

March 9, 1943.

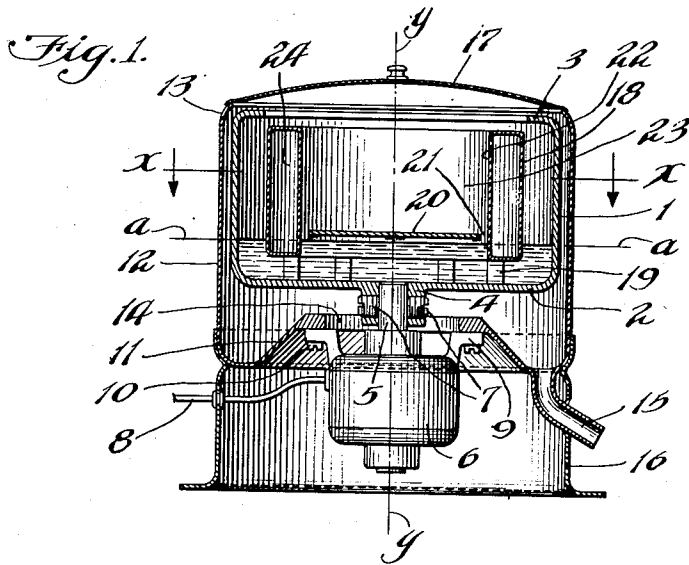
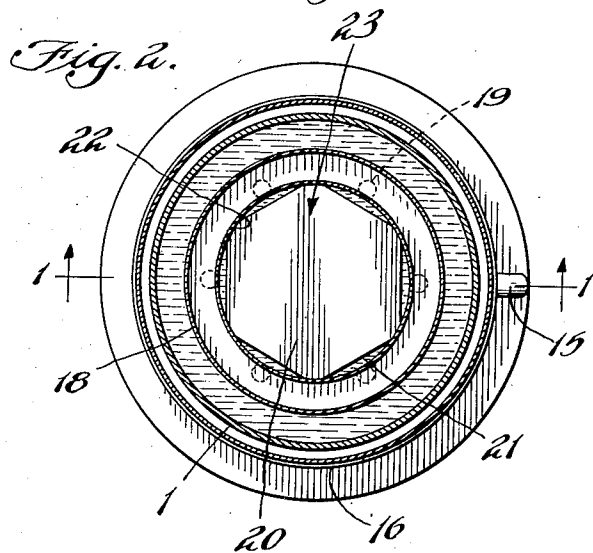
R. M. HVID

2,313,644

FORCED VORTEX BALANCING APPARATUS

Filed April 22, 1940

3 Sheets-Sheet 1.



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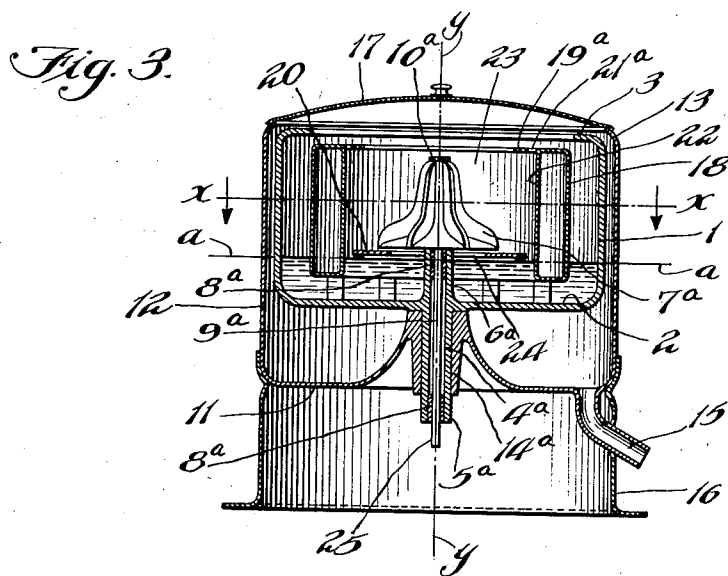
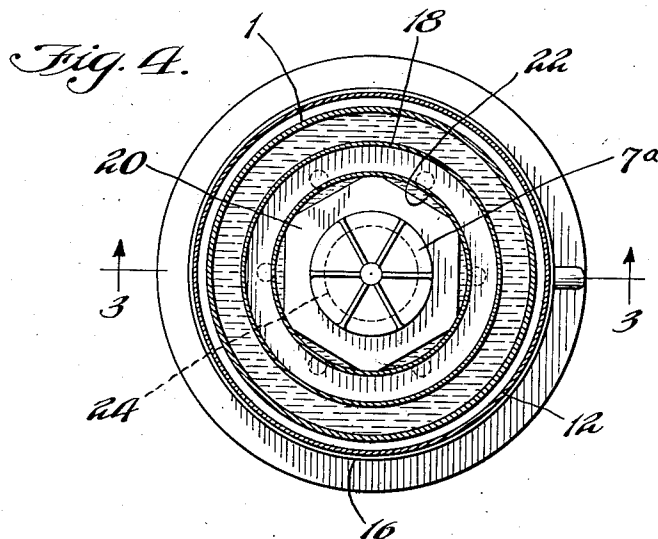
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FORCED VORTEX BALANCING APPARATUS

Filed April 22, 1940

3 Sheets-Sheet 2



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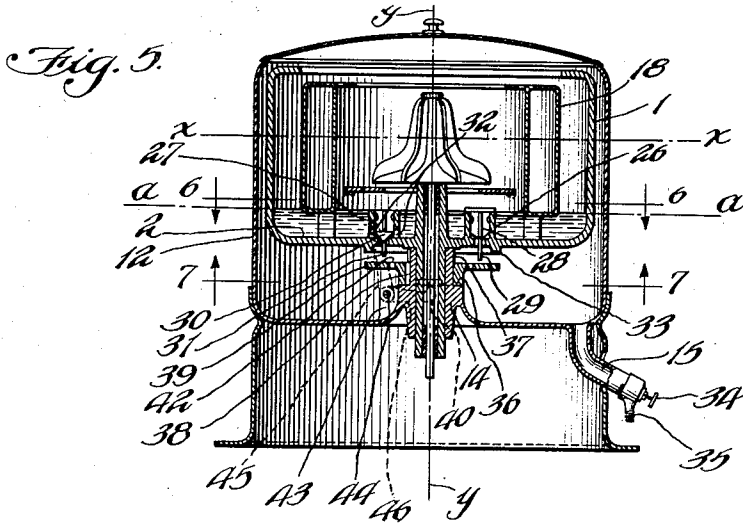
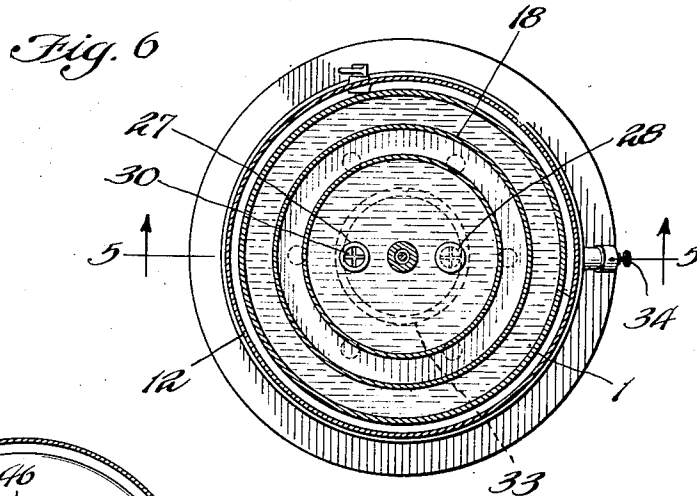
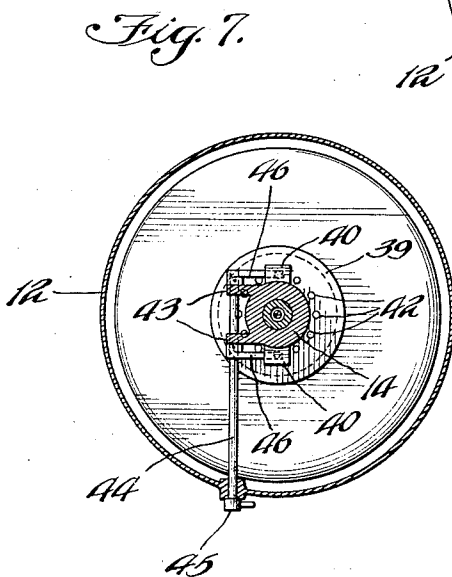
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FORCED VORTEX BALANCING APPARATUS

Filed April 22, 1940

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,313,644

FORCED VORTEX BALANCING APPARATUS

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Application April 22, 1940, Serial No. 330,966

8 Claims. (Cl. 68—23)

Having invented a new method of counteracting forces by employing a forced vortex in a liquid in a novel way, and apparatus embodying this method, I herein fully disclose the invention by means of the accompanying drawings, description and claims. The invention is of particular importance in connection with balancing problems wherein the weight of the rotating mass and the position of its center of gravity change during the rotation, neither change being subject to control.

Apparatus in which centrifugal force is utilized for the purpose of separating a liquid from solids is an example in which this problem exists, and the invention has special adaptation to drying of clothes and similar materials in a washing machine. The invention may also be used for extracting liquids, such as oil, from metal chips, dye solutions from yarn or cloth, sugar liquor from sugar beets, and many other uses.

The invention will first be described in connection with the drying of clothes in a machine adapted for that purpose; secondly, it will be described as being embodied in a washing machine. It will be perfectly obvious that the machine which will be described first may also be used for other purposes, as mentioned above.

In the washing machine art the invention is designed to prevent a washing machine embodying a centrifugal drying mechanism from moving around on the floor during the drying of the clothes. Centrifugally drying a mass of wet clothes in the mechanisms now on the market is generally considered to have been satisfactorily performed if the clothes, after the drying operation, contain an amount of water equal to the dry weight of the clothes. In the present invention it is expected that the amount of water usually remaining in the clothes after the drying operation may be reduced at least by one-half. In such case the clothes may be ironed immediately.

The trouble with the prior art washing machine embodying a centrifugal drying mechanism is that the R. P. M. of the drying mechanism cannot be very great and usually ranges between 300 and 600 R. P. M., depending, of course, upon the diameter of the drying cylinder which houses the wet clothes. This limitation in the R. P. M. is the result of the fact that the center of gravity of the rotating mass of wet clothes is not coincident with the axis of rotation. In my invention a means is provided which corrects or compensates for this trouble and, as a matter of fact, permits the centrifugal

drying mechanism to be operated at any speed up to the safe speed for the material of which the mechanism is made. This, of course, means that in my invention the centrifugal force created because the center of gravity of the wet clothes is not in the axis of rotation is always opposed by another force exactly balancing it.

In the drawings:

Figure 1 is a partial vertical section on the center line 1—1 in Fig. 2, and Fig. 2 is a horizontal section on line x—x in Fig. 1, both of these diagrammatic views illustrating a machine embodying one form of my invention, and which may be utilized for the purpose of drying or separating materials;

Fig. 3 is a partial vertical section on the center line 3—3 in Fig. 4, and Fig. 4 is a partial horizontal section on line x—x in Fig. 3, both of these diagrammatic views illustrating a clothes washing machine that embodies one form of my invention;

Fig. 5 is a partial vertical section on the center line 5—5 in Fig. 6, and Fig. 6 is a horizontal section on line 6—6 in Fig. 5, and Fig. 7 is a horizontal section on line 7—7 in Fig. 5, all of these diagrammatic views illustrating a modified form of the apparatus of Figs. 3 and 4.

The terms "vertical" and "horizontal" refer to the views in the drawings only, as the machines themselves do not necessarily have to be mounted thus.

Referring to Figs. 1 and 2, which show the single purpose machine referred to above, 1 is a round tub having a flat bottom 2 and an inwardly extending rim 3 of uniform width at its top. A shaft boss 4 is located at the center of bottom 2. Boss 4 is adapted to receive the upper end of armature shaft 5 of electric motor 6. Screws 7 and 7' position and secure tub 1 to armature shaft 5. The electric power cable 8 is a means to connect electric motor 6 to a suitable electric outlet whenever demanded. The upper end of motor 6 is provided with feet 9. Screws 10 position and secure motor 6 to the underside of bottom 11 of outer tub 12. Tub 12 is provided with a rolled-in rim 13 at its top and a central opening 14 in bottom 11. Bottom 11 is also provided with a drain-pipe 15. Tub 12 rests upon and is suitably secured to lower skirt 16. The opening in the top of outer tub 12 is fitted with removable cover 17. The lower skirt 16 supports the whole apparatus when resting upon the floor.

On the inside of tub 1 is placed member 18, which I will call a spinner. I prefer to make this spinner light of weight, and I have therefore

shown it as a hollow, ring-shaped member made of light metal. The hollow space or chamber 24 in it should be sufficiently tight to prevent any liquid from entering it. Spinner 18 is movably supported upon the inner flat surface of bottom 2 by means of feet 19 which are suitably affixed to the spinner. The spinner may slide anywhere and take any position inside tub 1. Near the lower end of spinner 18 I secure in a suitable manner spinner bottom 20. Openings 21 between surface 22 and spinner bottom 20 are provided by cutting away the edges of bottom 20, as best shown in Fig. 2.

The radial thickness of the spinner, which is equal to the difference between the outside radius and the inside radius of the spinner, is greater than the width, measured on a radius, of rim 3 of tub 1; and the inside height of tub 1 between bottom 2 and rim 3 is greater than the height of the spinner 18 including feet 19.

Referring to Figs. 3 and 4, which show a washing machine embodying my invention, 1 is a round tub having a flat bottom 2 and an inwardly extending rim 3 of uniform width at its top. A shaft boss 4 is located at the center of bottom 2. Boss 4a extends downward, and at 5a is adapted to be suitably connected to a source of power, such as an electric motor, by means of which tub 1 may be put into rotation or stopped, as desired. Inside tub 1 is an upwardly extending boss 6a on the same center line as boss 4. The upper end of boss 6a extends to or into agitator 7a. Boss 4a and extension boss 6a are bored out as shown, and at top and bottom are fitted with bearings 8a and 8a. Agitator shaft 9a fits bearings 8a and 8a with a running-fit, and shaft 9a is adapted to be suitably connected to agitator 7a at its top end by means of nut 10a. The lower end of agitator shaft 9a at 25 is suitably adapted to be connected to a suitable source of power, which may be the same source of power as is used for the purpose of rotation of tub 1. The mechanism for operating the agitator through agitator shaft 9a must be such, however, that a reciprocating or to-and-fro motion is imparted to the agitator in a manner well known in the washing machine art. The interconnection between tub 1, the agitator 7a, and the power source should be such that when the agitator is in operation the tub stands still, and when the tub is in rotation the agitator is free to rotate with the tub, or it may be coupled to and rotate with the tub. Agitator 7a is removable from the machine by first removing nut 10a. A suitable thrust bearing and packing (not shown) is provided between the upper bearing 8a and the agitator so that water cannot leak out of the machine along shaft 9.

Tub 1 rests upon the upper end of boss 14a located in the center of bottom 11 of outer tub 12. Boss 4a is a running-fit in boss 14a, and the upper end of boss 14a acts as a thrust bearing to carry the weight of tub 1 with its contents. Tub 12 in its bottom is provided with drain-pipe 15 and at its top with rolled-in edge 13. The opening in the top of outer tub 12 is fitted with removable cover 17. Lower skirt 16 supports the whole apparatus upon the floor.

Spinner 18, placed inside tub 1, is similar to the spinner shown in Figs. 1 and 2, with two exceptions. First, the spinner herein is shown having a rim 19a attached to its upper end. This rim extends inwardly and is provided with a plurality of openings 21a all around and flush with the inner surface 22 of the spinner. Secondly, 75

a circular opening 24 is made in the center of spinner bottom 20 as shown.

Referring to the washing machine shown in Figs. 5, 6, and 7, all the parts in this machine are similar to the parts in the machine shown in Figs. 3 and 4, except for the following described changes and additions. Inside bottom 2, tub 1, two upwardly extending bosses 26 and 27 are located. These bosses extend up to waterline a-a and are bored out alike to a larger diameter extending from the top of the bosses to a line flush with the inside surface of bottom 2, and to a smaller diameter through bottom 2. Boss 26 accommodates valve 28 which is fitted with guide vanes of ordinary design, and having a downwardly extending stem 29 as shown. The valve seat on boss 26 is at its upper end, and the valve seat on the head of valve 28 co-operates with the valve seat on the boss when the valve is closed. In the bore in boss 27 valve 30 is located. This valve is also fitted with a downwardly extending stem 31 which is somewhat shorter than stem 29 of valve 28. The valve is similarly fitted with guide vanes fitting the bore and a valve seat which, when the valve is closed, co-operates with the upper edge of the small bore through bottom 2. Openings 32 are made in boss 27 close to the inside surface of bottom 2. These openings form means of communication between the large space in tub 1 and the space immediately above the seat for valve 30. Except when the valves are being operated, they are held against their seats by their own weight, and in such case the water contained in tub 1 cannot leak out through the valves into outer tub 12.

Bosses 26 and 27, including their respective valves, must be so located and proportioned that they cannot at any time while tub 1 is in rotation interfere with the free movement of spinner 18 inside tub 1, nor affect the dynamic balance of tub 1.

On the underside of bottom 2 is located circular rib 33 having a flat horizontal face on its bottom.

Drain-pipe 15 from outer tub 12 is fitted with a drain-valve 34 as shown. This valve has a tubular projection 35 to which a drain-hose may be connected. Drain-valve 34 may be used to control the flow of water from the inside of tub 12, as desired and I prefer that the volume in tub 12 below the bottom of tub 1 be such that the maximum amount of water used at one time in the machine can be contained in tub 12 without touching the bottom of tub 1 while this tub is in rotation.

In the center of the bottom of tub 12 is located boss 14. This boss has a flat annular face 36, as shown. Upwardly from this face extends a cylindrical extension 37, the top face of which constitutes a bearing to carry the weight of tub 1 with its contents. On the side of extension 37 a longitudinal groove is cut for key 38. Surrounding extension 37, and with a sliding fit upon it, is a flanged member 39. This member is formed with a downwardly extending hub having at its lower end two diametrically opposed projections or ears 40, shown best in Fig. 7. Inside the bore of flanged member 39 is cut a keyway to fit key 38. When assembled, flanged member 39 can move up and down between limits but cannot rotate. Drain openings 42 are suitably located in flanged member 39. The outside diameter of member 39 corresponds to the outside diameter of circular rib 33 on tub 1, and its upper face is flat to correspond to the flat lower face

of circular rib 33. Normally, member 39 rests upon annular face 36, due to its own weight.

Projections 43 are fitted to or made integral with boss 14, and holes through them provide bearings for shaft 44. This shaft extends out through the side of outer tub 12 through a bearing in the tub wall, as shown, and handle 45 is secured to the outer end of shaft 44. Two levers 46 are secured to shaft 44 and straddle boss 14, and are adapted to contact and engage ears 40 on flanged member 39.

Operating handle 45 to the left, referring to Fig. 5, results in the lifting of member 39 and successive opening of valves 28 and 30. Continued movement of handle 45 brings the top face of flanged member 39 into contact with the bottom face of circular rib 33.

The power source and mechanism between it and the parts shown in Figs. 3 to 7, inclusive, are no part of my invention and are therefore not shown. Such details are well known in the art. A suitable mechanism for this purpose is, for instance, shown and described in United States Patent No. 2,035,481, issued March 31, 1936, to J. T. Hume.

Having now described the machines shown in Figs. 1 to 7, inclusive, in all of which my invention is incorporated, the method upon which they operate will be explained.

To simplify the explanation, refer to Fig. 1 and assume that spinner 18 is removed from tub 1 and that the tub is partially filled with water to line $a-a$. Tub 1 is therefore empty except for the water it contains. Let reference line $y-y$ represent the axis of symmetry and also the axis of rotation of tub 1, and let the tub be put into rotation by means of electric motor 6.

From the science of hydraulics we know that if an open cylindrical vessel, in which the axis of symmetry is also the axis of rotation, is partially filled with water and made to rotate, as the contained water acquires the angular velocity of the vessel, its free surface, which at first is horizontal, becomes dish-shaped or concave in form. The form of free surface is that of a paraboloid of revolution with its vertex on the axis of rotation.

In the present case, the angular velocity of the tub and the water gradually increases until the maximum speed of the motor has been reached, and a point is soon reached after the tub commences to rotate, when the whole ring-shaped volume in the tub below rim 3 is completely filled with water. When the angular velocity becomes sufficiently high, the free surface becomes almost cylindrical, and excess water, if any, flows from inside the tub over the rim 3 and into outer tub 12 from whence it passes out through drain 15. The annular-shaped body of water is a "forced vortex." While, as said before, the free surface of the vortex is almost cylindrical, and for purposes herein may be assumed to be so, it may be stated that, as a matter of fact, the free surface is still parabolic in form and is now that of a frustum of a paraboloid of revolution with its vertex on the axis of rotation.

The pressure intensity in the water at the free surface of the vortex is zero. The pressure intensity at any point in the water, at the same radial distance and in the same plane perpendicular to the axis of rotation, is the same. As a consequence, the tub with the water is in perfect dynamic balance about the axis of rotation during rotation.

Assume now that the spinner is replaced in the tub and that a mass of wet clothes is placed upon

bottom 20 in space 23 in the spinner; also that the tub contains an amount of water to line $a-a$. The tub is now again put into rotation, and the water in the tub gradually, as explained before, and as the angular velocity increases, assumes the annular form in the inner circumference of the tub.

Rotation of the tub causes the spinner to rotate with it, and as the center of gravity of the spinner, including the wet clothes, does not coincide with the axis of rotation, a centrifugal force acting upon the spinner and clothes is created. When this centrifugal force, as the result of the increasing angular velocity, becomes strong enough to overcome the frictional resistance existing between the spinner feet and the bottom of the tub, the spinner with its load of clothes shifts outwards toward the inner circumference of the tub and moves into the vortex. A certain amount of water in the vortex is thus displaced, and that of course leaves the vortex over the upper rim of the tub. In the vortex, below the free surface, the intensity of pressure is greater as the radial distance from the axis of rotation is greater, and the depth to which the spinner moves into the vortex of course depends upon the strength of the centrifugal force due to the spinner with its contents and the force opposing it. The opposing force, it will be readily understood, is the force or pressure in the water of the vortex acting upon the immersed outside surface of the spinner. Both are radial, and when the spinner has moved into the vortex to a position in which they exactly balance one another, a condition of dynamic balance exists.

With the spinner partly embedded in the vortex, the spinner will rotate with the same angular velocity as the tub, due to the frictional contact between the vortex and the outside surface of the spinner. It will also be understood that as soon as the machine begins to rotate, centrifugal force begins to affect the water contained in the clothes, and that as the rotation increases, this effect becomes more powerful. The result is that the water in the clothes finds its way through them to the inner surface 22 of the spinner. It then seeps along this surface, below the clothes, and to both ends or to one end of the spinner and is thrown out into the vortex. We thus have separation of water from the clothes, or in other words, we are drying them. Now, as the water leaves the clothes, the spinner with its contents becomes lighter; consequently, the centrifugal force becomes less and the spinner's embedment in the vortex becomes less. This means that the radial thickness of the vortex lessens. But now the water thrown off from the clothes enters the vortex and thus keeps it replenished. If at the beginning of rotation more water is thrown off from the clothes than the vortex can accommodate, such water is thrown over the rim of the tub and drained off from the machine as explained before.

When the clothes are put into the spinner before the machine is put into operation, no special care is required in arranging them in space 23. Consequently, the center of gravity of the clothes is in no definite location. Again, it will be readily understood that as rotation begins and continues, and as the weight of the wet clothes changes and becomes continually less, the position of the center of gravity of the clothes also changes. It may move in any direction. When the center of gravity of the spinner with its contents of clothes is in the middle of the vertical height of the spinner, the pres-

sure of the water in the vortex during rotation acts evenly against the top and bottom outside areas of the spinner wall. If, however, the center of gravity is either higher or lower than this middle position, the centrifugal force of the spinner, acting through the center of gravity, will have a tendency to tilt the spinner to a position in which one end of the spinner will be immersed more than the other in the vortex. In such case, however, the end of the spinner which has to be resisted most moves into a zone of higher pressure in the vortex, and the end which has to be resisted less moves into a zone of less pressure, and the centrifugal force of the spinner is, in such case also, completely counteracted and balanced.

It will be understood, therefore, that whatever the unbalanced weight of the spinner with contents is, or wherever its center of gravity is, or moves to, during rotation, the centrifugal force due to the spinner and its contents is always completely balanced at any speed of rotation. The location of spinner bottom 20 is such that when the machine is stopped after a drying operation, this bottom, is above water line *a-a* in tub 1.

In designing the machine, care must be taken that with the greatest possible out-of-balance condition of the spinner with its contents, the depth or thickness of the water in the vortex, measured on a radius, is sufficient, so that the spinner cannot during rotation contact the inner cylindrical surface of the tub and thus exert pressure upon it, because in such case the forces will not be completely balanced and the machine may move or rock on the floor. Obviously, from the standpoint of dynamic balance, it appears advantageous to make the spinner as light as possible. However, for the machines shown and described herein I prefer to make the spinners reasonably heavy, so that the buoyancy effect of the water acting upon the spinner in a vertical direction cannot float the spinner. I find, in general, that extreme low weight of the spinner is not necessary; in fact, the specific gravity of the spinner may be either less or more than the specific gravity of the water or the liquid forming the forced vortex, depending of course upon the other features of the design and upon the purpose for which the machine is intended.

Referring to Figs. 1 and 2, it will be observed that the outside diameter of spinner 18 is such that it may be inserted through the opening in the top of tub 1 formed by rim 3. I have built and tested such a machine. I have also built and tested a machine differing from the design shown in Fig. 1, in that the outside diameter of the spinner is larger in diameter than the diameter of the opening in rim 3 in tub 1. This, of course, necessitated that rim 3 be made in a separate piece for assembly purposes. The operation of both machines of course is similar because the underlying principle is the same, although for definite purposes one or the other of the designs may be preferred.

In the operation of the washing machine shown in Figs. 3 and 4, the dry clothes are placed in space 23 of spinner 18 and tub 1 is filled with soap-water to line *x-x* shown in Fig. 3. The agitator is then put into operation, and the clothes will now be washed in the same manner as in an ordinary agitator-type washing machine.

After the washing operation is completed, the agitator is disconnected from its driving mechanism and left free to rotate with tub 1. Said tub

1 is now put into rotation, and as its angular velocity increases, the water, with the clothes, near the center of the machine sinks down, depositing the clothes upon the lower part of the agitator, bottom 20 and against the inner surface 22 of the spinner. At the same time, the water rises along the inner circumference of tub 1, and the excess water, over and above the water required to fill the "forced vortex," is discharged by centrifugal force from the tub 1, over rim 3, into outer tub 12, from whence it is drained off through drain-pipe 15. The action of the water during rotation is exactly similar to the description given before for the other machine, and the action and behavior of the vortex and the spinner 18 containing the wet clothes, in the present machine, are also similar.

After the machine has been in operation a short while, most of the wash-water has left the clothes, and rinsing water is then introduced into space 23. The clean water passing through the clothes of course cleanses them. Several changes of rinsing water may be introduced if desired, and after the last one, and after a slight lapse of time, the machine may be stopped and the clothes removed. They will be found quite dry.

Rim 19a, which is attached to the upper end of the spinner, is a guard to insure that when a heavy load of clothes is being handled, part of the clothes does not leave space 23 over the upper end of the spinner. Openings 21a in rim 19a permit the water in space 23 to leave the spinner during the drying operation.

The operation of the washing machine shown in Figs. 5, 6, and 7 is similar to the operation of the machine which has just been described, except that instead of starting tub 1 with its whole contents in rotation after the finish of the washing operation, handle 45 may first be moved to the left, referring to Fig. 5, effecting opening of valve 28, thus permitting the water in the tub to drain out to water line *a-a*. The load upon the motor and its driving mechanism while bringing tub 1 up to speed is thereby lightened. After the finish of operations, the power driving the machine may be cut off and handle 45 may be moved still farther to the left, resulting first in the opening of valve 30, and next in member 39 contacting tub 1, as described before. A braking effect may thus be exerted upon the revolving tub, resulting in its stoppage earlier than otherwise, and when the tub is stopped, or nearly so, all the water in the tub drains out through valve 30 into outer tub 12, from whence it may be allowed to leave the machine through drain-valve 34. It stands to reason that the mechanism shown in Figs. 5, 6, and 7, and now described, may if desired be applied to the machine shown in Figs. 1 and 2.

In the operation of the machines embodying my invention, it is to advantage to accelerate and decelerate tub 1 relatively slowly, and at a uniform rate, at the beginning and at the end of rotation, respectively. Experiments show that the forced vortex in the liquid in such case is formed sufficiently early, and remains in force sufficiently late, to resist the increasing and decreasing centrifugal force of the spinner during the acceleration and deceleration periods, respectively.

While the invention has been shown and explained in connection with apparatus or machines wherein the object is to separate a liquid from solids, it must be understood that the invention may be found useful in connection with

many other balancing problems, and I do not want to be limited in any way except in accordance with the description and claims.

I claim:

1. In combination, an outer hollow rotor having a bottom wall and adapted to contain an unconfined body of liquid therein, an inner rotor disposed within said outer rotor in frictional engagement with said bottom wall and normally free from contact with all other portions of said outer rotor, whereby said inner rotor is freely movable transversely of the axis of rotation of said outer rotor, and means for rotating said outer rotor at a high angular velocity to cause said liquid to move upwardly between said rotors and form a forced vortex surrounding said inner rotor, said frictional engagement being effective to cause rotation of said inner rotor, said forced vortex upon movement of said inner rotor transversely of said axis of rotation being effective to counteract unbalanced centrifugal forces exerted by said inner rotor and to maintain said inner rotor out of direct transverse contact with said outer rotor.

2. In combination, an outer rotatable tub adapted to contain an unconfined body of liquid in the lower portion thereof, an inner tub of lesser diameter disposed within said outer rotatable tub for containing a material to be centrifuged, said inner tub resting on the bottom of said outer tub in frictional engagement therewith and being otherwise free from direct engagement with said outer tub, whereby said inner tub is freely movable transversely of the axis of rotation of said outer tub, and means for rotating said outer tub at a high angular velocity to cause said unconfined liquid to travel upwardly between said tubs to form said liquid into a forced vortex surrounding said inner tub, said frictional engagement being effective to rotate said inner tub, said forced vortex supporting and positioning said inner tub during said rotation out of direct transverse contact with said outer tub under maximum out-of-balance conditions and counteracting unbalanced centrifugal forces due to said rotation of said inner tub and the material therein.

3. A centrifuging apparatus for extracting a liquid from a body of material, comprising an outer cylindrical tub mounted for rotation about a fixed axis, said outer tub having a closed end and having an inturned flange at its open end, a cylindrical inner tub for containing said material and liquid, said inner tub frictionally engaging an end wall of said outer tub and being otherwise out of engagement therewith, said inner tub being freely movable within said outer tub transversely of said axis of rotation and having openings through which said liquid may pass to said outer tub, said outer tub containing an additional and unconfined body of liquid, and means for rotating said outer tub at a high angular velocity to form the liquid therein into a forced vortex of a maximum thickness equal to the width of said inturned flange and to discharge excess liquid over the edge of said flange, rotation of said outer tub and the liquid therein causing rotation of said inner tub to expel the liquid from the material therein by centrifugal force and to discharge said expelled liquid into said forced vortex, transverse movement of said inner tub due to unbalanced centrifugal forces exerted thereon being limited by said forced vortex which counterbalances said unbalanced centrifugal forces.

4. A centrifugal apparatus comprising an outer cylindrical tub mounted for rotation about a fixed axis and adapted to contain an unconfined body of liquid, said tub having a closed end and having an inturned flange at its open end, a cylindrical inner tub for holding the material to be centrifugally treated, said inner tub frictionally engaging said closed end and being otherwise free from direct engagement with said outer tub, and means for rotating said outer tub to frictionally cause a corresponding rotation of said inner tub and to form a forced vortex of liquid surrounding said inner tub and extending between the closed end and the inturned flange of said outer tub while maintaining said inner tub out of direct transverse contact with said outer tub under maximum out-of-balance conditions.

5. In a laundry machine, the combination of a rotatable tub for holding a bath of cleansing liquid, an agitator, an axially extending driving shaft for supporting said agitator within said tub, a basket member surrounding said agitator for holding the clothes to be cleansed in said liquid, said basket member having a large aperture in one wall thereof surrounding said shaft and thereby being free to move transversely of the axis of rotation of said tub and said shaft, valve means for controlling the liquid level in said tub, means for operating said agitator to cleanse said clothes, means for selectively operating said valves to reduce to a predetermined level the liquid bath in said tub, and means for rotating said tub at a high angular velocity to form a portion of the liquid in said tub into a forced vortex, and to expel a substantial portion of the liquid from said clothes and said basket member, the liquid expelled from said basket member and the excess liquid in said tub being discharged by centrifugal force over the upper edge of said tub, said forced vortex serving during rotation of said tub to control the position of said basket member and counteract any unbalanced centrifugal forces due to said basket member and the clothes therein.

6. A laundry machine comprising a cylindrical tub mounted for rotation about a fixed axis and adapted to contain an unconfined body of liquid therein, a cylindrical inner member for holding the clothes to be cleansed, said inner member being disposed within the liquid in frictional engagement with an end wall of said tub and being otherwise out of engagement therewith whereby said member is free to move transversely of the axis of rotation, and means for rotating said outer tub to frictionally cause a corresponding rotation of said inner member whereby the liquid is expelled from the clothes and said inner member, said rotation causing the liquid to travel into the annular space between said tub and said member to form a forced vortex surrounding and supporting said inner member.

7. In a laundry machine, the combination of a rotatable tub for holding a bath of cleansing liquid, an axially extending shaft, an agitator mounted on said shaft within said tub, a basket member disposed within said tub for holding the clothes to be laundered, said basket member surrounding said agitator and having an aperture in a wall thereof below said agitator through which aperture said shaft extends to permit free movement of said basket transversely of said tub and said shaft, means for actuating said agitator independently of rotation of said tub to cleanse the clothes within said basket member, and means for rotating said tub independently of said agitator to cause corresponding rotation of said

basket member, the speed of rotation of said tub and said basket member being sufficiently great to expel a substantial portion of the cleansing liquid from the clothes and the basket member and to form the liquid in said tub into a forced vortex, the excess liquid in said tub being discharged therefrom by centrifugal force and said forced vortex being effective under maximum out-of-balance conditions to maintain said basket member out of direct transverse contact with said tub and to position the basket member and its contents relative to the axis of rotation of said tub to reduce to a minimum the unbalanced forces tending to create vibrations in the laundry machine during rotation of said tub.

8. A laundry machine comprising a stationary outer shell, an inner tub rotatably mounted therein for holding a bath of cleansing liquid, a basket member of lesser diameter and height than said inner tub disposed therewithin and freely movable transversely of the axis of rotation, said basket member being adapted to hold the clothes to be laundered, a shaft extending through said inner tub and into said basket mem-

ber, an agitator mounted on said shaft within said basket member, a wall of said basket member underlying said agitator having an aperture therein for receiving said shaft, said aperture permitting said free transverse movement of said basket member, and means for selectively rotating said shaft and for selectively rotating said inner tub whereby said agitator and said inner tub are selectively operable independently of each other, the speed of rotation of said inner tub being such that the liquid bath contained therein is formed into a forced vortex to locate said basket member and its contents relative to the axis of rotation and reduce to a minimum the unbalanced forces tending to create vibrations in the laundry machine, the centrifugal forces exerted on the liquid during rotation of said inner tub and said basket member forcing a substantial portion of the cleansing liquid from the clothes contained in said basket member and discharging the liquid in excess of the portion required for forming the forced vortex from the inner tub into said outer stationary shell.

RASMUS M. HVID.

CERTIFICATE OF CORRECTION.

Patent No. 2,313,644.

March 9, 1943.

RASMUS M. HVID.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, first column, line 24, after the word "rotor" and before the period insert --under maximum out-of-balance conditions--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of April, A. D. 1943.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.