

June 3, 1958

H. D. JOHNSON ET AL

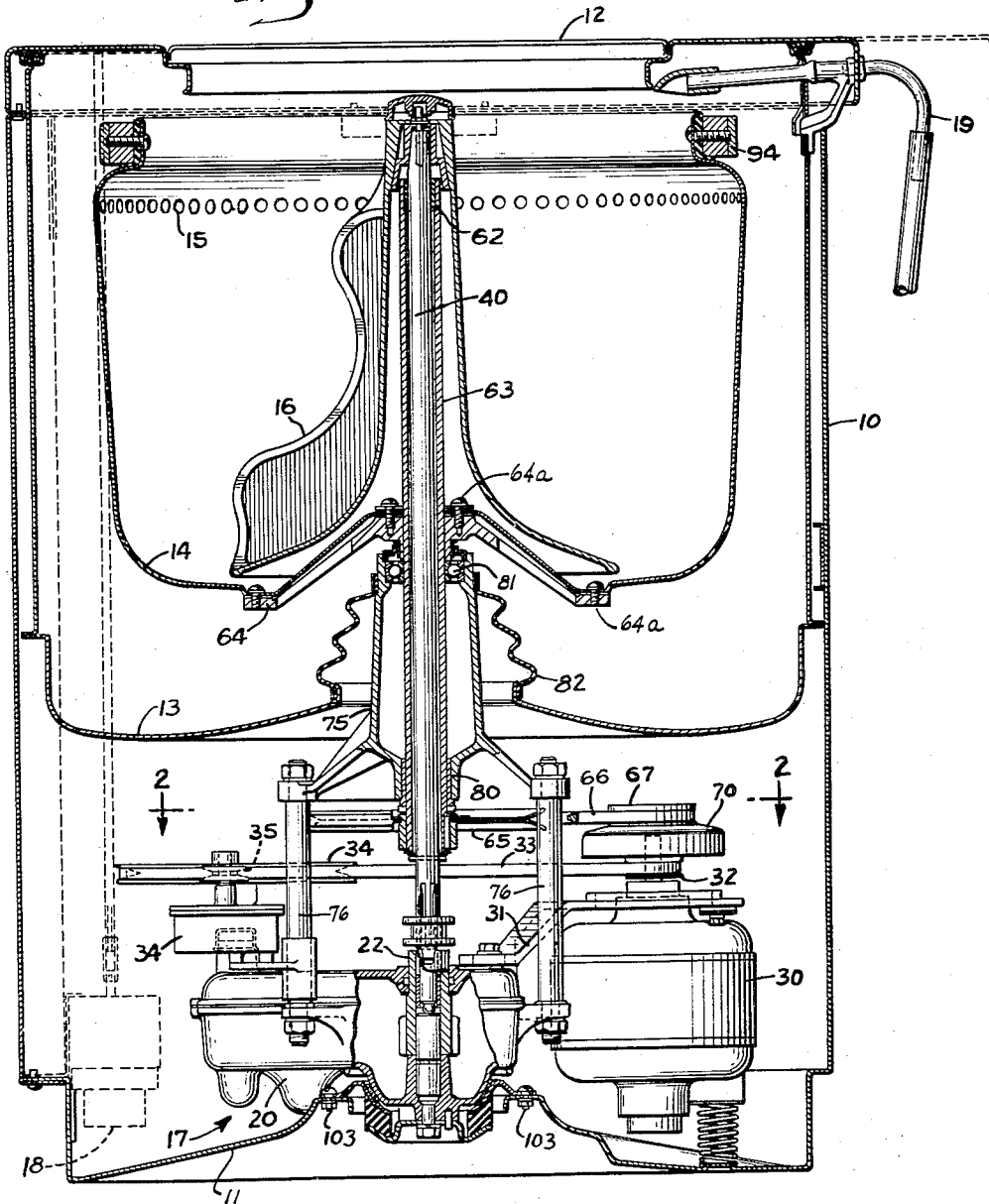
2,836,993

WASHING MACHINES

Filed March 21, 1955

4 Sheets-Sheet 1

Fig. 1



INVENTORS
HAROLD D. JOHNSON
RONALD S. BLOUGH
BY
Carl H. Lynne
AGENT

June 3, 1958

H. D. JOHNSON ET AL

2,836,993

WASHING MACHINES

Filed March 21, 1955

4 Sheets-Sheet 2

Fig. 5.

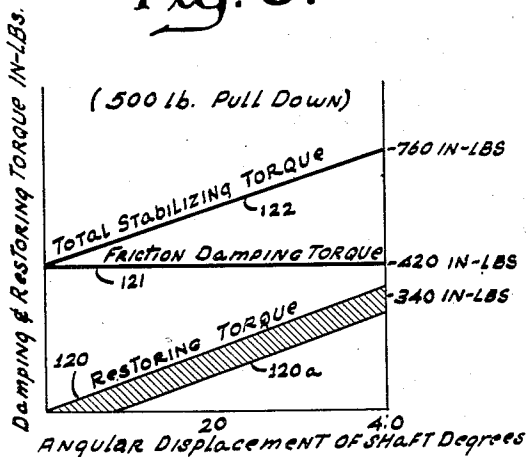


Fig. 6.

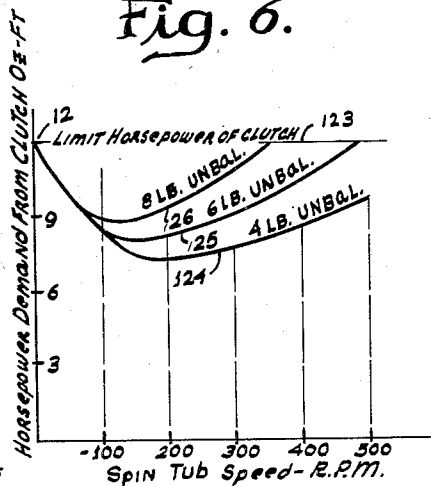


Fig. 7.

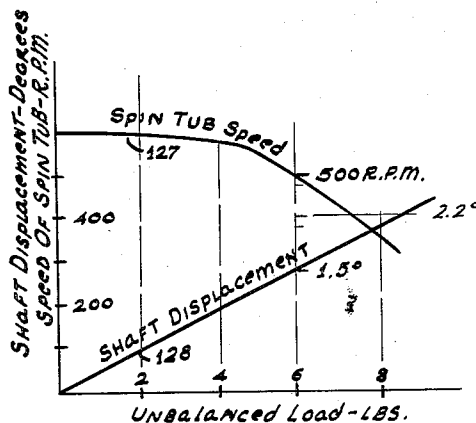
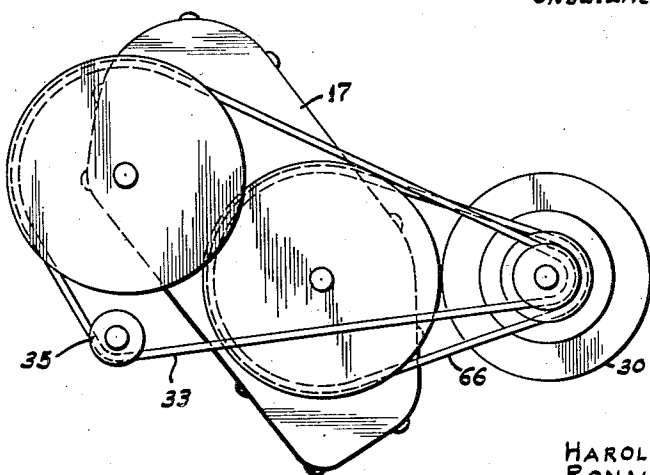


Fig. 2.

INVENTORS
HAROLD D. JOHNSON
RONALD S. BLOUGH
BY

Carl H. Lyness
AGENT

June 3, 1958

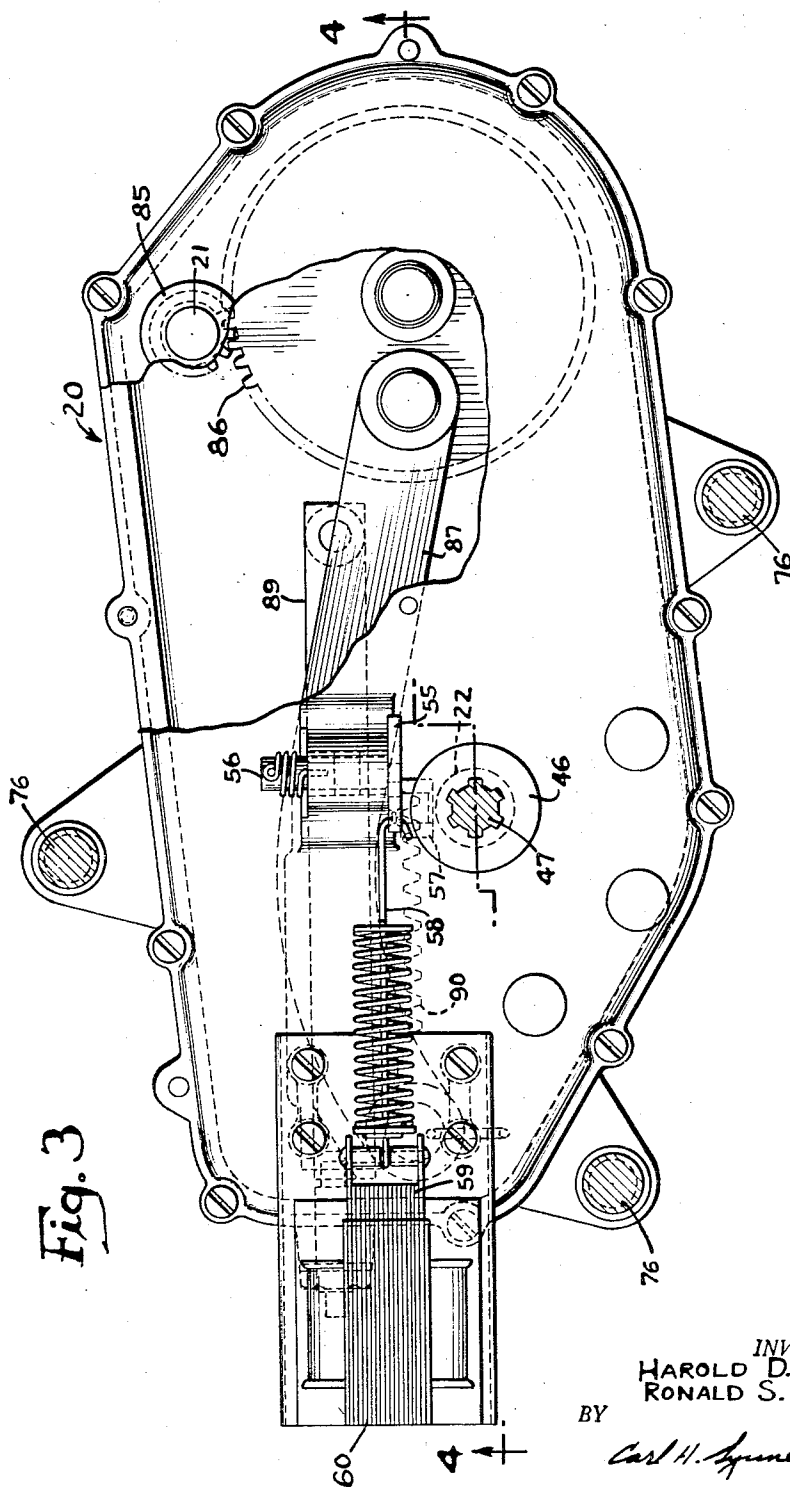
H. D. JOHNSON ET AL

2,836,993

WASHING MACHINES

Filed March 21, 1955

4 Sheets-Sheet 3



INVENTORS
HAROLD D. JOHNSON
RONALD S. BLOUGH
BY
Carl H. Lynestreet
AGENT

June 3, 1958

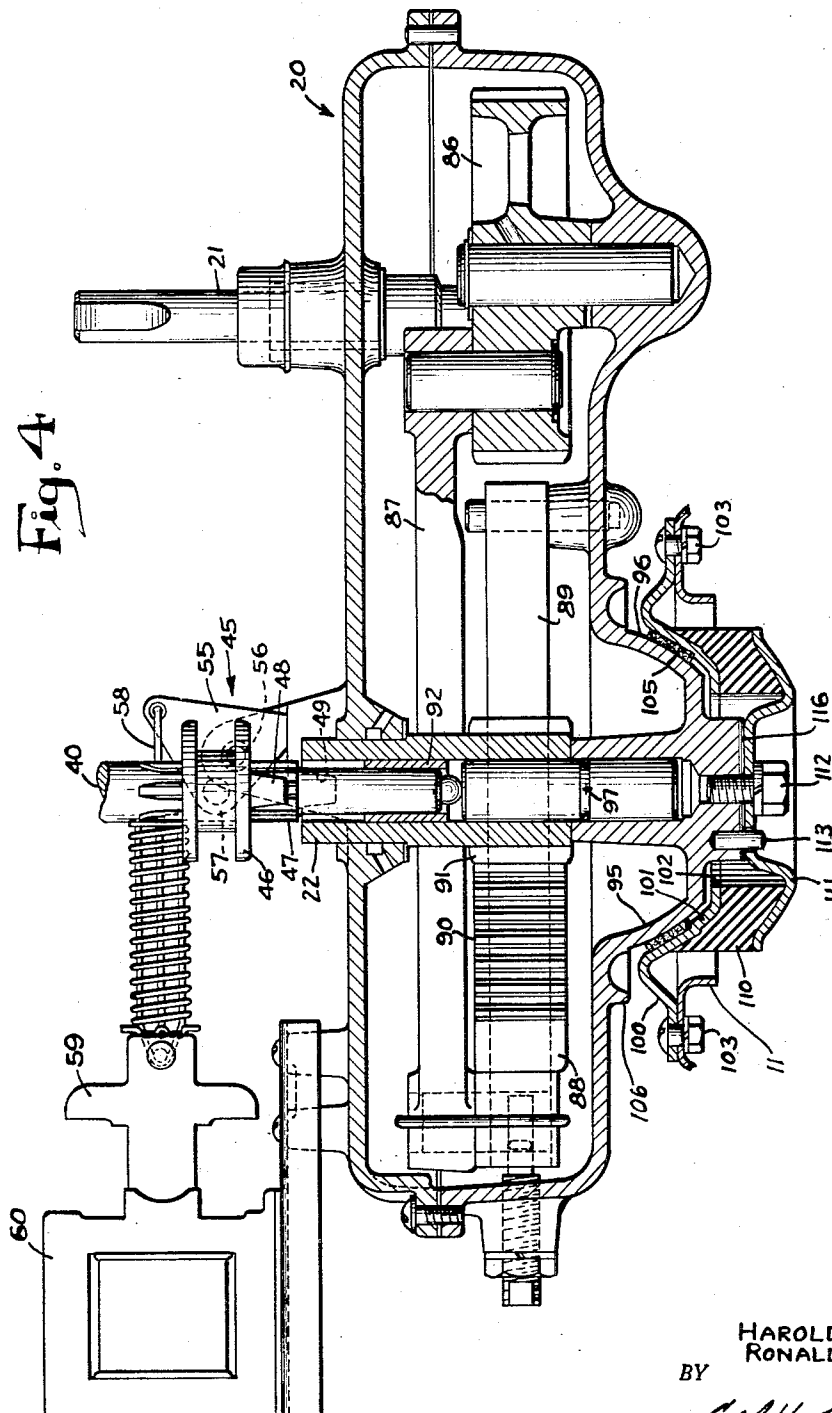
H. D. JOHNSON ET AL
WASHING MACHINES

2,836,993

Filed March 21, 1955

4 Sheets-Sheet 4

Fig. 4



INVENTORS
HAROLD D. JOHNSON
RONALD S. BLOUGH
BY

Carl H. Squier
AGENT

1

2,836,993

WASHING MACHINES

Harold D. Johnson and Ronald S. Blough, Fairfield, Iowa,
assignors to Philco Corporation, Philadelphia, Pa., a
corporation of Pennsylvania

Application March 21, 1955, Serial No. 496,847

12 Claims. (Cl. 74—665)

(Filed under Rule 47(a) and 35 U. S. C. 116)

The present invention relates to washing machines in which clothes are washed and centrifugally dried in the same receptacle, the invention being more particularly concerned with machines in which the clothes receptacle is arranged to rotate about a generally vertical axis.

It is a general object of the present invention to provide an improved spin-dry washing machine in which vibration caused by an unbalanced load is minimized and in which transmission of vibration from the mechanism to a supporting frame or cabinet is effectively prevented.

It is another object to provide a spin-dry washing machine of the vertical shaft type in which any tendency toward vibration of the clothes receptacle is effectively damped-out by means of a novel suspension system capable of establishing beyond-critical damping over a wide range of gravity loading and over a wide range of unbalance.

It is a further object of the invention to provide means for applying damping and centering forces to a spin tub, said means being such as to insure a high degree of tub symmetry about a predetermined rotational axis, and thereby to reduce the possibility of interference between the spin tub and surrounding structure under conditions of unbalanced load.

The invention is characterized by the provision of an improved driving arrangement for a spin tub, which arrangement insures that the spin tub will be driven at full rated speed and, therefore, that the driving arrangement will be fully effective for all normally encountered conditions of unbalance; but which arrangement acts to reduce the speed of the tub to a safe value, whenever a severe or unusual condition of unbalance is encountered. The improved driving arrangement is particularly advantageous in that it assures the provision of a spin tub which accelerates rapidly up to speed even with moderate load unbalance.

Another characteristic feature of the invention resides in the provision of a spin tub drive which may be efficiently operated by a motor of limited power and in which the motor is protected against overload under those operating conditions which are apt to take place in the use of the washing machine.

It is also a feature of the invention to provide a spin-dry washing machine in which the rotary mechanism forms a unitary structure which is of compact and simplified construction and which may be easily and quickly mounted in a cabinet or supporting structure.

Briefly stated, the above noted objects and features of the invention are achieved by utilizing means which advantageously takes the form of a ball and socket joint including a resilient centering device and a friction damp-

2

ing device. These devices are associated with each other and with the spin tub driving mechanism so as to stabilize said mechanism and damp-out undesirable vibrations which are apt to arise in the use of the washing machine.

5 The resilient centering device has a force characteristic which is correlated in a novel manner with the force characteristic of the friction damping device to achieve damping beyond the critical value, thereby insuring against the uncontrolled oscillation occurring at certain critical spots.

10 In particular accordance with the invention, the rotating parts of the washing machine are formed into a single assembly which may be resiliently mounted as a unit at a central point at the bottom of the machine, and the gear case which is part of the unitary mechanism is utilized in a novel manner not only to support the motor, clothes receptacle and other rotating parts, but also is utilized as an integral ball and socket damping connection with the stationary base plate or the like on which the mechanism is mounted.

15 Other objects and advantages of the invention will become apparent upon reading the attached detailed description and upon reference to the drawings in which:

Figure 1 is a vertical section of a spin-dry washing machine incorporating the present invention;

25 Figure 2 is a simplified plan view of the drive mechanism of the machine shown in Figure 1, taken along the line 2—2 and showing the driving connections, certain parts being omitted;

30 Figure 3 is a plan view of the gear casing and its associated solenoid, a portion of the casing being broken away to show the internal construction;

Figure 4 is a section taken along the line 4—4 in Figure 3;

35 Figure 5 is a graph of the restoring torque and damping torque, as a function of displacement, in one embodiment of the invention;

Figure 6 shows graphically the variation in horsepower as a function of speed for various off-center loads; and

40 Figure 7 illustrates the drop-off in speed with severely unbalanced loading.

45 While the invention has been described in connection with the preferred embodiment, it will be understood that we do not intend to limit the invention to such embodiment but intend to include all modifications and alternative constructions falling within the spirit and scope of the appended claims.

Referring now to Figure 1, a spin-dry washer is shown having a housing 10, a lower mounting plate 11 and a suitable closure 12. Suspended within the housing 10 is an outer or splash tub 13. Centrally arranged within the splash tub is a spin tub 14 having holes 15 for the escape of water during the spinning operation. For the purpose of washing the clothes, an agitator 16 is provided which is arranged to oscillate back and forth in the usual fashion.

55 In accordance with the present invention, improved means are provided for supporting and driving the spin tub 14 and the agitator 16, this being accomplished by a novel driving mechanism generally indicated at 17. In the discussion which follows, it will be assumed that one skilled in this art is familiar with the programming mechanism, water system and the like, conventionally used for automatic washers. It will be understood that the present invention is not limited to any particular program of control and the sequence timer has been indicated (Fig. 1)

65

simply in outline form at 18. For simplicity, the "plumbing" has been omitted entirely, except for the tub intake line 19. Any other components customarily included in washers of this type but not shown herein will be understood to conform with the usual practice of the prior art.

Mounted on the mounting plate 11 is a gear casing 20 having an input shaft 21 and an output quill shaft 22, the output shaft being arranged more or less centrally in the gear casing. Mechanism is provided in the gear casing for oscillating the output shaft 22 back and forth at a relatively low rate of speed when the input shaft is driven by an electric motor. The mechanism included within the casing 20 will be discussed at a later point. It will suffice for the present to say that the input shaft 21 is driven by a motor 30 which is mounted on the gear casing by brackets 31. The motor 30 has a constantly driven pulley 32 which drives a belt 33 which is trained about a speed reducing pulley 34 mounted on the input shaft 21. As shown in Fig. 2, the belt 33 is also used to drive a water pump 34, the belt 33 being trained about the water pump pulley 35. For the purpose of transmitting the oscillating motion of the output shaft 22 to the agitator 16, an agitator drive shaft 40 is provided; such shaft is coaxial with the output shaft 22 and is connected to the agitator at its upper end.

As is conventional in automatic washers, provision must be made for disconnecting the agitator from the driving mechanism, and in the present instance this is accomplished by a clutch which is indicated generally at 45 (see Fig. 4). Such clutch includes a clutch collar 46 which is slidable endwise on splines 47 milled in the lower end of the agitator shaft 40. The clutch collar 46 includes an integral dog 48 which engages a notch 49 in the output shaft 22. To operate the clutch, there is provided a clutch operating crank 55 which is in the form of a plate mounted to pivot about an axis 56. The crank 55 carries a roller 57 which engages the clutch collar, and said crank is rocked by means of a resilient pull rod 58 which is coupled to the armature 59 of a solenoid 60. It will be apparent that when the solenoid 60 is energized by the sequence timer, the crank 55 will rock in a direction to lower the clutch collar and to bring the clutch dog 48 into engagement with the output shaft 22.

The means for mounting and driving the spin tub 14 is shown in Fig. 1 and comprises a hollow drive shaft 63 which is arranged to telescope over the agitator drive shaft 40, the two shafts being separated from one another by an upper sleeve bearing 62. A spin tub support 64 is brazed or otherwise secured to the hollow drive shaft 63. This support flares outwardly, with its periphery fastened to the spin tub by suitable bolts 64a or the like. For the purpose of driving the tub drive shaft, a tub drive shaft pulley 65 is provided at its lower end, such pulley being driven by a belt 66 which is trained about a drive pulley 67 on the motor. This drive pulley 67 is connected with the motor shaft through the intermediary of a clutch 70. This clutch forms the subject matter of a co-pending application, Serial No. 395,917, filed December 3, 1953, now Patent No. 2,823,779 to which reference is made. It will suffice to say that the clutch 70 is a one-way clutch which drives the spin tub 14 when the motor rotates in one direction, but which is ineffective to drive the spin tub when the motor rotates in the reverse direction. The clutch is of the friction type so constructed that only a limited amount of torque may be transferred when it rotates in the driving direction. The clutch acts automatically to reduce the speed of rotation of the spin tub with a severely unbalanced load as will be later discussed.

The hollow drive shaft 63 and agitator drive shaft 40 are stably supported by means of an upstanding bracket or pedestal 75 which is generally tubular and which is mounted at its lower end on post 76. The pedestal in-

cludes two vertically spaced bearings 80, 81; the first bearing 80 is of the sleeve type and engages the lower end of the hollow shaft 63; second bearing 81 is of the ball type and is disposed at the upper end of the pedestal to steady the center portion of the shaft 63 and to absorb the end thrust. A bellows-like rubber boot 82 circles the pedestal at its upper end and is peripherally sealed to the splash tub 13 at its base, making the splash tub watertight, yet permitting free relative movement between the tub and the mechanism.

With the overall organization of the driving mechanism in mind, attention may next be given to the specific construction of the speed reducing and oscillating mechanism included within the casing 20, with particular reference being made to Figs. 3 and 4. The input shaft 21 previously referred to terminates in the pinion 85 which meshes with the gear 86. Eccentrically mounted on the gear 86 is a pitman 87 which is pivotally connected at its opposite end to a rack bar 88. The rack bar is in turn slidably mounted on a rack bar shaft 89 which guides the rack bar for reciprocating movement. The rack bar is provided with a rack 90 which engages a rack pinion 91 formed integrally in the output shaft 22. The output shaft 22 is of the quill type to provide a bearing 92 for the lower tip of the agitator drive shaft 40. Assuming that the clutch 45 is engaged, it will be apparent that rotation of the input shaft in, say, the counterclockwise direction, will cause oscillation of the output shaft 22 and its connected agitator shaft 40.

After the agitation has been completed and it is desired to extract the water, the agitator clutch 45 is disengaged and the motor is reversed, which operations may be taken care of automatically by the sequence timer 18 and which is a matter well within the skill of the art. A motor reversing arrangement which may be used is disclosed in copending application Serial No. 391,094 filed November 9, 1953. With the motor rotating in the clockwise direction, the friction clutch 70 is engaged, driving the spin tub shaft through the belt 66 and the pulley 65. The spin tub then begins to rotate about its axis. In order to reduce the effect of a minor unbalanced load in the spin tub, we prefer to use a weighted balancing ring 94 in Fig. 1, located at the rim of the tub and which may have a weight of about 20 lbs.

As a primary feature of the present invention, a novel ball and socket friction connection is provided for the spin tub and driving mechanism. Such connection is located between the gear casing 20 and the mounting plate 11, and novel centering means are further provided for urging the gear casing and drive shaft assembly toward a normal vertical position. In the present instance, the ball portion of the connection is provided by a boss 95 integrally formed on the underside of the casing 20 and having a spherical surface 96 machined thereon, the center of the spherical surface being at a point 97 lying within the gear casing. The socket portion of the connection is formed by a cup-shaped supporting plate 100 having a concave surface 101 and a central opening 102, the plate 100 being fastened to the mounting plate 11 by a circular row of bolts 103. Interposed between the ball and socket is a liner 105 of friction material which may be in the form of a continuous annular strip or which may be discontinuous with individual pieces located at evenly spaced points around the inner surface of the annular plate 100. The liner 105 may, in any event, be formed of the same type of molded material conventionally employed for automobile brake linings, and is preferably ground concave on its inner surface to form a more perfect fit with the spherical surface 96 on the gear housing. Entry of moisture between the friction surfaces is effectively prevented by providing an integral drip skirt 106 on the casing 20.

In accordance with one of the aspects of the invention, a block of resilient material stressed in compression and shear is employed to maintain the ball and socket joint

in a normally centered condition with the spin tub drive shaft 63 vertical. In the present instance this is accomplished by a block of rubber 110 in annular form centered with respect to the ball and socket joint. At its lower surface the block is bonded to a circular shear plate 111 which is bolted at its center to the boss 95 by a bolt 112. Relative rotation of the plate 111 and the boss 95 is prevented by a key 113 engaging both of them. At its upper surface the annular block 110 is bonded to the underside of the annular supporting plate 100. It will be apparent therefore that any ball and socket movement between the boss 95 and the supporting plate 100 will develop a shear stress in the rubber tending to restore vertical alignment. In order that the stress progressively developed in the rubber by the ball and socket action may be substantially linear, the block 110 is so formed that the median surface thereof lies in the locus of a sphere having the same center 97 as the ball and socket joint with which it is associated.

In carrying out the invention, the rubber block 110 used for centering purposes is also employed for resilient loading of the friction-damping surfaces, with the rubber block placed in compression. Thus, as seen in Fig. 4, tightening of the bolt 112 tends to draw the spherical boss 95 down more intimately against the friction liner 105, at the same time compressing the rubber block 110 so that the friction-damping surfaces are resiliently preloaded. The degree of such pre-loading determines the amount of initial damping torque, in other words, the amount of torque available to resist the movement of the ball in the socket. The preloading may be adjusted by employing a shim 116 sandwiched between the shear plate 111 and the mounting surface on the boss 95.

The above arrangement results in a number of worthwhile advantages, both alone and in association with the friction clutch 70. Such advantages may be more clearly understood by reference to Figs. 5-7, inclusive which, by way of example, show the operating characteristics of a washing machine constructed in accordance with the present invention. One of the primary advantages is the "speed protection" which is attained, in which full speed operation of the spin tub is assured for all normal amounts of unbalance, but in which a severely unbalanced load produces an automatic reduction in the speed of the spin tub to a safe value.

Referring now to Fig. 5, the restoring shear characteristic of the rubber block 110 is indicated by the curve 120. This curve shows that the torque tending to restore the shaft to a vertical position increases almost linearly with the angular displacement of the shaft, in the given example reaching a value of about 340 inch-pounds for an annular displacement of 4 degrees. Such angular displacement corresponds to an unbalanced load of eleven to twelve pounds, which is much greater than the actual angular displacement occurring under normal operating conditions.

When employing the present invention, it is found that the friction-damping torque, i. e., the torque which acts at the friction surfaces and which tends to prevent displacement of the shaft, is relatively constant over a wide range of displacement as indicated by the horizontal curve 121. In the given example, both curves 120 and 121 correspond to a "pull-down" of 500 pounds caused by prestressing the rubber block. The amount of pull-down may be adjusted, as previously stated, by changing the thickness of the shim 116 (Fig. 4).

The conditions set forth in Fig. 5 may be easily achieved in the present device, because the block 110 is such and so arranged that the shear stress increases at a relatively low rate with displacement. Preferably, the restoring torque is less than the damping torque over substantially the entire range of angular displacement of the shaft or torque transmitting member. In this manner, there is obtained a degree of damping which is greater than critical damping, thus eliminating the danger that the

oscillation of the spin tub will build up penduously under certain critical running conditions.

The addition of the storing torque and damping torque produces a torque characteristic 122 which may for convenience be referred to as the "total stabilizing torque." This is the torque which must be overcome before there can be an increase in angular displacement from any given value. Such torque varies in the example here given from approximately 420 inch-pounds when the shaft is vertical to approximately 760 inch-pounds at an angular displacement of 4 degrees.

In order more fully to understand the speed limiting which occurs because of the action of the slip clutch 70 under conditions of severe unbalance, reference is made to Figs. 6 and 7. Fig. 6 sets forth the horsepower demanded from the clutch 70 as a function of spin tub speed. The limiting torque of the clutch is indicated at 123. Such limiting torque is substantially less than the maximum torque of a split phase motor of the type normally employed in washing machines and may, for example, be on the order of 12 ounce-feet. In the given example, the horsepower required to rotate the spin tub over the speed range for various amounts of unbalance is indicated by curves 124, 125 and 126, the unbalance being simulated for test purposes by bags of lead shot disposed close to the bottom of an otherwise empty tub. It will be noted that all of the curves start at the limiting value, indicating that a certain amount of slippage takes place at the beginning of spin tub rotation regardless of the amount of unbalance. The curves further indicate that as the spin tub picks up speed, the horsepower requirement decreases, but that after a speed of approximately 150 to 200 R. P. M. is reached, the horsepower requirement again increases, as indicated by the upward swing of the curves.

The characteristics shown in Fig. 6 should be interpreted in the light of Fig. 7, which sets forth spin tub speed and shaft displacement as a function of unbalanced loading, the two curves being indicated at 127, 128, respectively. It will be noted that in the given example, the spin tub speed remains relatively constant, dropping only about 16 percent (to 500 R. P. M.) as the unbalanced loading is increased up to 6 pounds. However, when the unbalanced loading is increased further, say from 6 pounds to 8 pounds, a more substantial drop in speed occurs (from 500 R. P. M. to 350 R. P. M.). Returning to Fig. 6, it will be noted that in the given example, the curves 123, 126 cross at a speed of approximately 350 R. P. M. This indicates that with an unbalanced loading of 8 pounds, the speed is reduced automatically to 350 R. P. M. Since the motor continues to rotate at its full rated speed, the difference is accounted for in the slippage of the clutch 70. Even though the spin tub may be run for long periods of time with greatly unbalanced loading, say on the order of 8 pounds, the entire mechanism is prevented from damage. While substantial amounts of power must be released at the damping surfaces and also at the clutch surfaces under such conditions, experience shows that the energy is efficiently dissipated without substantial temperature rise. Slippage of the clutch 70 insures that the motor is not called upon for any more horsepower than that for which the clutch has been set. Consequently, the motor cannot be subjected to any more than a predetermined torque loading which can be maintained indefinitely without a damaging increase in motor temperature.

It is apparent, therefore, that the mechanism described above provides for "speed protection" which insures that an average load, e. g., 2 to 6 pounds of unbalance, will be spun at a high rate of speed for efficient extraction of water but which, nevertheless causes the speed to be automatically reduced under more severe conditions. Cut-out switches and similar emergency devices employed in the prior art to stop the machine are therefore made unnecessary. Instead, the spin tub is rotated with its un-

balanced load at a safe speed until the greater portion of the water has been removed. This appreciably lightens the load and reduces the amount of unbalance, whereupon the speed automatically increases so that under most conditions of unbalance, final extraction of water will take place at or near the rated speed of the spin tub.

To vary the equilibrium speed which exists for a given amount of unbalance, the torque characteristic of the clutch 70 may be varied, thereby raising or lowering the value of limiting torque indicated at 123 in Fig. 6. The torque may, for example, be increased by reducing the preload on the springs in the clutch, or by substituting lighter springs. Torque variation may also be brought about by increasing or decreasing the weight of the clutch dogs. Regardless of the means employed for changing the setting of the clutch, it will be apparent from Fig. 6 that increasing the torque setting of the clutch will cause an increase in the equilibrium speed for a given amount of unbalance, while decreasing the setting of the clutch will cause a decrease in such equilibrium speed.

It is of interest to note that the characteristics shown in Figs. 5-7 are largely independent of the gravity loading. While it is true that initial spinning occurs with a heavy tub of water, the weight of the water presses down upon the friction-damping surfaces, temporarily increasing the damping effect and compensating for the added weight. As the water is thrown out of the spin tub by centrifugal force, the gravity loading is lightened and the amount of damping force is correspondingly reduced.

The above discussion has been directed toward explanation of observed data. In attempting further explanation of the "speed protection" afforded by the present construction, it is helpful to consider the friction-damping surfaces as an energy absorber, the absorption being a function of the angular displacement, frictional force and speed. Since the angular displacement is large for large values of unbalanced load, the speed must necessarily fall in order to avoid exceeding the power-transferring capacity of the slip clutch 17, the reduction occurring automatically in accordance with the degree of unbalance. It is our observation that additional damping action is caused by hysteresis in the rubber block 110, such hysteresis being indicated by the shaded area 129a (Fig. 5). Such hysteresis constitutes a useful means for dissipating energy and the amount of the hysteresis loss may be varied by appropriate selection of the type of rubber or other resilient material used in the block 110.

As a further practical advantage of the present construction, it is found that there is no tendency for the washer to "walk" either under normal spinning at rated speed or under conditions of severely unbalanced loading. One reason for this is that the reaction forces at the point of mounting are inherently kept at a low value. Such reaction forces arise from two sources, pendulous reaction and gyroscopic couple reaction. The pendulous reaction is due to the fact that the load is not pivoted about its center of gravity but at a point 97 which lies below the center of gravity. It should, however, not be overlooked that the present construction enables the center of pivoting to be brought more closely to the center of gravity than in conventional machines. With regard to gyroscopic couple reaction, this will be recognized by one skilled in the art as that force which acts at right angles to the axis of rotation and the force exerted by gravity. Both of these forces vary with speed, and since the speed is kept to a low value during severe unbalance and is not excessive (approximately 600 R. P. M.) for normal amounts of unbalance, the reaction forces are correspondingly limited. Furthermore, since the spin drive shaft constitutes a relatively long, low amplitude pendulum, such pendulous reaction forces which do exist, and the gyroscopic couple forces as well, are not only close to the floor but parallel to the floor and adequately resisted by floor friction.

The lack of any connection to the housing of the machine insures that any vibration of the mechanism is

transmitted directly to the floor and the housing therefore remains substantially free of vibration. As a result, smooth and efficient operation is obtained, and the noise level caused by the "sounding board effect" found in most machines of conventional design is reduced.

Gyratory movement of the spin shaft is to be expected under conditions of unbalance because of the fact that the spun load tends to rotate about its actual center of gravity. Since the clearance between the spin tub and the splash tub is limited, it is, of course, desirable that such gyratory movements be centered at all times with respect to the vertical axis of the machine. In conventional machines having a plurality of spaced damping elements and restoring elements, the slightest unbalance between them will cause the gyration to take place eccentrically, with the result that the spin tub may come in contact with the splash tub or other stationary part of the machine. In the present construction the centered annular restoring element in the form of the rubber block 110 and the centered annular damping surfaces surrounding the boss 95 are inherently balanced in all directions, thereby insuring that the spin tub will move equally about the central axis of the machine. This is true, even though the characteristic of the rubber block and damping surfaces may vary slightly through the passage of years.

The mechanism described above makes an ideal unit for quantity production and for mounting in a variety of cabinets since auxiliary connections with the cabinet for the purpose of mounting centering springs, damping devices or the like, have been eliminated. This not only reduces the possibilities of transmitting vibration to the cabinet, but also makes possible a much "cleaner," more economical installation, both initially and for purposes of later servicing.

In Fig. 1 the motor 30 is shown supported by a small coil spring 130. This merely indicates that additional support may be provided between the mechanism and the mounting plate where desired to correct objectionable weight unbalance, as caused for example by an excessively heavy motor. Where a lighter weight motor is employed, the spring 130 may be omitted.

We claim:

1. In a spin-dry washer, a supporting frame, a spin tub, a vertical drive shaft having an upper portion connected to said spin tub and extending coaxially therewith, a mount at a lower portion of said drive shaft and supported on said frame to permit limited rocking movement of said shaft in response to gyrations of said spin tub, first and second plate members arranged opposite one another, resilient means between said plate members and anchored to each of them, said first plate member being coupled with said frame, said second plate member being coupled with said shaft and so arranged that departure of said shaft from its vertical position causes progressive stress to be developed in said resilient means, and means for applying a damping force to said shaft to damp out rocking movement thereof, said damping means being so constructed and arranged that the damping torque exceeds the restoring torque of said resilient means over the range of movement of said shaft from its normal vertical position.

2. In a spin-dry washer, a supporting frame, a spin tub, a vertical drive shaft having an upper end portion connected to said spin tub and extending coaxially therewith, a mount at a lower portion of said drive shaft and supported on said frame to permit limited rocking movement of the shaft about a fixed center in response to gyrations of said spin tub, resilient material secured to said frame and concentric with but vertically offset from said center, a movable plate member anchored to said resilient material to stress the same in shear upon edgewise movement of the plate member, means for coupling said plate member and said shaft so that departure of said shaft from its vertical position causes a restoring shear

stress to be developed in said resilient material, and means for applying a damping force to said shaft to damp-out rocking movement thereof about said center, said damping means including friction surfaces symmetrically disposed about said center.

3. In a spin-dry washer, a mounting plate, a spin tub, a vertical drive shaft having an upper portion connected to said spin tub and extending coaxially therewith, a ball and socket connection at a lower portion of said shaft including a ball associated with said drive shaft and a socket associated with said mounting plate, resilient material underlying said mounting plate and centered with respect to said ball, a shear plate underlying said resilient material, means interconnecting said ball and said shear plate so that rocking movement of said drive shaft from a normal central position in response to gyrations of said spin tub causes a shear stress to be developed in said resilient material tending to restore the shaft to said central position, and friction damping means coupled with the shaft for opposing said movement.

4. In a spin-dry washer, a mounting plate including a generally spherical socket, a spin tub, a vertical drive shaft connected to said spin tub and extending coaxially therewith, a ball disposed axially of said shaft and in mating relation with respect to said socket, friction material interposed between said ball and said socket, resilient material having one side affixed to said mounting plate and having a shear plate on its opposite side, said shear plate being coupled with said ball and so arranged that displacement of said shaft from its normal central position causes shear stress to be set up in said resilient material for restoring the shaft to its central position.

5. In a spin-dry washer, a spin tub, a torque transmitting member connected with said spin tub and extending concentrically with respect thereto, said member being subject to rocking movement due to gyrations of said spin tub, resilient means connected with said member and adapted to apply a restoring force urging said member toward a centered position, means arranged in association with said member and adapted to apply a damping force thereto which is greater than said restoring force over substantially the entire range of movement, and means for driving said member, the torque capacity of the driving means being so limited that the speed of rotation of the spin tub is reduced under conditions of severe unbalance.

6. In a spin-dry washer, a spin tub, a drive shaft connected with said tub and extending concentrically with respect thereto, said drive shaft being subject to rocking movement due to gyrations of said spin tub, resilient means coupled with said shaft and adapted to apply a restoring force urging the shaft toward a centered position, means arranged in association with said drive shaft and adapted to apply a damping force thereto which is greater than said restoring force over substantially the entire range of said rocking movement, a motor having a substantially constant speed for driving said drive shaft at rated speed under balanced load conditions, and a slip clutch interposed between said motor and said drive shaft having a limiting torque which is substantially less than that of the motor so that the speed of the spin tub is reduced below rated speed under severely unbalanced load conditions.

7. In a spin-dry washer, a spin tub, a drive assembly including a driving motor, said drive assembly having a vertical drive shaft connected to said tub and extending coaxially therewith, said drive assembly and drive shaft being subject to rocking movement due to gyrations of said spin tub, resilient means connected with said drive assembly and adapted to apply a restoring torque to said assembly to urge the same to a position in which said drive shaft lies in a substantially vertical centered position, means connected with said drive assembly and adapted to apply a damping torque opposing said rocking movement of said driving assem-

bly, said damping means being so constructed and arranged that the damping torque remains relatively constant and exceeds the restoring torque of said resilient means over substantially the entire range of rocking movement.

8. For a spin-dry washer having a spin tub and central agitator, a power unit comprising, in combination, a mounting member, a gear casing having an input shaft and an agitator shaft, a motor mounted on said gear casing and coupled with said input shaft, a spin tub shaft telescoped over said agitator shaft, clutch means carried by said gear casing and operable to provide for alternate driving of said agitator shaft and said spin tub shaft, means underlying said gear casing and supporting the same for limited rocking movement on said mounting member in response to gyrations of said spin tub, and friction-damped means interposed between said mounting member and said gear casing for resiliently centering the same with said spin tub shaft in a substantially vertical position.

9. For a spin-dry washer having a spin tub and central agitator, a power unit comprising, in combination, a mounting member, a gear casing having an input shaft and an agitator shaft, a motor mounted on said gear casing and coupled with said input shaft, a spin tub shaft telescoped over said agitator shaft, clutch means carried by said gear casing and operable to provide for alternate driving of said agitator shaft and said spin tub shaft, means disposed at the underside of said gear casing and supporting the same for limited rocking movement on said mounting member about a center lying within the gear casing, and friction-damped means interposed between said mount and said gear casing for resiliently centering the same with said spin tub shaft in a substantially vertical position.

10. For a spin-dry washer having a spin tub and central agitator, a power unit comprising, in combination, a mounting plate, a gear casing having an input shaft and an agitator shaft, a motor mounted on said gear casing and coupled with said input shaft, a spin tub shaft telescoped over said agitator shaft, clutch means carried by said gear casing and operable to provide for alternate driving of said agitator shaft and said spin tub shaft, a ball surface on the underside of said gear casing, a mating socket in said mounting plate to support said ball surface and allow for limited rocking movement of said gear casing in response to gyrations of said spin tub, and friction-damping means interposed between said mounting plate and said gear casing for resiliently centering the same with said spin tub shaft in substantially vertical position.

11. For a spin-dry washer having a spin tub and central agitator, a power unit comprising, in combination, a mounting plate, a gear casing having an input shaft and an agitator shaft, a motor mounted on said gear casing and coupled with said input shaft, a spin tub shaft telescoped over said agitator shaft, clutch means carried by said gear casing and operable to provide for alternate driving of said agitator shaft and said spin tub shaft, a convex boss on the underside of said gear casing, a socket on said mounting plate for mating with said boss to support said gear casing for limited rocking movement in response to gyrations of said spin tub, friction material interposed between said socket and said gear casing, and means associated with said socket for resiliently centering the gear casing with said spin tub shaft in a substantially vertical position.

12. For a spin-dry washer having a spin tub and central agitator, a power unit comprising, in combination, a mounting member, a gear casing having an input shaft and an agitator shaft, a motor mounted on said gear casing and coupled with said input shaft, a spin tub shaft telescoped over said agitator shaft, clutch means carried by said gear casing and operable to provide for alternate driving of said agitator shaft and said spin tub

11

shaft, means providing a ball surface on the underside of
said gear casing, a socket on said mounting member
mating with said ball surface and thus supporting the
gear casing for limited rocking movement in response to
gyrations of said spin tub, a layer of friction material be- 5
tween the ball surface and socket, and means including
a block of resilient material connected to said mounting
member and to said gear casing for resiliently centering
the same in said socket, said block of resilient material
being so arranged as to apply a resilient loading to said 10
ball and socket surfaces to provide a predetermined de-
gree of frictional damping.

12

References Cited in the file of this patent

UNITED STATES PATENTS

2,346,158	Dyer	Apr. 11, 1944
2,346,668	Dunham	Apr. 18, 1944
2,406,226	Kimball	Aug. 20, 1946
2,421,251	Dunham	May 27, 1947

FOREIGN PATENTS

300,874	Great Britain	Nov. 22, 1928
---------	---------------	---------------