and rinsing operations is provided, which in turn is connected to any suitable supply of hot and cold water under control of suitable valve means, not shown. Also, the lowermost portion of the cylindrical wall 36 has an outlet or drain opening 48 therein which may be connected to any suitable valve and pump

means (not shown) to either retain the liquid in the chamber 34 during the washing and rinsing operations or to discharge the washing liquid to drain, as desired. It is to be understood that, should a suitable drain be positioned below the outlet 48 in the container, a pump would not be necessary. Since the foregoing forms no essential part of the invention, further description is not deemed necessary.

The cabinet 16 is provided with the usual access opening 49 in its front wall 51 in alignment with the respective access openings 41 and 21 in the container and drum through which the clothing to be washed is inserted and removed. The cabinet also carries a double walled door or closure 52 which is hinged thereto and is adapted to either open or close the opening 49. The door also includes an inwardly dished inner wall 53 for generally restricting the access opening 21 in the rotatable drum to deflect any falling clothing tending to pass through the opening back into the interior of the drum.

Due to the fact some of the falling liquid may be discharged through the openings 41 and 49 in the container and cabinet and soil the surrounding area, a rubber gasket 54 is positioned about both access openings and it has an enlarged central section 56 mounted between their inner and outer faces, respectively, to prevent leakage therebetween. The gasket further includes a forwardly projecting sealing portion 57 for contacting the inner door panel 53 to seal about the opening 49 and an annular rearwardly directed and outwardly flaring portion 58 which provides a deflector.

Referring now to the supporting and rotating means for the rotatable drum 11, the rearwardly projecting end 28 of the horizontal drum shaft 27 terminates and is journaled in the co-axial gear housing construction 29 which houses a two speed planetary gear arrangement 59 for selectively rotating the shaft 27 at a low or a high speed. The end 28 of the shaft is journaled in a bearing 61 and is recessed to journal therein the forward end 62 of a substantially constant speed horizontal driving shaft 63. The opposite or rearmost end 64 of the driving shaft projects through a pivotal or universally mounted combined radial and thrust roller bearing 66 and has a driven pulley 67 splined thereto. This pulley is driven by means of a belt 68 which in turn engages a driving pulley 69 secured on the drive shaft of a suitable constant speed drive motor 71 mounted on the base 14. The motor may also be utilized to drive additional mechanism, such as, for example, a pump or the like, if desired.

The driving shaft 63 extending through the pivot bearing 66 is free to tilt or pivot at this point, since the outer race of the bearing is carried in a collar or sleeve 72 mounted in a rubber bushing 73 that in turn is held in position with respect to a rigid supporting frame construction 74 by means of a flanged outer sleeve 76. The frame construction includes a horizontal channel 77 extending transverse to the shaft and drum axis and a pair of downwardly extending angles 78 whose lower ends are secured to the base frame 14. This provides a rigid construction which prevents the pivotal end of the driving shaft from shifting laterally about its axis, and suitable ties, not shown, may be provided between the supporting frame 74 and container 12 to prevent relative axial shifting movement of the rotatable drum 11.

Forwardly of the planetary gear housing 29 and surrounding the drum shaft 27 is a combination movable or resiliently mounted bearing support and damper housing 79 which is adapted to resiliently hold the rotatable drum 11 in a generally horizontal position. In the embodiment shown, the inner race of a radial ball type bearing 81 is slidably mounted on the drum shaft and the outer race is carried and secured within a recess 82 provided in the damper housing 79; thus with any lateral or shifting movement of the drum shaft 27, the bearing and housing must move with it.

The forward face 83 of the damper housing 79 is

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spherical on a radius substantially equal to the distance between the pivot point of the fixed bearing 66 and the rear wall 37 of the container 12, and suitable friction material 84 is secured thereon. This friction material in turn is adapted to frictionally engage a similarly concave spherical contact surface 86 provided on an annular stamped bracket 87 welded on the back wall 37 of the container about the opening 38 concentric to the normal axis of rotation of the drum.

In order to resiliently maintain the rotatable drum 11 substantially centered in its horizontal position during the washing operation, four equally spaced radially projecting centering springs 88, only one of which is shown, have their inner ends attached to spaced webs 89, forming part of the damper housing, and their outer ends connected to stationary brackets 91 secured to the back wall 37 of the stationary container. The upper centering spring 88 preferably has a higher spring loading than the others and acts as a counterbalance to equalize the weight of the rotatable drum and average load of clothing, and thus compensate for the natural tendency of the tub to tilt or tip downwardly at the forward end.

In addition, the damper housing 79 is biased forwardly in the direction of the spherical seat 86 by means of a plurality of tension springs 92, only one being shown, which are also secured to the webs 89 and to brackets 93 on the rear wall of the container. These springs act to maintain a substantially constant pressure between the surface 86 and the friction material 84 on the damper housing to thereby resist and dampen lateral movement of the tub when it is rotated about its axis during the washing operation, and about its center of mass during the extraction operation.

In order to prevent leakage of liquid through the opening 38 in the rear wall 37 of the stationary container, an encompassing C-shaped annular bead 94 is provided in the rear wall and a resilient bellows type sealing element 96 having an integral annular outer enlarged marginal portion is carried within the bead to provide a liquid type seal thereat. The inner central portion of the bellows 96 terminates in an enlarged collar 97 encompassing the drum shaft 27 and it carries thereon a forwardly projecting annular sealing ring 98 which is adapted to contact the rear radial face of the supporting hub 24 for the rotatable drum. A compression type spring 99 encompassing the drum shaft reacts between the inner race of the bearing 81 carried by the damper housing and the rear face of the bellows to maintain the sealing ring 98 in contact with the hub 24 under all conditions of operation.

Referring now more particularly to the change speed mechanism 59, as shown in Figure 3, it can be seen that the rotatable drum 11, drum shaft 27, planetary gear arrangement 59, driving shaft 63 and driven pulley 67 are coaxially aligned and are all rotatable about a horizontal axis by means of the motor 71. The housing 29 surrounding the concentric shafts and planetary gear arrangement 59 also encloses a concentric constant torque limiting clutch 101.

The planetary gearing includes a sun gear 102 secured to the driving shaft 63 which, in the embodiment shown, meshes with a pair of oppositely disposed relatively large planet gears 103 to provide for a gear reduction. These planet gears in turn are each secured to a mating hub or sleeve having a pinion gear 106 formed thereon to form a planet gear unit, and the unit is journaled on stub shafts 107 projecting from a planet carrier 108. The planet carrier has an integral hub portion 109 keyed or otherwise secured to the inner end 23 of the drum shaft 27 to either rotate the shaft or to be rotated by it. The pinion portion 106 of the planet gears 103 meshes with an orbit or ring gear 111 formed as part of the housing 29.

In order to control the speed of rotation of the drum shaft 27, the housing 29 is provided with a brake mechanism 112 diagrammatically shown in Figures 3 and 4. This brake mechanism includes a brake band 113 carry-

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ing suitable friction material 114 thereon encompassing a slightly relatively rotatable or shiftable brake drum 116 which abuts a thrust washer 117 to limit axial shifting movement in a forward direction. The brake band 113 has one end 118 anchored to a stationary abutment 119, see Figure 4, and the other end 120 movable by means of an electrically operated solenoid 121 to either expand or release the brake 112 to permit the housing 29 to rotate, or be acted upon by means of a spring 122 to contract the brake to engage the brake drum 116 to prevent rotation of the housing. In addition, the edges of the brake band 113 are guided by the thrust washer 117 and a radial shoulder 123 on the opposite side of the brake drum 116.

When the brake is released and the housing is rotating, the torque from the rotating housing is transferred to the drum shaft 27 by means of the constant torque limiting clutch 101 which includes a series of friction discs 124 carried in a recessed portion 125 of the housing, with alternate discs slotted to engage splines 126 in the interior of the housing and the others slotted to engage mating splines 127 on the drum shaft 27. The torque transmitted through the friction discs 124 is limited or controlled in a manner to be hereinafter described.

Assuming the drum 11 is to be rotated for the washing operation, the solenoid 121 is deenergized and the spring 122 applies the brake 112 and the housing 29 is held against rotary movement. As the driving shaft 63 is rotated by the motor, the sun gear 102 rotates the planet gears 103 and since the housing 29 and thus the orbit gear 111 is locked against rotary movement, the planet pinions rotate within the stationary orbit gear and this, of course, rotates the planet carrier 108 at a reduced speed. Due to the fact that the drum shaft 27 is directly keyed to the planet carrier 108, they must rotate in unison and the drum is rotated about its horizontal axis at a reduced speed. Under this condition of operation the friction discs 124 are spaced slightly from each other, therefore, no or very little torque or energy is absorbed at this point.

When it is desired to rotate the drum at high of extraction speed at the end of the slow or washing speed operation, the brake 112 is released by energizing the solenoid 121. Upon release of the brake, the brake drum 116, which has a plurality of integral equally spaced radially inwardly and then backwardly projecting lugs 128 thereon extending through mating slots 129 in the forward open end of the housing 29, is rotated slightly relative to the housing by means of a plurality of spaced compression type springs 131 carried in pockets provided by the lugs 128. These springs react between abutment surfaces 132 on the housing and brake drum to rotate or shift the brake drum 116 in a counterclockwise direction with respect to the housing 29, as viewed in Figure 4.

A portion of each of the rearwardly projecting lugs 128 terminate in an inner end or cam follower 133 for engaging mating cam surfaces 134 provided on an axially shiftable force transmitting ring or collar 136 whose opposite face engages the forward friction disc 124. The counterclockwise rotation of the brake drum by the springs 131 forces the cam followers 133 against the cams 134 to apply an axial compression loading on the friction discs. Since the springs 131 are preloaded, the axial force transmitted to the friction discs is constant, therefore the torque transmitted from the rotating housing 29 through the discs 124 to the drum shaft 27 will be a function of the spring loading. Thus, should the load on the drum shaft tend to exceed the proportional force applied by the springs 131, the mating discs merely permit slippage with respect to each other. The loading of the springs 131 will depend upon the capacity of the drive motor 71 and should be at some value below its safe rating.

As previously mentioned, when the brake is released and the springs 131 act to apply a constant load to the

friction discs 124, the housing 29 is free to rotate about its axis. Since the inertia of the drum is large with respect to the housing, the housing will begin to rotate because the planet pinions 106 will drive the orbit or ring gear at a higher speed than the planet carrier 108 will rotate. This increased speed is applied to the friction discs 124 and of course acts directly on the drum shaft to increase its speed. Since the spring loading on the discs is constant, the accelerating torque transmitted to the drum shaft is constant, thus the drive motor 71 cannot be overloaded. As the drum shaft 27 increases in speed and finally attains that of the housing 29, the drum shaft 27, housing 29 and planetary gear arrangement 59 will all rotate in unison at the same speed as the driving shaft 63. An important feature with this arrangement is that substantially the entire drive mechanism is carried on the drum axis and is effective to increase the mass of the rotating drum to provide for improved operation.

In order to limit the axial end thrust of the drum shaft 27 in the forward direction, a thrust washer 137 is carried between the planet carrier 108 and a portion of the housing at the bearing 61, and a second thrust washer 138 between the opposed ends of the drum shaft 27 and sun gear 102, limits axial thrust in the rearward direction. The housing 29 is held in axial alignment by means of a thrust washer 139 acting on the opposite face of the sun gear 102 and a second thrust washer 141 disposed between the rear end of the housing and the forward portion of the supporting collar for the inner race of the rear pivot bearing 66. Between the hub of the driven pulley 67 and the inner race of the pivot bearing 66 is another thrust washer 142 which limits the forward axial movement of the driving shaft, its rearward movement being limited by the thrust washer 139 at the rear face of the sun gear 102.

At the end of the extraction operation, the solenoid 121 is deenergized and the spring bias or loading on the brake band 113 causes it to engage the brake drum 116 and rotatably shift the same slightly relative to the housing 29 which acts to stop the rotation of the housing. This shifting movement compresses the springs 131 and withdraws the lugs 133 from contact with the cams 134 to release the axial pressure on the friction discs 124 and thereby disconnect the drum shaft from the housing.

As the housing is disconnected from the drum shaft 27 and the brake mechanism 112 acts to stop the housing, it can be seen that the orbit gear 111 begins to stop rotating also. Since the inertia of the drum is relatively high with respect to the driving mechanism when operating at its extraction speed, the drum now drives the drum shaft and it in effect becomes the driving means. Due to the speed reduction between the driving shaft 63 and drum shaft 27, and with the drum shaft rotating at high speed, the driving shaft 63 in effect becomes the driven shaft and the speed reduction mechanism becomes a speed increasing mechanism which may result in driving the driving shaft 63, pulley 67 and drive motor 71 at an excessively high speed.

Therefore, in order to obviate this situation and to provide an effective means for braking and decelerating the drum, there is shown, by way of example, a centrifugally operated brake or clutch mechanism 143 which includes a stationary brake drum 144 journaled on an extension 145 of the hub of the driven pulley 67 and a pair of centrifugally operated weights or clutch shoes 146 pivotally mounted by means of stub shafts 147 secured on the radial web of the driven pulley 67. Preloaded spring means 148 disposed adjacent the free ends of the clutch shoes normally hold the same in its retracted position against their respective stops 149, and the outer surface of each clutch shoe is provided with suitable friction material 151 adapted to engage the inner periphery of the brake drum 144.

Under operating conditions when the driven pulley 67

and the driving shaft 63 are rotated at their normal speed during the washing and extraction operations, the loading of the spring means 148 is great enough to hold the clutch shoes 146 against their respective stops 149 while being rotated. However, at the end of the extraction, when the driving shaft 63 is accelerated above its normal speed by the reverse driving of the drum shaft, centrifugal force acting on the weighted clutch shoes 146 overcomes the restraining force of the spring means 148 and they move outwardly to engage the stationary brake drum 144 to absorb the energy and decelerate the rotating drum at a relatively rapid rate. As soon as the driving shaft 63 reaches a value substantially near its normal operating speed, the spring means 148 acting on the brake shoes overcomes centrifugal force and retracts the shoes away from the drum 144 and moves them back to their inactive positions against the stops 149. This action would take place at some speed approximating the drum speed during the washing operation, after which the drum will quickly come to rest due to the internal friction and other forces in the system.

In order to permit the shaft 63 to freely pivot about its pivot bearing 66 without restraint, the brake drum 144 is held against rotary motion by means of oppositely disposed flexible cables 152 which have ends secured to lugs 153 formed on the outer surface of the brake drum and their opposite ends anchored to a portion of the supporting frame construction 13 (not shown). These cables are, of course, positioned so that during the braking operation the brake drum forces are such as to hold them in tension.

From the foregoing it can be seen that when the drive shaft 63 is rotated above its normal speed, the centrifugally operated weights are operative to move the friction material 151 on the brake shoes 146 into engagement with the drum 144 to brake the same, and that while this braking action is taking place the flexible cables 152 permit the brake mechanism to move with the shaft without applying eccentric loadings thereto or other distorting influences on the rotating mechanism.

While the foregoing described mechanism will rotate the drum 11 at low and high speeds and means are provided to resiliently hold the drum substantially central with respect to its horizontal axis, under most conditions when liquid is being extracted from the clothing, the clothing is not uniformly distributed about the interior of the drum. This unequal distribution of clothing causes the center of mass of the rotating drum to shift with respect to the geometrical center of the drum which may result in rough operation and, if the unbalance is great, damage to the machine may result.

Accordingly, therefore, supplemental means are provided for counteracting the unbalance condition caused by the unequal distribution of the clothing during the extraction operation. In the disclosed embodiment, there is shown an annular hollow balancing ring or chamber 156 which is mounted on the forward face of the vertical front wall 19 of the rotatable drum 11 and its outside diameter is preferably less than the outside diameter of the drum. The ring 156 may be resiliently centered in position about the geometrical axis of the drum by means of a plurality of bent leaf type springs 157 having portions in contact with the inner periphery 158 of the ring and against an inner concentric annular rigid ring 159 secured to the front wall of the drum and surrounding the access opening. In addition, a plurality of spaced radially projecting retaining members or dampener strips 161 carried by the ring 158 are adapted to engage the front wall 162 of the annular ring 156 and resiliently hold the same against the front wall of the drum and provide a dampening action for the ring 156 should it move laterally relative to the drum during the extraction operation.

Confined within the hollow balancing ring 156 is a balancing liquid 163 of any suitable type and, by way of example, comprises a mixture of acetylene tetrabromide, which has a relatively high specific gravity, and a suitable thickener to increase its viscosity to such degree as to prevent surging of the liquid and allow substantially even distribution within the ring when the drum is rotated at low speeds during the washing operations and below the critical speed of the rotatable drum when it is being accelerated. However, when the rotating drum 11 exceeds its designed critical speed with an unbalanced load of clothing therein, the rotation of the drum will shift from its geometrical axis and rotate about its axis of mass. This shifting results in the confined liquid 163 moving within the chamber to a point diametrically opposite the unbalanced load and which eccentric loading by the liquid tends to shift the center of mass in the direction of the geometrical center of the drum. Should, however, the unbalanced loading be great, as is more likely the case with horizontally rotatable drums, the shifting of the liquid will not be sufficient; therefore, as the liquid shifts, the loading on the balancing ring 156 increases at that side which in turn causes the entire ring to move laterally in the same direction against the compression of the opposite centering springs 157. This action results in a still greater counterbalancing force for the unbalanced load and in practically all instances will provide a force sufficient to balance the load. Should the lateral movement of the balancing ring be excessive or over travel, the balancing liquid will automatically redistribute an amount sufficient to maintain the proper balance in the system.

The rigid ring 159 carrying the springs 157 also acts as a stop to limit the lateral outward eccentric movement of the shiftable balancing ring 156 in any one direction by direct contact with its inner periphery 158. The resilient retaining strips 161 holding the shiftable balancing ring 156 in position against axial movement also provides a dampening means to prevent or restrict any tendency for the ring to hunt or oscillate in a lateral direction while the drum is being rotated.

Upon completion of the extraction operation and when the drum speed drops to a sufficiently low value, the centering springs 157 will overcome centrifugal force and the restraining action of the strips 161 and automatically shift the balancing ring back to its normal concentric position about the geometrical axis of the drum.

While a single means for centering the hollow balancing ring 156 has been disclosed, it is to be understood that other constructions for performing the same function may be provided as long as they act to effectively maintain the center of mass of the rotatable drum relatively close to the geometrical center of the drum during the extraction operation. Also, under some installations wherein the contemplated unbalance of the rotatable drum may not be excessive it is possible to provide for adequate balancing by substituting a solid laterally shiftable balancing ring for the hollow balancing ring and liquid.

In the operation of a horizontal tumbler type washing machine incorporating the features of the present invention, the operator opens the closure 52 carried by the cabinet 16 and inserts the clothing to be washed into the interior of the rotatable drum 11 through the aligned access openings 21, 41 and 44, at which time the proper quantity of detergent may also be included and the closure is then sealed by latching it tightly against the sealing gasket 57.

Next the operator manipulates suitable automatically operated control mechanism (not shown) to cause the proper quantity of washing liquid at the proper temperature to be conducted by the liquid supply means 47 to the imperforate container 12. In addition, the duration of the washing cycle is preferably set at the same time and the motor 71 for rotating the drum 11 at a low washing speed is also energized. Upon energization of the mo-

tor, the driving shaft 63 is rotated at a reduced speed by the driven pulley 67 and the sun gear 102 rotates the drum shaft 27 at a reduced speed through the planet carrier 108 because the gear housing 29 carrying the ring or orbit gear 111 is braked or locked against rotary movement.

With the rotating mechanism at rest, the springs 131 reacting between their abutments 132 apply a force to connect the constant torque clutch 101 to the drum shaft 27. As the sun gear begins to rotate the housing will also rotate a slight amount which in turn compresses the springs 131 and shifts the cam surfaces 134 on the shiftable member 136 away from the abutments 133. When this slight shift occurs, the loading is removed from the friction discs 124 and the brake is free to hold the housing stationary without any loss of energy through the torque limiting clutch.

As the drum rotates, the clothing being washed is agitated in the washing liquid by means of the elevating vanes 23 lifting the clothing toward the top of the relatively narrow and large diameter drum and as the clothing approaches the upper portion of the drum it drops to the bottom thereof into the washing liquid in a tumbling manner. Since the distance the clothing falls is relatively great, the velocity of the clothing is considerably higher when compared with ordinary domestic tumbler type washing machines; therefore, a more effective cleaning operation is provided within a given length of time. The centering springs 38 and counterbalance, along with the damper springs 92, tend to maintain the drum in a substantially horizontal position during the washing operation by holding the movable forward bearing 81 relatively stationary.

At the end of the washing operation, the cleaning liquid is withdrawn from the container 12 through the outlet opening 48, the brake mechanism 112 is released by energizing the solenoid 121 and the planetary gear housing 29 is free to rotate. As the housing rotates the brake drum is shifted by the springs 131 to load the friction discs 124 to a constant value and the torque is transmitted to the drum shaft 27 through the constant torque disc clutch 101 to accelerate the drum to a high speed. This constant torque clutch is designed to limit the load on the motor to a value less than its rated capacity. As the drum is accelerated and exceeds its critical speed and with an uneven distribution of clothing therein, the drum pivoting about its pivot bearing 66 will shift and rotate about its center of mass rather than the geometrical center of the drum. This gyration is resisted to a degree by the centering springs 38 and the dampener mechanism 79; however, this is not normally sufficient to provide for smooth, relatively vibrationless, operation.

As the drum exceeds its critical speed, the confined balancing liquid 163 in the annular balancing ring 156 shifts and redistributes itself so a major portion is opposite to the unbalance load. This action causes the center of mass to shift or move toward the geometrical center of the drum to help balance the load. However, should this not be sufficient, the resiliently mounted balancing ring 156 also shifts laterally against the centering springs 157 to apply a still greater counterbalancing force to shift the center of the mass still further toward the geometrical center of the tub, and this latter movement is usually sufficient to provide substantially vibrationless operation during the liquid extraction operation. When the drum attains its full high operating or extracting speed, the driving shaft 63, planet gearing 59, planetary gear housing 29 and drum shaft 27 all are rotated about the substantially horizontal axis in unison.

After a predetermined length of time of operation at the extraction speed, the solenoid 121 is de-energized and the spring 122 applies the brake 112 to the gear housing 29 to stop the same and at the same time shift the rotatable brake drum 116 to remove the pressure on the constant torque friction disc clutch 101. As the housing

begins to stop or slow down the drum drives the driving shaft 63 through the planetary gearing 59 at an increased speed. This increased speed of the driving shaft results in the actuation of the centrifugally operated brake shoes 146 which frictionally engage the brake drum 144 to decelerate the drum at a relatively rapid rate. As the decelerating drum approaches its washing speed, the speed of the driving shaft reaches a value where the spring means 148 retract the brake shoes 146 to their disengaged position against their stops 149 to free the drum from interference for continued operation. When the drum approaches its washing speed, rinsing liquid is admitted to the container through the liquid supply means 47 for the agitate rinse portion of the washing cycle.

After a predetermined length of time, determined by the control mechanism, the rinsing liquid is withdrawn from the container through the outlet opening 48 therein and the drum is again accelerated to extract the liquid from the clothing in the aforescribed manner.

At the end of the final extraction operation, the motor is deenergized and the brake 143 is applied as described above to decelerate the drum, whereupon the operator need but open the closure and remove the clothing which has been both cleaned, rinsed and centrifuged.

In a device of the type herein described, the tumbling or washing speed of the drum is approximately 33 R. P. M. and the extraction speed is approximately 600 R. P. M.

While the above described apparatus is sufficient for a normal washing cycle, there are times when the operator may wish to eliminate the washing and/or tumbling rinse operations and will move the control mechanism directly to the extraction portion of the cycle. Should this occur when the drum is at rest, the brake 112 would be released upon energization of the solenoid 121 and the torque limiting clutch 101 may not initially transmit enough torque to start the drum with the clothes therein, especially when wet, with the result the drum and clothes would remain stationary during this period.

Accordingly, to obviate this problem if it arises, a condition responsive control mechanism 166 is provided which in the disclosed modification is mounted on the shaft 167 of the drive motor 71. For the purpose of illustration, the control mechanism includes a rotatable cage 168, having a plurality of radially outwardly opening pockets 169, rigidly secured to the shaft 167 in any suitable manner. Each pocket 169 has a relatively light centrifugally operated weight 171 therein shaped to loosely fit and be guided by the pocket. The outer end of each weight is rounded and adapted to contact the inner periphery 172 of a surrounding annular ring 173 to rotate or shift the same by sliding contact when the motor is rotating above a predetermined speed. The annular ring has a downwardly projecting integral arm 174 which abuts an upwardly projecting arm 176 of a pivotable switch carrying bracket 177. This bracket has mounted thereon a switch, such as, for example, a mercury switch 178 which is adapted to normally lie in a horizontal position under the influence of gravity, as shown, or to be tilted upwardly about an offset pivot 179 to bridge the contacts therein to complete the circuit to the solenoid 121 of the brake mechanism 112. The pivot 179 for the switch bracket 177 is mounted on a suitable base or support 181 which in turn is secured to the stationary portion of the motor housing or to any other suitable stationary structure. In addition, a portion of the switch bracket 177 is adapted to contact an abutment 182 on the support 181 to limit the upward movement of the switch about the pivot 179. The leads 183 from the switch 178 form part of the brake solenoid circuit and it is obvious that the solenoid can only be energized while the switch is in its upwardly tilted position.

Assuming the drum 11 is at rest with a load of clothing therein and the operator advances the control mechanism to the extraction position, the contacts to energize the

solenoid 121 to release the brake are conditioned for operation to carry out the extraction portion of the cycle; however, the solenoid remains de-energized because the tiltable switch 178 has not been actuated. However, the drive motor 71 is energized and begins to rotate, and in doing so rotates the drum at a low speed through the planet carrier 108 and begins to tumble the clothing. As the drum approaches its normal tumbling speed, the motor approaches its normal rotating speed also. At some speed below this, centrifugal force acting on the relatively light weights 171 increases the frictional contact or pressure on the annular ring 173 and causes the same to rotate, which in turn overcomes the gravitational pull or resistance of the combined switch and bracket. As the arm raises the bracket about its pivot to a predetermined angle, the mercury in the switch completes the circuit to the solenoid and energizes the same to release the brake 112 and permit the drum to be accelerated to its normal extraction speed through the torque limiting clutch 101. Upon the de-energization and/or deceleration of the motor, gravity acting on the switch causes the same to overcome the turning movement of the weights and it drops back to its normal position wherein the solenoid circuit is opened.

It is to be understood that the above description is given by way of example and that other forms of speed or condition responsive switches may be utilized whose prime purpose is to prevent release of the brake means, if required, until the drum is being rotated at a speed sufficiently high to insure its proper acceleration to the extraction speeds.

From the foregoing, it can be seen that a horizontally mounted tumbler type clothes washing machine having a rotatable drum has been provided which is resiliently mounted to rotate about a single stationary pivot, is normally held in a horizontal position by centering means but is free to gyrate about its pivot. Also, that a means has been provided for both dampening the magnitude of the gyration of the drum and balancing of the load by means of a confined shiftable viscous liquid within a resiliently mounted chamber carried on the outer portion of the drum and the drum is resiliently mounted to absorb and prevent vibrations from being transmitted to the supporting structure.

In addition, a change speed mechanism has been provided about the horizontal axis of the drum shaft which is effective to drive the drum shaft at either a low washing speed or a high extraction speed and to increase the rotating mass during this time. Also, a constant torque limiting clutch is disposed between the drum shaft and the driving shaft which acts to limit the torque transmitted to the drum shaft during the acceleration period at the beginning of the extraction operation, and a centrifugally operated braking mechanism for decelerating the drum at the end of the extraction operation is provided between the drive shaft and supporting frame construction.

While I have herein described and upon the drawings shown an illustrative embodiment of the invention, it is to be understood that the invention is not limited thereto, but may comprehend other constructions, arrangements of parts, details and features without departing from the spirit of the invention.

It is claimed:

1. In a tumbler type washing machine, the combination of a substantially horizontally rotatable drum having a rear wall and a front wall with an access opening therein, concentric shaft means secured to said rear wall for rotating said drum about its axis at a low washing speed and a relatively high extraction speed, a spaced pivot bearing for said shaft means, a resiliently mounted bearing disposed between said pivot bearing and the rear wall of said drum to permit said drum to gyrate on said pivot bearing about a generally horizontal axis, a concentric resiliently mounted hollow balancing ring carried on the

front wall of said drum and shiftable laterally with respect to said drum when the same is rotated above a predetermined speed under unbalanced load conditions, a viscous balancing liquid partially filling said ring and shiftable therein above the predetermined speed to counteract unbalanced loads in said drum, and means for dampening the relative lateral movement of said balancing ring and said drum.

2. In a tumbler type clothes washing machine, the combination of a clothes receiving drum rotatable about a generally horizontal axis, a coaxial drum shaft for rotating said drum about its horizontal axis, a drive shaft, a speed change mechanism disposed between said driving shaft and said drum shaft to rotate said drum at a low washing speed and at a relatively high extraction speed, said speed change mechanism including planetary gearing, a housing for said gearing, means for holding said housing stationary to provide for low speed rotation of said drum through said speed change mechanism and for releasing said housing for rotation to provide for high speed rotation of said drum through said housing, said speed change mechanism including a torque limiting clutch disposed between said housing and drum shaft, and means for rendering said last named means inoperative for driving said drum through said housing until said drum has been initially rotated through said speed change mechanism.

3. In a tumbler type clothes washing machine, the combination of a clothes receiving drum rotatable about a generally horizontal axis, a coaxial drum shaft for rotating said drum about its horizontal axis, a drive shaft, planetary gearing disposed between said shafts for rotating said drum at a low washing speed and a high extraction speed, a rotatable housing for said gearing, said gearing including a sun gear driven by said driving shaft, a planet carrier connected with said drum shaft with planet gears mounted thereon in mesh with said sun gear, an orbit gear formed as part of said housing, a brake including a relatively shiftable brake drum carried by said housing for holding the same stationary to cause said planet carrier to rotate said drum shaft at a low speed, means for releasing said brake to permit said housing to rotate, a clutch between said housing and said drum shaft for transmitting torque therethrough when said housing is rotated, means carried by said brake drum for engaging said clutch to load the same, resilient means acting between said brake drum and housing to limit the load on said clutch to limit the torque transmitted therethrough when the clothes receiving drum is accelerated to its high extraction speed, and speed responsive means for rendering said brake releasing means inoperative until said clothes receiving drum has been initially rotated by said planet carrier to a predetermined speed.

4. In combination, a driven element, a drive element, a speed change mechanism disposed between said ele-

ments whereby said driven element is driven by said drive element at a relatively slow speed and a relatively high speed, said speed change mechanism including planetary gearing, a housing for said gearing, means for holding said housing stationary to provide for low speed rotation of said driven element through said speed change mechanism and for releasing said housing for rotation to provide for high speed rotation of said driven element through said housing, said speed change mechanism including a torque limiting clutch disposed between said housing and driven element, and means for rendering said last named means inoperative for driving said driven element through said housing until said driven element has been initially rotated through said speed change mechanism.

5. In combination, a driven element, a drive element, planetary gearing disposed between said elements for rotating said driven element at a relatively low speed and a relatively high speed, a rotatable housing for said gearing, said gearing including a sun gear driven by said drive element, a planet carrier connected with said driven element with planet gears mounted thereon in mesh with said sun gear, an orbit gear formed as part of said housing, a brake including a relatively shiftable brake drum carried by said housing for holding the same stationary to cause said planet carrier to rotate said driven element at a low speed, means for releasing said brake to permit said housing to rotate, a clutch between said housing and said driven shaft for transmitting torque therethrough when said housing is rotated, means carried by said brake drum for engaging said clutch to load the same, resilient means acting between said brake drum and housing to limit the load on said clutch to limit the torque transmitted therethrough when said driven element is accelerated to its higher speed, and speed responsive means for rendering said brake releasing means inoperative until said driven element has been initially rotated by said planet carrier to a predetermined speed.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,836,046

May 27, 1958

Thomas R. Smith

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 70, for "the ring 158" read -- the ring 159 --.

Signed and sealed this 12th day of August 1958.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents