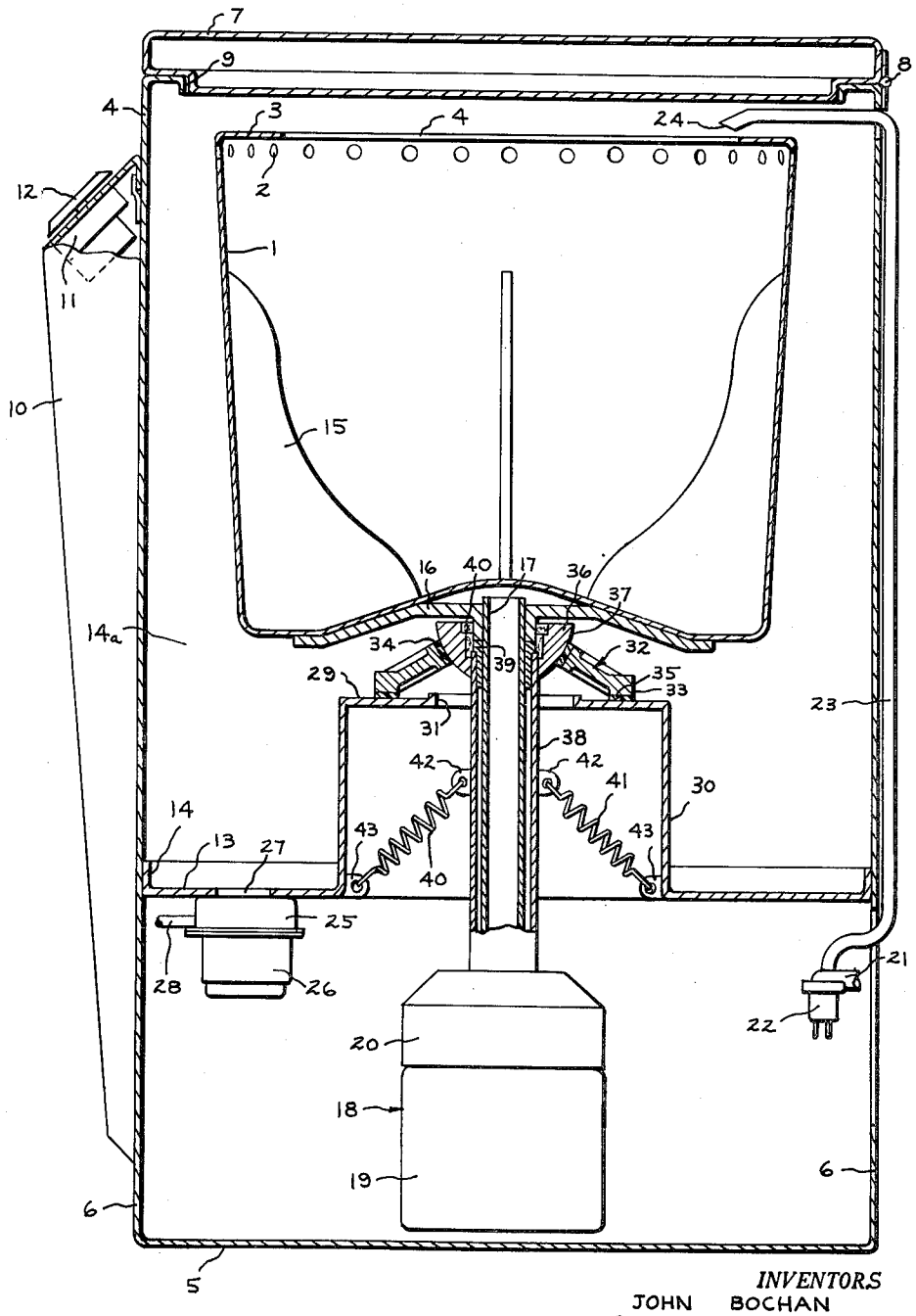
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CLOTHES WASHING MACHINE HAVING A SUSPENSION SYSTEM WHICH SERVES AS A LIQUID SEAL

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CLOTHES WASHING MACHINE HAVING A SUSPENSION SYSTEM WHICH SERVES AS A LIQUID SEAL

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This invention relates to centrifuging machines, and more particularly to vertical axis washing machines wherein improved vibration-isolating means are provided to prevent unbalance-caused vibrations of the rotating parts from being transmitted to the casing of the machine to the extent that damage to or "walking" of the machine may occur.

An object of our invention is to provide a washing machine having a suspension system which also serves to seal the liquid-containing portion of the system from the driving portion of the system.

In one aspect of the invention there is provided a floor-mounted cabinet with an imperforate tub formed within the cabinet. The tub includes a horizontal support surface, and slidingly seated on this horizontal support surface is the continuous annular lower surface of an annular assembly. The assembly is biased to a substantially central position on the support surface relative to the cabinet by any suitable means such as, for instance, springs. Within the tub there is positioned a clothes basket rotatable about a substantially vertical axis, the clothes basket thus constituting the centrifuging means of the structure. Means are provided in the basket for washing clothes, and drive means below the basket are connected to it so as to cause either washing of clothes in the basket or rotation of the basket to centrifuge liquid out of the clothes. Above the drive means, but below the basket and coaxially therewith, there is provided a support member; the support member, drive means, and basket form together a moving system supported by the seating of a continuous annular surface formed on the support member on a continuous annular upper surface formed on the assembly. Both of these last mentioned surfaces are formed as spherical surface portions having a common center on the axis of rotation of the basket. With this arrangement, the support member surface is slidingly supported on the assembly upper surface, relative sliding of the two surfaces causing a tilting of the moving system relative to the assembly. The moving system extends down through the annular assembly, and because of the positioning of the drive means has its mass distributed low enough to cause its center of gravity always to fall at a point lower than the center of the spherical surface portions. This provides stability to the system by virtue of the fact that, with such a structure, the center of gravity always moves up upon movement of the basket away from a vertical axis and therefore always has a tendency to move back down and return the container to its vertical axis.

The system as described provides all degrees of freedom except for purely vertical movement which, as has been stated, is preferably eliminated. In addition, our system has the substantial advantage that the horizontal support surface and the assembly lower surface form together a first liquid seal in the tub, and the support member surface and the assembly upper surface form together a second liquid seal in the tub. Thus, the structure which actually effects the support of the moving system on the rigid system also provides a liquid seal between the two systems.

The features of my invention which we believe to be novel are set forth with particularity in the appended

claims. The invention itself, however, both as to organization and method of operation together with further objects and advantages thereof, may best be understood by reference to the following detailed description taken in conjunction with the accompanying drawing.

In the drawing, the single figure is a side elevational view, partly broken away and partly in cross section to show details, of a centrifuging machine, more particularly a vertical axis washing machine, incorporating the improved suspension system of our invention.

Referring now to the figure of the drawing, there is shown therein a vertical axis centrifuging machine which, for illustrative purposes and because of the special additional advantages which are obtained therein, is depicted as a washing machine having a clothes basket 1 preferably formed, as shown, as an inverted frustum of a cone. Basket 1 is substantially imperforate except for openings or perforations 2 provided therein at the largest diameter, i.e., adjacent the top thereof, the top of the clothes basket being formed as an inwardly extending flange 3 defining a loading and unloading opening 4. Enclosing the basket 1 is a frame in the form of an appearance cabinet 4 which includes a base 5 adapted to be seated on an appropriate floor, vertically extending walls 6, and a lid 7 pivotable on a hinge 8. In closed position lid 7 covers an opening 9 provided to afford access to the interior of basket 1 so that clothes may be inserted into and removed from the basket when the lid 7 is pivoted to an open position. Secured on the front wall 6 there may be an appropriate control supporting structure 10 on which there is mounted a conventional sequence control mechanism 11 manually presettable by means of a member 12 so as to provide a washing operation. The side walls 6 of cabinet 4 and a member 13, which is continuously secured around its outer edge 14 to the side walls 6, form together a liquid-receiving tub 14*a* within which the basket 1 is positioned.

Within basket 1, suitable means are provided for effecting a circulatory motion of water contained therein in order to effect washing of clothes placed in the basket. In the present case, these means comprise vanes 15 arranged to cause a suitable circulatory motion of water in the basket to effect washing of the clothes upon oscillation of basket 1 about a vertical axis. It will, of course, be recognized that a separate agitator device may be provided extending up into the basket 1 as is the case with many commercially available machines, but for simplicity of the explanation of the general structure the vanes 15 may be considered as typical.

The basket 1 is rigidly secured through an intermediate supporting flanged member 16 to a shaft 17 formed substantially coaxially with basket 1 and extending downwardly into a driving and transmission structure generally indicated by the numeral 18. In the conventional manner, this structure may include a reversible motor 19: when motor 19 is rotated in one direction, a transmission 20 transmits the motor movement to the shaft 17 so as to cause rotation of basket 1 at high speed for centrifuging purposes; when the motor rotates in the opposite direction the transmission 20 causes it to provide an oscillatory motion to the shaft 17. This oscillates the basket back and forth to cause vanes 15 to circulate water therein in the appropriate manner for washing purposes. Transmissions for effecting rotary motion of a shaft in one direction of rotation of the motor and an oscillatory motion of the shaft in the opposite direction of the motor are well known in the art, and therefore the transmission is not described in detail herein.

Conventional means for introducing water into the machine are provided. These are schematically shown in the present case by an inlet conduit 21 leading into a valve 22 which controls flow of liquid through a conduit 23 having an outlet 24 discharging into the basket

1. Of course, both hot and cold water may be brought into the machine in this manner so that hot, cold or warm (mixed)water may be used for any given operation. In order to discharge liquid from the machine, a suitable pump 25, which may be driven by any desired means such as a separate motor 26, is secured to member 13 so as to have its inlet 27 communicating with the lowest point in tub 14*a*. The pump 25 leads through a suitable conduit 28 to an appropriate drain (not shown) so that when removal of the water is desired (as during centrifuging operations for instance) motor 26 may be energized to run pump 25 which then pumps water from the tub through inlet 27 and then through conduit 28 to drain.

With the structure described thus far, a suitable sequence of operations may be provided in the machine. As one typical cycle, a liquid may be introduced by energization of valve 22 for a period appropriate to fill basket 1 to the desired level; then the motor 19 is energized in the direction to cause basket 1 to oscillate back and forth to wash the clothes. After a predetermined period of this washing action, the motor 19 is reversed and the motor 26 is energized to cause, respectively, the basket to rotate at a high centrifuging speed, and the pump to remove the liquid from the tub as it passes into the tub through openings 2 as a result of the high speed rotation of the basket. Following this extraction operation, a supply of clean liquid may then be introduced into the basket to rinse the clothes as the basket is once again oscillated. Finally, the basket may then be once more rotated at high speed to extract the rinse water and discharge it through openings 2 for removal from the tub by pump 25. All of these operations may be effected automatically in sequence by suitable connections from control 11 to the operating components; the control of the components by a conventional sequence control means is well known in the art and therefore is not further described herein.

Member 13 includes an annular horizontally extending surface 29 which, by virtue of vertically extending portion 30 of member 13, is substantially above the lowest part of tub 14*a*. This insures that, while a substantial amount of splashing may occur at the level of surface 29, the liquid level reached by water standing in the tub will normally remain substantially below surface 29, the capacity of pump 25 being sufficient to prevent the liquid from rising to level 29 as it is passed out through openings 2 during high speed rotation of basket 1.

The surface 29, as stated, is annular; it includes a central opening 30 which is provided to accommodate in spaced relation the downwardly extending assembly which includes shaft 17 passing from the basket 1 down to the drive and transmission assembly 18. An annular assembly 32 is provided which includes a continuous annular lower surface 33 and a continuous annular upper surface 34. The lower surface 33 is formed so as to be flat, and therefore rests on the assembly 29 in slidable relation thereto. The amount of friction which is provided between the surfaces 29 and 33 is controlled by the composition of the two surfaces. In this connection the surface 33 is shown to be formed of a particular damping material 35 such as for instance nylon. It will, however, be recognized that the damping materials selected may vary from a very high coefficient of friction to a very low coefficient of friction, depending on the amount of damping required or desired; the particular example of nylon gives a relatively low coefficient of friction, found to be desirable where low critical speeds are involved. As the assembly 32 moves horizontally on surface 29, material 35 has a damping or energy-absorbing characteristic sufficient to provide the desired amount of damping as the rotating basket 1 passes from a standstill up through critical speed during the high speed rotation part of the washing machine cycle. Thus, assembly 32 is horizontally movable in all directions relative to the surface 29, and, in addition, it inherently provides the desired amount of energy absorption as a result of the sliding friction between the two surfaces.

As will be more fully discussed herebelow the surface 34 is formed as a surface portion of a sphere. Nested within the surface 34 and supported thereby is a member 36 having a spherical surface 37 and which forms a part of the moving, or suspended, system together with the container 1, shaft 17, and assembly 18. In the present case, the member 36 is secured to a downwardly extending sleeve member 38 which supports a bearing 39 within which shaft 17 rotates and on which the flange member 16 is supported. At its lower end, the sleeve 38 provides the support for the assembly 18. Since supporting flange member 16 is rotatable at high speed with basket 1, and since member 36 is not intended to be so rotated, suitable liquid sealing means such as packing 39 is preferably provided as shown.

Surfaces 34 and 37 are formed as part of a single sphere having its center on the axis of rotation of basket 1, so that in effect the part 36 may tilt, or rock, in any direction within the supporting assembly 32 by virtue of sliding motion occurring between surfaces 37 and 34. In the same manner as the surfaces 33 and 29, the surfaces may be formed of appropriate material to provide the desired amount of damping for the system, and in this connection the surface 34 is shown as being formed of a suitable composition material.

The weight distribution of the moving system is such that its center of gravity is sufficiently low that upon tilting of the system (by movement of member 36 in assembly 32) the center of gravity will always move up upon movement of shaft 17 away from a vertical axis. This may readily be effected by causing the assembly 18 to be positioned, as shown, substantially below the basket 1 and member 36, with the sleeve 38 and shaft 17 extending downwardly through the opening in annular assembly 32 so as to join the basket to the assembly 18. With the structure shown, and with the assembly 18 having the mass conventional in such structures, the distribution of mass in the moving system insures that, even when basket 1 is full of clothes and water, the center of gravity of the system will not rise above the center of the sphere of which surfaces 34 and 37 are a part. When this relationship is provided, it insures stability of the system: when tilted away from a vertical axis, the system always tries to right itself because its center of gravity tends to move down to its lowest point and at its lowest point the system is in its desired vertical position.

Suitable means are necessary to establish correct horizontal positioning of the system since the system is made free to move in all horizontal directions. In order to achieve this, relatively light coil springs 40 and 41 (two or more, and preferably equispaced) are provided connected at one end to lugs 42 extending from sleeve 38 and at the other end to lugs 43 which form a part of member 13. Since any horizontal movement of assembly 32 away from the position shown, that is, a centered position within cabinet 4, will cause compression of one of springs 40 and 41, and extension of another one of the springs, the springs tend to return assembly 32 (and the moving system) to a horizontally centered position. In addition, springs 40 and 41 limit pivoting of the moving system about a vertical axis without, however, preventing such movement.

In effect, when the drive system 18 is causing high speed rotation of basket 1 through shaft 17, horizontal movement occurs as a result of surface 33 of assembly 32 sliding on surface 29, with the two sliding surfaces also providing the necessary damping as the speed passes through critical. Also, tilting movement in all directions occurs as a result of the member 36 being supported within assembly 32 with surfaces 37 and 34 providing additional damping as the device passes through critical speed. The combination of the two supporting arrange-

ments provides in effect five degrees of freedom for the basket relative to the cabinet 4 (two horizontal degrees of freedom, two degrees of freedom to pivot about horizontal axes, and one degree of freedom to pivot about a vertical axis). This leaves only the vertical direction of movement in which no freedom is provided.

In addition to the desired vibration-isolating suspension and the damping function performed by my structure, it provides another highly important function when used in a washing machine as depicted. It will be noted that the member 32 is, in effect, a part of the bounding surface of tub 14*a* so that, although the tub is preferably formed so that surface 29 is above the highest liquid level reached in the tub, liquid will splash in the area of the member 32. In addition to their other functions, surfaces 33 and 29 provide, by virtue of their continuous engagement with each other, a first liquid seal to prevent water in the tub from escaping and passing down onto the drive system 18. The continuously engaging surfaces 34 and 37 provide a second liquid seal which achieves the same desired function. Thus, the sealing between the tub, which is part of the stationary frame 4, and the moving system is effected by the same structure which provides the vibration isolating suspension and the damping effect.

It will be recognized that, while the preferred structure wherein the surfaces 34 and 37 are concave relative to basket 1 is provided, it is also possible to provide a structure wherein the two surfaces are convex relative to the basket. The major effect of such a change would be to lower the center point of rotation around which the spherical surfaces are formed, and thereby to lower the highest point at which the center of gravity of the moving system may be provided.

Thus, while in accordance with the patent statutes we have described what at present is considered to be the preferred embodiment of our invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and we therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A vertical axis washing machine comprising: a floor mounted cabinet; an imperforate tub formed within said cabinet; means for draining liquid from said tub; means forming a horizontal support surface in said tub; an annular assembly having a continuous annular lower surface seated on said horizontal support surface in sliding relation thereto; means biasing said assembly to a substantially centered horizontal position relative to said cabinet; and a moving system including a clothes basket positioned within said tub and rotatable on a substantially vertical axis, means within said basket for washing clothes therein, drive means positioned below said basket and connected thereto, said drive means being effective alternatively to cause washing of clothes in said basket and to cause rotation of said basket to centrifuge liquid out of the clothes therein, and a support member positioned above said drive means and beneath said basket coaxially therewith; said support member having a continuous annular surface and said assembly having a continuous annular upper surface both formed as spherical surface portions having a common center on the axis of rotation of said basket, said support member surface being slidingly supported on said assembly upper surface whereby said moving system is tiltable on said assembly, said moving system extending down through said annular assembly and having its mass distributed low enough to cause its center of gravity always to fall at a point lower than said center of said spherical surface portions, said horizontal support surface and said assembly lower surfaces forming together a first liquid seal in said tub, said support member surface and said assembly upper surface forming together a second liquid seal in said tub.

2. The apparatus defined in claim 1 wherein said tub is formed with said horizontal support surface substantially above the lowest part of said tub, said tub having a substantial volume therein below said horizontal support surface.

3. The apparatus defined in claim 1 wherein said cabinet has substantially vertical side walls, said side walls forming the sides of said imperforate tub.

4. The apparatus defined in claim 1 wherein said spherical surfaces are concave relative to said basket.

5. The apparatus defined in claim 1 wherein said horizontal support surface and said assembly lower surface are formed of material providing a damping effect upon sliding of one surface on the other.

6. A vertical axis washing machine comprising: a floor mounted cabinet having substantially vertical side walls forming an enclosure; a member connected to all of said side walls therewithin forming an imperforate tub within said cabinet, said member having a portion forming a horizontal support surface in said tub; means for draining liquid from said tub; an annular assembly having a continuous annular lower surface seated on said horizontal support surface in sliding relation thereto; means biasing said assembly to a substantially centered horizontal position relative to said cabinet; and a moving system including a substantially imperforate clothes basket positioned within said tub and rotatable on a substantially vertical axis, said tub having an inverted frusto-conical shape and having openings provided adjacent its top, means within said basket for washing clothes therein, drive means positioned below said basket and connected thereto, said drive means being effective alternatively to cause washing of clothes in said basket and to cause rotation of said basket to centrifuge liquid out of the clothes therein, and a support member positioned above said drive means and below said basket coaxially therewith; said support member having a continuous annular surface and said assembly having a continuous annular upper surface both formed as spherical surface portions having a common center on the axis of rotation of said basket, said support member surface being slidingly supported on said assembly upper surface whereby said moving system is tiltable on said assembly, said moving system extending down through said annular assembly and having its mass distributed low enough to cause its center of gravity always to fall at a point lower than said center of said spherical surface portions, said horizontal support surface and said assembly lower surface forming together a first liquid seal in said tub, said support member surface and said assembly upper surface forming together a second liquid seal in said tub.

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