

May 27, 1958

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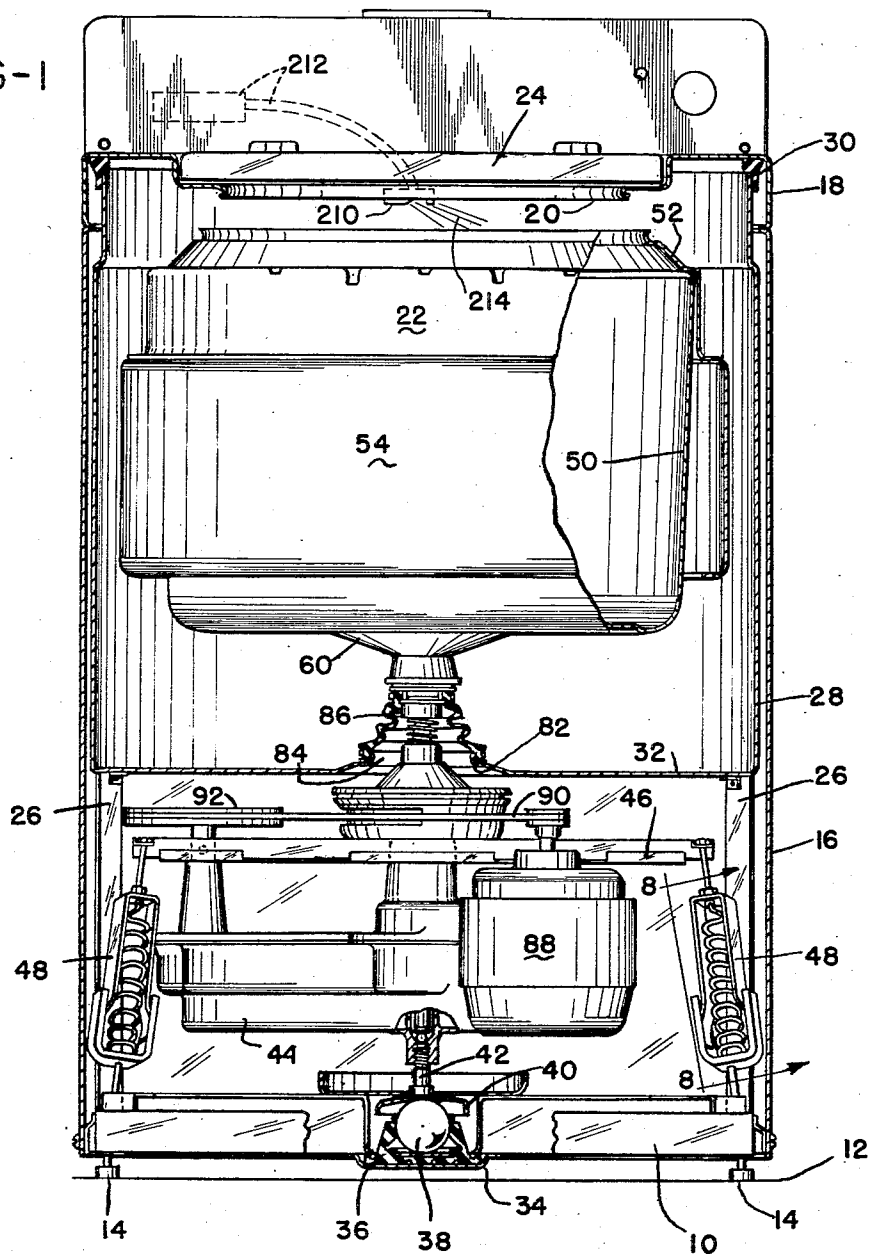
2,836,301

TUB STRUCTURE

Filed Aug. 26, 1953

4 Sheets-Sheet 1

FIG-1



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TUB STRUCTURE

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4 Sheets-Sheet 2

FIG-2

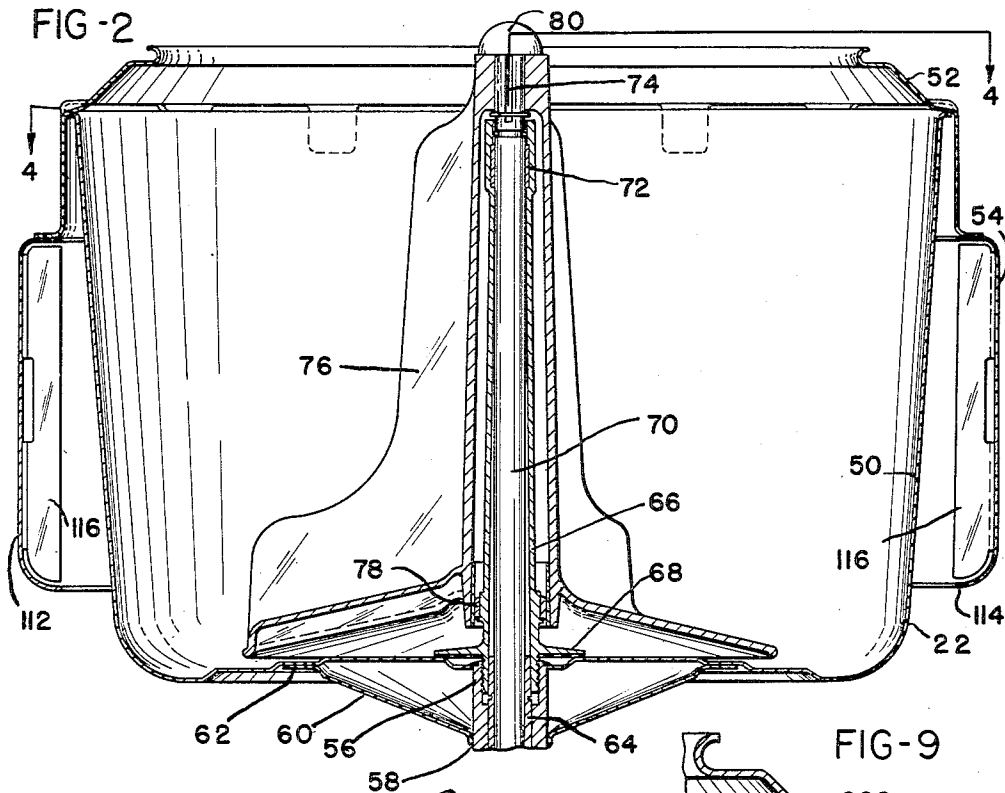


FIG-3

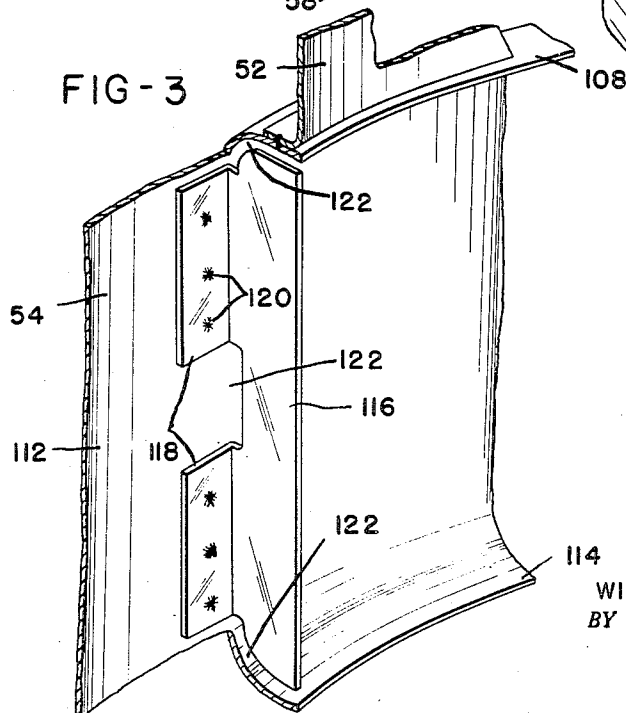
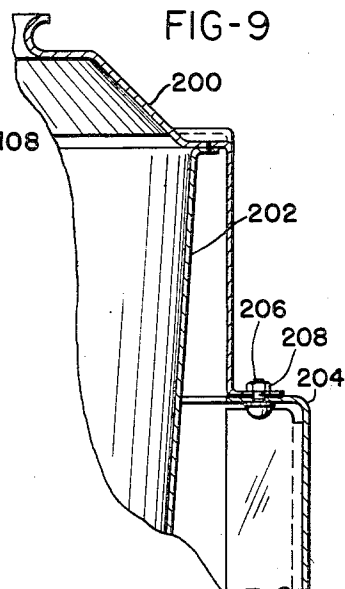


FIG-9



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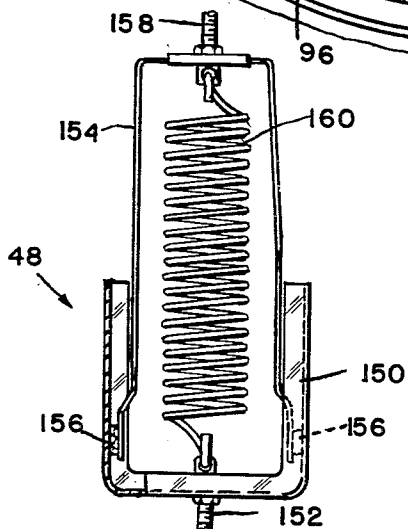
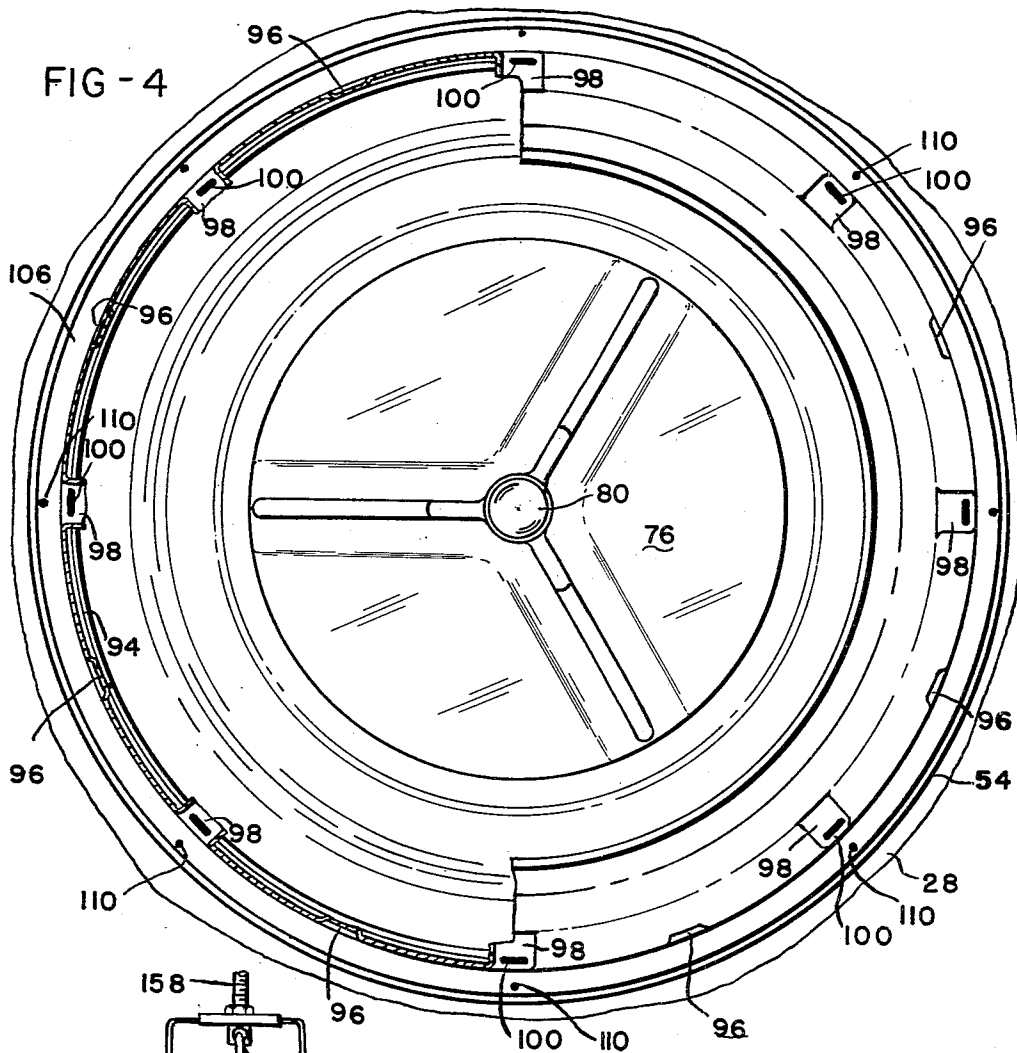
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TUB STRUCTURE

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4 Sheets-Sheet 3



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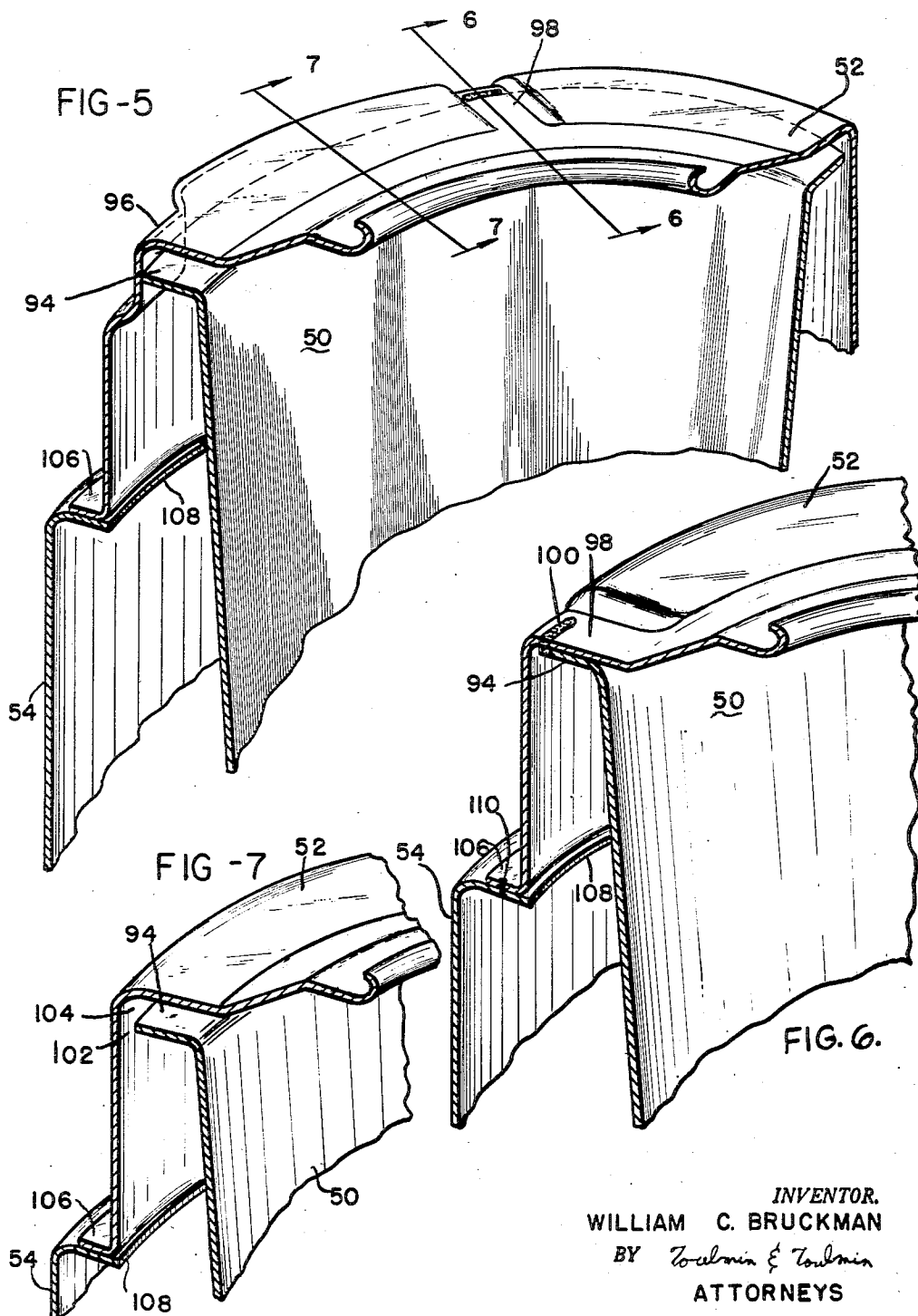
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TUB STRUCTURE

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4 Sheets-Sheet 4



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2,836,301

TUB STRUCTURE

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Application August 26, 1953, Serial No. 376,643

6 Claims. (Cl. 210—369)

This invention relates to washing machines, particularly clothes washing machines, and especially to a tub structure for use with a clothes washing machine having an automatic counterbalancing arrangement for preventing vibration of the machine during a spinning cycle.

Automatic washers of the type with which the present invention is concerned comprise, generally, a tub in which clothes to be washed are placed and which clothes are agitated within the tub during a washing cycle, either by rotation or oscillation of the tub or by oscillation of an agitator means within the tub while the tub is held stationary. Such washers normally accomplish at least a partial drying of the clothes after a washing cycle by means of spinning the tub at a fairly high speed, and which spinning will centrifuge substantially all of the water from the clothes, leaving them in a damp condition suitable for quickly drying by further means, such as an automatic gas or electrically heated drier.

The great majority of such washers have a perforated clothes receiving tub surrounded by an imperforate jacket, and from which jacket the wash or rinse water is centrifuged when the tub is on a spin cycle. Inasmuch as the clothing within the tub seldom is uniformly distributed therein, and, in fact, is probably more or less concentrated toward one side of the tub, it is evident that the spinning of the tub during a spin cycle will create large forces of unbalance tending to vibrate and shake the washing machine, particularly at about the time the free water from the tub or surrounding jacket has been centrifuged therefrom, and before the water entrained in the clothes has had a chance to be thrown therefrom and also centrifuged out of the tub or jacket. Assuming that an ordinary washer load consists of about nine pounds of clothes, it will be evident that forces of unbalance of this nature could become extremely high, and if means were not provided for counteracting such forces, it would be necessary to firmly bolt the washing machine to a solid foundation.

It has been common practice in the past to eliminate vibration of the washing machine during the spin cycle by providing a dampening mass either carried by the tub or built into the frame of the machine, thereby substantially to absorb the vibrations created by such unbalance forces and eliminate the necessity for bolting the machine down to a solid foundation. In other cases, mechanical balancing devices have been associated with the tub of an automatic nature which are operable to create counterbalancing forces on the tub, thereby more or less effectively preventing transmission of these forces of unbalance to the frame of the washing machine.

In U. S. Patent Number 2,534,194, issued December 12, 1950, assigned to the same assignee as the instant application, issued in the names of Clayton R. Emmert and William H. Stouder, there is shown a greatly improved counterbalancing arrangement for washing machines of this nature, which not only eliminates the vibration of the washing machine referred to, but does so without in-

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cluding in the tub structure or in the frame of the machine any heavy expensive dampening weight structures and without imposing any severe loads on the supporting shaft of the tub and the bearings therefor, and which balancing arrangement is operable to maintain substantially perfect balance of the spinning tub at all times.

The counterbalancing arrangement referred to illustrated in the Emmert et al. patent comprising an imperforate clothes receiving tub having integrally associated therewith a jacket which receives water centrifuged from the imperforate tub during a spin cycle through apertures about the upper edge of the tub, and which jacket retains a portion of the water which positions itself within the jacket so as to counterbalance any unbalanced load within the tub.

The integrated assembly of the tub and counterbalancing jacket makes field servicing difficult and limits the manner in which the assembly can be finished in the shop.

With the foregoing in mind, it is a primary object of the present invention to provide a washer of the nature described in which the tub during a spin cycle is counterbalanced to a high degree of perfection, thereby eliminating vibration of the washing machine during a spin cycle.

Another object is the provision of a washing machine of the nature referred to in which vibration of the machine is prevented during a spin cycle of the washer, but without requiring any expensive and heavy dampening weights to be built into the tube structure or into the frame of the machine.

A still further object is the provision of an improved tub structure for a washing machine of the nature referred to which is relatively light, and which can be fabricated and assembled by relatively simple techniques, thus maintaining the manufacturing cost of the tub structure as low as possible.

A still further object is the provision of an automatic washing machine of the nature referred to in which during the spin cycle the forces of unbalance set up within the tub by a nonuniform distribution of the clothes therein are compensated for and balanced out without imposing loads on the shaft supporting the tub or the bearings in which the shaft is journaled.

A still further object is to provide a tub for a washing machine of the nature referred to with an automatic counterbalancing arrangement which has minimum effect on counterbalancing the tub when the tub is commencing its spin cycle and is below its critical speed, and has maximum effect in counterbalancing the tub when the tub is above critical speed.

These and other objects and advantages will become more apparent upon reference to the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a vertical sectional view more or less diagrammatic through a washing machine embodying my invention;

Figure 2 is a vertical section drawn at somewhat increased scale through the tub structure of the machine;

Figure 3 is a perspective view showing a portion of the balancing ring or jacket surrounding the tub and the manner in which the baffles are placed therein;

Figure 4 is a view indicated by line 4—4 on Figure 2 and is a partial plan and partial section of the tub structure;

Figure 5 is a perspective view showing details in connection with the tub structure balancing ring and crown;

Figure 6 is a perspective view indicated by line 6—6 on Figure 5, showing the manner in which the crown, tub, and balancing ring are fabricated;

Figure 7 is a sectional perspective view, indicated by line 7—7 on Figure 5, showing the manner in which the

crown and tub are shaped to provide metering openings therebetween for the delivery of water from the tub to the balancing ring during a spin cycle;

Figure 8 is a partial sectional view indicated by line 8—8 on Figure 1, showing the construction of one of the snubbers that assists in limiting the movement of the tub laterally during a spin cycle when the tub is below or passing through its critical speed; and

Figure 9 is a fragmentary sectional view showing how the counterbalancing jacket can be detachably mounted on the crown ring.

Referring to the drawings somewhat more in detail, as will be seen in Figure 1, the washing machine comprises a base part 10 adapted to rest on floor 12 as by the adjustable feet 14 provided in the corners of base part 10. Slidably fitting about base part 10 and upstanding therefrom is an outer cabinet part 16 having a top portion 18 with a central aperture 20 positioned above the open upper end of tub structure 22 and adapted for being closed by a lid 24.

Upstanding from base part 10 at spaced points thereabout are angle members 26 carrying at their upper ends the splash shield 28 extending upwardly around tub structure 22 and having a rubber-like gasket 30 about its upper edge sealing against top part 18 of the washer cabinet. Splash shield 28 has a bottom wall 32 whereby it can act as a sump for receiving water discharged from the tub and pumping means, not shown, may be provided for draining the sump.

The base portion 10 at the center thereof has a shallow metal cup 34 supporting a rubber-like member 36 that receives a fairly large metallic ball 38 on top of which rests a second metallic cup 40 secured to the lower end of a screw 42 that is screw-threadedly mounted in a boss projecting from the lower surface of a transmission housing 44.

The transmission housing 44 is rigidly secured to a framework 46 parallel with base 10 and between the corners of framework 46 and the corners of base 10 are connected the snubbers 48 which will be described more in detail hereinafter.

Referring now to Figure 2 together with Figure 1, the tub structure 22 will be seen to comprise an imperforate portion 50 forming the tub proper and mounted about the upper open edge of which tub proper is a crown member 52 that is also dependent about the periphery of the tub 50 for supporting a balancing ring or jacket 54.

The bottom wall of tub 50 extends inwardly and has a relatively small central aperture therein and within which aperture is welded the upper end of a sleeve 56, the lower end of which is welded at 58 to a shallow inverted conical member 60 that has a marginal flange about its base at 62 that is rigidly connected with tub 50 as by spot welding.

Sleeve 56 surrounds and is keyed to a smaller sleeve 64 that extends downwardly into transmission housing 44 and serves to support the tub structure. Firmly connected with the upper end of the smaller sleeve 64, as by screw threads, is a column 66 extending upwardly on the axis of the tub structure to above the normal water level therein. A gasket 68 seals between a flange adjacent the bottom of column 66 and the upper surface of the bottom wall of the tub. The described assembly of the tub structure, sleeves 56 and 64, and column 66 is thus substantially rigid and water-tight against leakage at the bottom of the tub.

Rotatable within smaller sleeve 64 is the agitator shaft 70 of the machine, and this extends upwardly through a journal 72 in the upper end of column 66 and out the top of the said column to a splined end portion 74. Splined end portion 74 is adapted for nonrotatably receiving a correspondingly internally splined upper end of a vaned agitator member 76 adapted for engaging a bearing 78 adjacent the lower end of column 66.

A manually operable clamp screw 80 serves for releasably retaining agitator member 76 on agitator shaft 70.

Turning now to Figure 1, it will be seen that arranged between the lower end of sleeve 56 and an upstanding flange 82 that surrounds a central aperture 84 in the bottom wall 32 of splash shield 28 is a resilient rubber-like accordion sleeve 86. The described arrangement forms a seal about aperture 84 in wall 32, but, at the same time permits lateral movement of the supporting and driving arrangement for the tub structure and agitator extending from transmission housing 44 upwardly through the said aperture.

The drive for the tub structure and agitator is not disclosed in any detail in the instant application but is illustrated and described completely in my copending application Ser. No. 377,153, filed August 28, 1953 and entitled "Drive For Automatic Washer."

In brief, there is provided a reversible electric motor 88 driving a flexible belt 90 that passes over a pulley 92 and also engages a drive member adapted for being clutched to sleeves 56 and 64.

In one direction of rotation belt 90 drives pulley 92 and through a drive mechanism in transmission housing 44 drives the agitator shaft 70 and agitator member 76 in oscillating movement while the tub structure is simultaneously braked stationary to the frame of the machine. In the opposite direction of rotation of motor 88 pulley 92 is unclutched from the agitator shaft, and, instead, the member that is driven by belt 90, previously referred to, is clutched to sleeves 56 and 64, while simultaneously the agitator shaft is also clutched to the said sleeves, whereupon the entire tub structure, including the agitator, is driven in rotation as a unit and at substantial speed.

Returning now to the tub structure, the exact nature thereof is clearly illustrated in Figures 2 through 7. In these figures, it will be observed that the tub proper 50 has a peripheral flange 94 extending radially outwardly therefrom about its upper edge. The crown 52 which surrounds the upper open end of the tub has a plurality of vertically extending radially inwardly indented portions 96 which closely embrace the outer edge of flange 94 of the tub and thus locate the tub and crown radially. As will be seen in Figure 4, I may provide eight indented portions about the periphery of the tub, although a greater or lesser number could be utilized, if desired.

It will also be observed, particularly in Figures 4, 5, and 6, that interposed between the radially indented portions 96 in crown 52 are the axially indented portions 98 which bear on the upper face of flange 94 of the tub, and thus provide means for axially locating the crown on the tub. The indented portions 98 are provided with apertures 100, and these apertures are availed of for welding the tub to the crown, thus making a rigid integral structure. It will be evident that the indented portions 96 and 98 provide complete means for exactly locating the crown and tub when they are assembled, and that the said indentations can quite readily be formed in the crown by ordinary pressing techniques and do not complicate the structure or make it expensive to manufacture.

It will also be observed that because of the axially indented portions 98, there are vertical spaces 102 between the top of the tub and the bottom of the crown, and these spaces communicate with the radial spaces 104 between the outer periphery of flange 94 and the crown that are provided by the radial indentations 96. These passages provide a flow path for water centrifuged from the tub during a spin cycle and may be considered as metering passages in that they will permit the discharge of water from the tub at a predetermined rate.

Extending radially outwardly from the bottom of the crown 52 is a flange 106 which engages an inwardly extending flange 108 about the upper edge of the balancing ring or jacket 54. The flanges 106 and 108 are rigidly interconnected as by welding 110 whereby the tub, crown and balancing ring form an integral structure after assembly.

Turning now to Figures 2 and 3, it will be observed that the balancing ring 54 has a vertical side wall portion 112 and a lower intumed flange 114. Extending vertically inside the balancing ring is a plurality of baffle plates 116 having tabs 118 turned up from their outer edges and secured to the balancing ring as by the spot welding 120.

The baffle plates 116 are slightly spaced from the balancing ring where they are not connected thereto by the tabs 118, as is indicated by the spaces 122. The baffle plates thus permit circumferential movement of fluid within the balancing ring but serve to inhibit surges thereof and to control the rate of said circumferential movement, and likewise serve to cause any water that is within the balancing ring to accelerate with the balancing ring as the tub structure is coming up to speed during the spin cycle thereof.

The particular construction illustrated for the balancing ring, and the location of the balancing ring vertically along the tub is of importance in that counterbalancing liquid that is within the balancing ring, and which serves to counterbalance an unbalanced load within the tub, is in approximately the same horizontal plane as the clothes within the tub that are creating the unbalanced condition whereby the counterbalancing of the tub is accomplished without setting up a couple thereon that would tend to load the supporting shaft and bearings of the tub structure.

Rather, the counterbalancing of the tub structure takes place entirely within the tub structure, and this has a tendency materially to prolong the length of life of the supporting bearings for the tub structure, as well as permitting a lighter construction than would otherwise be possible.

As to the particular height of the balancing ring, it has been found that with the tub spinning, and with water in the balancing ring, if the tub tilts a perpendicular surge of the fluid within the balancing ring is set up, because, upon tilting the tub the upper flange of the balancing ring on one side will press down on the water therein, while the lower flange on the opposite side will press upwardly on the water therein. This will create a vertical surge in the water moving downwardly on one side and upwardly on the upper side, and with the two waves being 180° out of phase. By constructing the balancing ring of such a height relative to its diameter that these waves will balance each other out, it is possible to produce a structure in which the vertical surging of the fluid is entirely eliminated.

I have determined that the balancing ring should not exceed seven and one-half inches in height to cause the waves to cancel each other out and, in practice, the ring is formed to a height of seven inches.

In Figure 3 there is disclosed the details of construction of a typical one of the snubbers 48. In this figure it will be seen that one end of the snubber comprises a U-shaped member 150 having an anchor bolt 152 and with the upstanding leg portions of the U-shaped part 150 being channel-shaped in cross-section. The other portion of the snubber is an elongated resilient U-shaped member 154 having friction pads 156 on the ends of its legs bearing on the inside faces of the channel-shaped legs of part 150.

An anchor bolt 158 is provided for part 154 and a tension spring 160 interconnects the anchor bolts inwardly of the parts 150 and 154. The arrangement provides means for resiliently holding the tub structure and the drive mechanism therefor downwardly against supporting ball 38, while at the same time permitting tilting movements of the machine about the said ball, and with the snubbers damping the tilting movements, particularly when the tub structure is operating below or at critical speed.

Operation

In operation, assuming the tub 50 to contain clothing and water, and that a washing cycle has been completed during which the tub structure was held stationary and the agitator member 76 oscillated to and fro, a spin cycle is initiated by reversing motor 88, which will serve to clutch the tub structure and the agitator member together, to release the tub structure from the brake which has been holding it stationary, and to commence acceleration of the tub structure and agitator member in rotary movement.

As the tub structure and agitator member commence to rotate, the clothes and water therein will also commence to rotate, and the agitator member, in turning with the tub structure, particularly assists in bringing the clothes and water therein up to the speed of the tub. As the tub structure and its contents begin to speed up, the water will move outwardly and upwardly in the tub until it commences to spill through the passage between the tub and crown into the balancing ring. When the tub structure is rotating below the critical speed thereof, the heavy side of the tub structure will be thrown outwardly, and the tiltable support for the tub structure will permit the tub structure to gyrate about a vertical axis heavy side out.

At this time, any water that is in the balancing ring will not tend to counteract this condition of unbalance, but will add to it. However, the construction of the rotating parts and the support therefor is such that the critical speed occurs in the neighborhood of about eighty to one hundred twenty revolutions per minute, and, at this low speed, the forces of unbalance are fairly small. Because these forces of unbalance are relatively small, the snubber means 48 are ample to limit the gyratory movement of the tub structure to within reasonable limits.

It is to be noted, however, that this value of critical speed is high enough that the tub structure remains stable and stationary during a working cycle when only the agitator is in motion.

Furthermore, since the inclined sides of the tub incline off the vertical only by 5°, and the passages between the crown and the tub are in the form of metering passages, by the time the tub structure reaches its critical speed, there is only a small amount of water in the balancing ring, and the clothes within tub 50, which may be largely concentrated on one side thereof, are buoyed up by the water within the tub, whereby a condition of minimum unbalance for the distribution of the clothes will obtain.

During the brief period that the tub structure is being accelerated through critical speed, the gyration thereof about a vertical center line is somewhat erratic, because it is changing from a condition where it rotates heavy side out to the condition where it will rotate heavy side in above critical speed. During this brief period, however, the snubber means limit any excessive gyration of the tub structure.

As the tub structure continues to accelerate above critical speed, there is increased flow of water through the metering passage means between the tub and crown and into the balancing ring, and the quantity of water within the tub is thus reduced, and any condition of unbalance thereof due to the distribution of the clothes therein, becomes more pronounced, and lateral forces on the tub because of this unbalance become greater because of the greater speed of rotation of the tub. At this time, however, the tub is rotating heavy side in, and the water that is in the balancing ring will move to the side of the balancing ring opposite the heavy side of the tub and will counterbalance the unbalanced load within the tub.

During this period, any excess of water delivered to the balancing ring over what can be retained therein will

spill out the bottom of the balancing ring into the splash shield to be discharged to drain.

As the spinning of the tub continues, it may reach a top speed on the order of eleven or twelve hundred revolutions per minute, although normally a top speed of 750 to 800 revolutions per minute is satisfactory for spin drying, and will continue to spin for a predetermined length of time. During this period the clothes in the tub have the water centrifuged therefrom, and there will thus be a change in the condition of unbalance in the tub which will be reflected in the tub taking a new gyratory path, and the water in the balancing ring will be redistributed to maintain the tub structure in perfect balance.

During the high speed rotation of the tub structure, the forces of unbalance that might be created by shifting of the clothes within the tub or the change in water content of the clothes in the tub are sufficiently great readily to overcome the damping action of the snubbers, whereby the tub will quickly move to the proper position to create perfectly balanced conditions.

At the end of a spin cycle, the tub structure is halted, and at this time any water remaining in the balancing ring will pour from the bottom thereof into the splash shield and then to drain.

The connection of the balancing ring to the crown ring can advantageously be made detachable, as illustrated in Figure 9, wherein the crown ring 200 resting on and welded to tub 202 is secured to balancing ring 204 by means of bolts 206 and nuts 208. Bolts 206 may advantageously be inserted upwardly through the top flange of the balancing ring and welded thereto if desired. The arrangement of Figure 9 has the important advantage of permitting detachment of the balancing ring from the tub for field servicing should it become necessary.

Another distinct feature that obtains in connection with the detachable arrangement of the balancing ring on the crown ring is that in the manufacturing of the machine, the crown ring and tub can be finished with a vitreous enamel, while the balancing ring can be finished with a less expensive synthetic enamel.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions, and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. In a washing machine of the nature described; a tub structure comprising an imperforate tub open at the top for receiving clothes and having its side walls tapering outwardly toward the top, an annular balancing ring coaxial with said tub and surrounding the tub in the region of the level of a load in the tub, said balancing ring having a vertical outer wall and flanges extending radially inwardly at the top and bottom of said wall, a crown ring mounted about the top of the tub and having a wall extending inwardly above said tub and a skirt encircling said tub and dependent therefrom, means securing said crown ring to said tub substantially at the top thereof, said crown ring skirt and said balancing ring being rigidly interconnected, said balancing ring and said crown ring being supported solely by the attachment of said crown ring to said tub and depending from the top of said tub, and said crown ring and tub being formed to provide a plurality of openings between the tub and crown ring to provide for the controlled discharge of fluid from the tub into said balancing ring during rotation of the tub structure.

2. In a washing machine of the nature described; a tub structure comprising an imperforate tub open at the top for receiving clothes and having the side walls of the tub tapering outwardly toward the top and there being a radially outwardly projecting flange about the upper open end of the tub, an annular balancing ring surround-

ing said tub coaxial therewith at about the level of a load within the tub, said balancing ring having a vertical wall and radially inwardly projecting circumferential flange at the top and bottom ends of said wall, a crown ring mounted about the top of said tub having a dependent skirt portion about said tub rigidly joined to the flange at the upper end of said balancing ring, said crown ring having alternate offset portions whereby to engage the top and outer surfaces of the flange about the tub at spaced points about the tub to locate said crown ring and tub relatively and also to provide openings between the crown ring and tub through which water is discharged from the tub to the balancing ring during rotation of the tub structure.

3. In a washing machine of the nature described; a tub structure comprising an imperforate tub open at the top for receiving clothes and having its side walls tapering outwardly toward the top and with an outwardly projecting flange about the top of the tub, a crown ring resting on top of the tub tapering upwardly and inwardly therefrom to define an opening smaller than the top of the tub and having a dependent skirt about the upper portion of the tub, said crown ring being provided with circumferentially spaced axially recessed portions engaging the upper face of said flange and circumferentially spaced radially indented portions engaging the outer periphery of said flange whereby said tub and crown ring are precisely located relative to each other, an annular balancing ring surrounding the tub and coaxial therewith, said balancing ring comprising an outer vertical wall and in-turned flanges at the top and bottom ends of said wall, the flange at the upper end of the balancing ring being rigidly joined to said dependent skirt on the crown ring, the said indentations in said crown ring providing for spaces between the crown ring and the tub to provide for the discharge of fluid from the tub into the balancing ring during rotation of said tub structure.

4. In a washing machine of the nature described; a tub structure comprising an imperforate tub open at the top for receiving clothes and having its side walls tapering outwardly toward the top and with an outwardly projecting flange about the top of the tub, a crown ring resting on said flange tapering upwardly and inwardly therefrom to define an opening smaller than the top of the tub and having a dependent skirt about the upper portion of the tub, said crown ring being provided with circumferentially spaced axially recessed portions engaging the top of said flange and circumferentially spaced radially indented portions engaging the outer periphery of said flange whereby said tub and crown ring are precisely located relative to each other, an annular balancing ring surrounding the tub and coaxial therewith, said balancing ring comprising an outer vertical wall and in-turned flanges at the top and bottom ends of said wall, the flange at the upper end of the balancing ring being rigidly joined to said dependent skirt on the crown ring, the said indentations in said crown ring providing for spaces between the crown ring and the tub to provide for the metered discharge of fluid from the tub into the balancing ring during rotation of said tub structure, said balancing ring comprising baffle means therein inhibiting surging of the fluid therein but permitting circumferential movement of the fluid about the balancing ring.

5. In a tub structure for a washing machine of the nature described; an imperforate tub having a bottom wall with a central aperture and having its side walls tapering outwardly toward the top, a frusto-conical element having its base secured to the bottom of the tub and projecting downwardly therefrom, a sleeve member extending through said frusto-conical element and the aperture in the bottom of said tub and rigidly secured to both said tub and element, a crown ring mounted on top of the tub tapering inwardly and upwardly there-

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from and having a dependent skirt surrounding the upper part of the tub, said crown ring being provided with both axial and radial indentations engaging the top and peripheral edges of said tub, thereby to locate the crown ring and tub relatively, apertures in said axial indentations and welding in said apertures connecting the tub with the crown ring, and a balancing ring having an in-turned upper flange connected with the bottom of said skirt portion of the crown ring and an in-turned bottom flange spaced from the outer periphery of said tub, the space between the crown ring and tub provided by said indentations forming metering openings for the discharge of fluid from said tub into said balancing ring during rotation of said tub.

6. A washing machine comprising a tub for receiving clothes and having side walls tapering outwardly to a top edge, the tub being substantially imperforate, an annular balancing ring surrounding said tub coaxial therewith at about the level of a load within the tub, and a crown ring mounted about the top of said tub and

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joined to said balancing ring, said crown ring having a plurality of inwardly directed embossments engageable with the outer portion of the tub adjacent the upper edge thereof and a further plurality of embossments engageable with the top of the tub adjacent the upper edge thereof, said embossments locating said crown ring and said tub relative to one another and providing openings between the crown ring and tub through which water is discharged from the tub to the balancing ring during rotation of the tub.

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