Dec. 13, 1960 L. H. BROWN 2,964,192

LIQUID CENTRIFUGAL BALANCER

Filed Sept. 18, 1957

Fig. 1

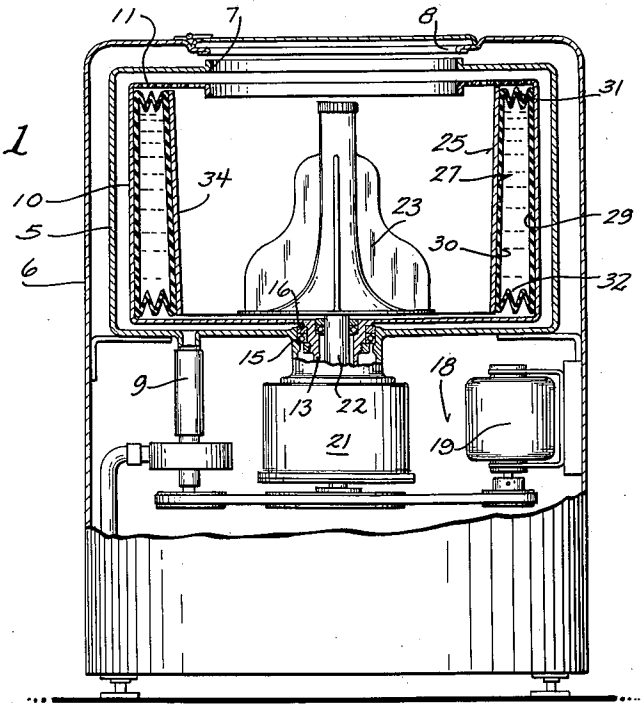


Fig. 2

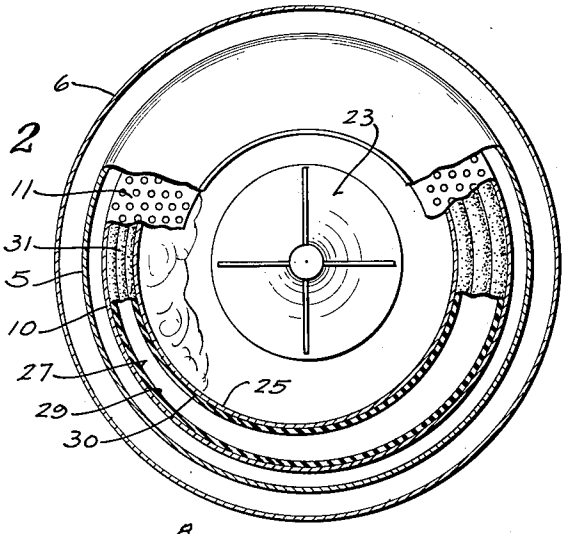


Fig. 3

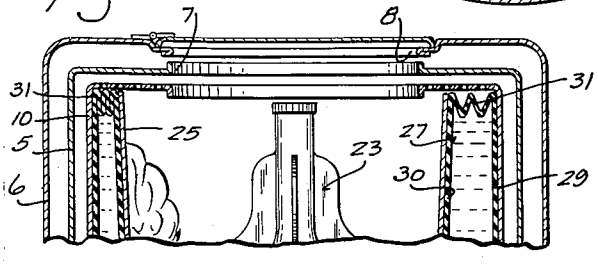


Fig. 4

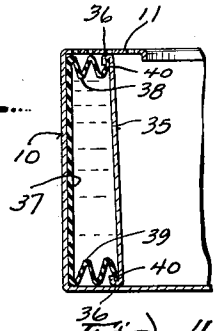
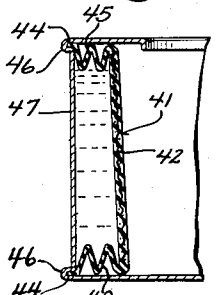


Fig. 5



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LIQUID CENTRIFUGAL BALANCER

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1 Claim. (Cl. 210—363)

This invention relates generally to centrifugal machines of the type adapted to have a rotatable receptacle containing an unbalanced load. The invention pertains more particularly to means for hydraulically balancing such a receptacle and finds particular utility in automatic washing machines in which washing, rinsing and extracting operations are performed in the same receptacle.

Various attempts have been made in the past to counterbalance high speed tubs or baskets of washing machines, particularly during the water extraction cycle thereof. These prior art devices usually use a portion of the liquid load in the tub to provide the necessary counterbalancing means, and in quantities which are proportional to the magnitude of the unbalanced load. The counterbalancing fluid is usually contained in a concentric chamber formed by a second tub or in annular rings which are secured to the load receptacle for rotation therewith as an integral unit. Some of these devices have provision for maintaining the fluid in substantial radial symmetry with respect to the axis of rotation of the receptacle while the latter accelerates below its critical speed.

Many of the prior art devices provide for tilting of the tub unit to permit gyratory or swaying movement thereof so as to reduce vibration. These devices, however, require snubbing means, springs, shock absorbers or the like to limit the extent of these gyrations and dampen out the vibrations.

In accordance with the present invention there has been provided a hydraulically balanced centrifugal machine in which a rotary receptacle is adapted to contain an unbalanced load, said receptacle being non-tiltable and rotatably driven about a stationary axis. The receptacle has an inner cylinder which defines a fluid chamber between the receptacle and cylinder, said cylinder being bodily and eccentrically shiftable within said receptacle by the centrifugal force imposed thereon by an unbalanced load.

The invention contemplates a deformable, sealed fluid chamber within a receptacle rotatable about a fixed axis, which chamber is adapted to distribute counterbalancing fluid around the receptacle in proportion to the magnitude of an unbalanced load. The construction is such that the actual radial shifting of the load due to centrifugal force is effective to redistribute the counterbalancing fluid in the chamber, and at any rotational speed of the receptacle.

By means of this invention there has been provided a fluid balanced centrifugal machine which is simple in construction, economical to manufacture and highly efficient in performing the functions for which it is intended.

These and other objects and advantages of the invention will appear hereinafter as this disclosure progresses, reference being had to the accompanying drawings in which:

Figure 1 is a vertical sectional view of an automatic washing machine embodying the features of the invention;

Figure 2 is a plan view of the device shown in Figure 1 but showing the inner cylinder in the eccentric position as when counterbalancing an offset load;

Figure 3 is a fragmentary view of the machine shown in Figure 1 but showing the balancing cylinder and the accordion fold seals in the position assumed when counterbalancing an unbalanced load; and

Figures 4 and 5 are fragmentary elevational views in section showing modified forms of the balancing chamber construction.

For purposes of illustration the invention has been shown in a form particularly suitable for use with automatic washing machines.

Referring more particularly to the drawings, a cylindrical outer tub 5 is mounted rigidly to the outer casing 6 of the machine, both of which have top openings 7 and 8, respectively, through which articles to be cleaned are loaded into the machine. It will be noted that outer tub 5 is mounted directly to the casing without the necessity of employing springs, shock absorbers or weights of any kind. The tub 5 has a drain conduit 9 at its lowermost point.

An inner cylindrical receptacle or basket 10 is provided in which the articles to be laundered are placed and in which they remain throughout the laundering cycle. The basket 10 is open at its upper side and has a perforated inwardly extending flange 11 through which water is discharged during the spin portion of the cycle.

The basket 10 is mounted for rotation within tub 5 about a fixed vertical axis. For this purpose the shaft 13 is rigidly secured to basket 10 and extends downwardly therefrom. The anti-friction bearing assembly 15 rotatably supports the shaft 13 and a shaft seal 16 prevents leakage from the tub. The lower end of the shaft is connected to the drive mechanism 18.

This drive mechanism is shown only diagrammatically as it, per se, forms no part of this invention and is conventional and well-known in this art. It is believed sufficient to say that the mechanism includes a driving motor 19, of any preferred form and shown here as an electric motor. The motor furnishes power to the transmission 21 which may be secured directly to the tub 5. The transmission is selectively operable to rotate shaft 13 when the centrifuge action is desired during a water extracting cycle, or oscillate shaft 22 of the agitator 23 during the washing cycle.

In one embodiment of the invention shown, a balance cylinder 25 is mounted within the basket and is of a height slightly less than the internal height of the basket. The cylinder 25 is free to slide within limits in any radial direction within the basket. In other words, the cylinder is free to eccentrically position itself within the basket 10.

A sealed balancing ring 27 is positioned within the basket 10 and contains a balancing fluid, for example, water. The outer diameter of the ring 27 is approximately the same as the internal diameter of the basket so as to form a snug fit therein. The ring is preferably made of flexible material such as rubber, plastic or neoprene and comprises an outer wall 29, inner wall 30 and upper and lower walls 31, 32 which are pleated in accordion fashion. The ring walls may be formed integrally with one another as by being molded. The inner diameter of wall 30 of the ring is of substantially the same diameter as the external diameter of the cylinder 25 so that the ring fills the annular chamber formed between the basket and cylinder.

During the washing cycle, counterbalancing will be unnecessary and as shown in Figure 1, the cylinder 25 is concentrically located in respect to shaft 13. There is an even distribution of fluid around the annulus formed between cylinder 25 and basket 10. This is also the position the parts would assume if the basket were

spinning with no load as centrifugal force would hold the liquid to the extreme outward position and equally distributed circumferentially around the basket.

As shown in Figure 2, a load of clothes has been loaded into the basket in an offcenter position. This unequal distribution of the load within the basket occurs frequently when one article, such as a throw rug, is being washed and is thrown by centrifugal force in a concentrated area. Also, when the basket is filled with a plurality of clothes, obviously some are larger in size and some absorb and hold more water, and therefore even with the normal regular distribution of the same around the periphery of the basket, the heavier articles cause unbalance and vibration.

In the modification of Figure 4 the cylinder 35 has an outwardly turned, U-shaped flange 36 around its upper and lower edges. The inner wall 30 of the flexible ring shown in Figure 1 has been eliminated and instead this deformable member comprises the outer wall 37, which bears against the receptacle, and the upper and lower flexible walls 38 and 39, respectively, which are formed integrally therewith. The upper and lower inner edges 40 of the flexible ring are inserted into the channel-shaped flanges 36 and the latter are then crimped tightly against the edges 40 to seal the latter to the cylinder.

Figure 5 shows another modification of the invention wherein the inner cylinder 41 is formed by a sheet of stiff material, such as sheet metal, or the wire mesh 42 as shown. This reinforcing sheet is molded into the inner wall of the flexible ring and thus made an integral part thereof.

Figure 5 also shows a modification for eliminating the outer flexible wall of the ring and which could be utilized in combination with any of the chambers of the other figures. Here the outer edges 44 of the upper and lower walls 45, 48 are engaged in the V-shaped flanges 46 of the receptacle 47 and the flanges then crimped shut to sealingly hold the edges 44 captive therein.

In the devices of all of the figures an inner cylinder is provided which has a diameter less than that of the receptacle. A balancing fluid is sealed in the chamber defined by the cylinder and receptacle.

The counterbalancing means of the present invention functions to substantially eliminate any unbalanced conditions and reduces the off center and unbalanced loads to a minimum, resulting in a smooth and quiet spinning action for water extraction from the articles. This unbalance is corrected, regardless of the amount or disposition of the eccentric loading of the machine. Furthermore, this correction takes place at any appreciable rotational speed of the basket, without waiting until a critical speed is reached, and the load is thus balanced early in the spin cycle.

When spinning of the basket commences, centrifugal force shifts the clothes tightly against the cylinder. The offset load then shifts the cylinder in the radial direction of the offset load, or to the heavy side of the basket. This shifting movement of the cylinder causes the annular chamber between the cylinder and receptacle to deform, forcing the fluid in the chamber to redistribute itself. Thus fluid is transferred from the heavy side of the tub, in correct proportion to the centrifugal force imposed on the cylinder by the offset load. The result is a completely balanced basket.

As the water is extracted from the clothes by centrifugal force, it travels upwardly along the cylinders which may, if desired, have an inner inclined surface 34 diverging outwardly in an upward direction. The water leaves the basket through its perforated top and is ultimately carried off by the drain conduit 9.

By means of this invention there has been provided a simple yet highly effective water balanced centrifugal machine which has a non-gyrating basket. Any unbalanced loading of this basket is compensated for early in its rotary movement and by the radial shifting of the load itself due to centrifugal force. Centrifugal force tends to keep the balancing fluid evenly distributed around the basket and this fluid is displaced only in precisely correct proportions to the amount of unbalance and the basket will thus revolve without vibration.

By means of the invention, it is unnecessary to provide mechanism to permit tilting of the basket or tub. No snubbers, springs or other shock absorbing devices are required to dampen gyratory movements or vibrations. Complicated water balance tubs or rings are not required to effect counterbalancing. Bolting of the machine to the floor or other installation costs are eliminated or greatly reduced. The elimination of many parts results in a more economical structure to manufacture, service and maintain.

Various modes of carrying out the invention are contemplated as being within the scope of the following claim particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

In a centrifugal machine, a non-tiltable cylindrical receptacle adapted to have an unbalanced load and rotatable about a fixed shaft axis, said receptacle having a radially extending flange defining a central loading opening, said flange having a series of perforations spaced circumferentially therearound, an open ended cylinder mounted within said receptacle for bodily sliding movement and in non-sealing engagement in respect thereto between concentric and eccentric positions in respect to said axis, said cylinder being substantially coextensive in height with the interior of said receptacle to prevent tipping of the cylinder within the receptacle, the diameter of said cylinder being less than that of said receptacle but sufficiently greater than the diameter of said opening to insure overlapping of the cylinder wall by said flange in all possible positions of said cylinder, flexible sealing means between the upper and lower end of said cylinder and the receptacle walls defining therebetween an annular chamber, a balancing liquid substantially filling said chamber, whereby centrifugal force will cause said unbalanced load to radially shift said cylinder to thereby displace some of said liquid to counterbalance said load, and fluid extracted from said load will pass through said perforated flange.

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