LAUNDERING MACHINE FOR WASHING AND CENTRIFUGAL DRYING

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Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

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My invention relates to drum-type laundering machines which sequentially perform two operations, namely first the washing and rinsing operations proper and subsequently the drying or damp-drying of the laundry by rotating the drum at relatively high speed. During washing or rinsing, the drum loaded with the articles to be laundered, rotates at relatively slow speed to permit the laundering or rinsing water to thoroughly act upon the laundry. Thereafter the water, into which the bottom portion of the drum is submerged, is drained from the machine and the rotary speed of the drum is increased, for example, to about ten times the previous value, whereby the laundry is centrifugally pressed against the drum wall and thus dried.

As a rule, the articles loaded into the drum do not distribute themselves uniformly over the periphery of the drum during centrifugal operation. Hence, the loaded drum in unbalanced causes a greater or lesser amount of vibration or shaking of the rotating drum and thus of the entire machine. Since the unbalance differs from load to load and cannot be predetermined, it has heretofore been necessary to put up with such unbalance, for example, by anchoring the machine to the floor or giving it a correspondingly rugged construction.

Such machines however are limited as to the location where they can be installed. They also have the disadvantage that obnoxious vibration and noise cannot be avoided. It has therefore been attempted to resolutely suspend the entire drum assembly within the housing of the machine. This reduces the transmission of unbalance-responsive vibrations from the drum to the housing but does not eliminate the other disadvantages. For that reason, another known design aims at having the unbalance of the elastically suspended drum equalized by weights through correspondingly constructed lever arms so that the entire rotating assembly is substantially balanced during rotation. This type of unbalance equalization requires a complicated mechanism, is rather expensive, necessitates an excessive amount of space for accommodating the weights and levers in the water space of the machine, and also requires the weights and levers to be particularly resistant to corrosion due to their exposure to chemical action by the laundering water.

It is an object of my invention to eliminate the above-mentioned shortcomings by a machine design of utmost simplicity. To this end, and in accordance with my invention, I provide a drum-type machine with means for the automatic formation of counterpoises at the rotating drum which minimize or virtually eliminate any unbalance caused by uneven loading, regardless of the location or degree of the unbalance.

According to a more specific feature of the invention, I provide such a machine with a number of compensating containers of the same shape which are uniformly distributed over the periphery of the article-receiving drum and which, prior to centrifugal drying operation, are uniformly filled with water and are provided with valves for releasing the water from the proper containers during centrifuging operation thus leaving only those containers filled or partially filled that, due to their content of water, counteract the drum unbalance.

The foregoing and more specific objects, advantages and features of my invention, said features being set forth with particularity in the claims annexed hereto, will be apparent from, and will be described in, the following with reference to the drawings showing a number of embodiments of my invention by way of example. On the drawings:

FIG. 1 is a schematic vertical section of a laundering machine according to the invention.

FIG. 2 is another vertical section through a laundering machine similar to that of FIG. 1 but modified with respect to the drum bearing.

FIG. 3 is a cross section through the drum of the machine along the vertical plane denoted by the line III—III in FIG. 1.

FIG. 4 shows a drum cross section of somewhat modified design.

FIG. 5 is a cross-sectional view of a detail applying to the machine according to FIG. 3 or FIG. 4.

FIG. 6 is a schematic cross-sectional view of a drum according to FIG. 4 and of the surrounding housing of the machine, mainly for explanatory purposes.

FIGS. 7 and 8 are partial and sectional views, corresponding to the lower portion of FIG. 1 or FIG. 2, and relating to two further modifications respectively.

FIG. 9 is explanatory and shows a detail similar to that of FIG. 5 in a different stage of operation.

FIG. 10 is a schematic cross section, comparable to that of FIG. 4, but relating to a modified machine design.

FIG. 11 is a partial and sectional side view of the machine according to FIG. 10.

FIG. 12 is a schematic cross-section of another embodiment of the invention shown in the detail of FIG. 9.

The rigid base and frame structure 1 of the laundering machine according to FIG. 1 comprises rigid supports 2 upon which a cylindrical housing 3 is mounted. The structure 1 also forms a frame for a sheet-metal enclosure 4 of the machine. The rear wall of housing 3 carries a bearing 5 in which a shaft 6 is journaled. The shaft 6 carries a flange 11 by means of which the shaft is coaxially joined with a perforated drum 12. The front side of housing 3 has an opening through which the articles to be laundered are loaded into the drum 12 which is likewise open at the front of the machine. The opening of housing 3 is covered and sealed by means of a lid or cover 3a with a circular gasket 3b.

The drum shaft 6 carries a belt sheave 7 driven by an endless belt 9 from the sheave 8 of a motor 10 elastically supported by members 10a, 10b. According to the invention, the drum 12 is provided with a number of compensating containers 13 which are uniformly distributed over the periphery of the drum and can be filled with water during operation of the machine. The containers 13 are equipped with tap or ball valves 14 located on the peripheral side of the respective chambers and serving to release water from the containers during centrifugal drying operation of the machine. The drum bearing 5 is joined with the housing 3 by means of springs or an elastic diaphragm 5a so that the bearing can yield radially, thus permitting the drum 12 to elastically deflect in the radial direction due to unbalanced loading during the high-speed centrifuging operation. Such deflection, at any moment, is in the active direction of the unbalance and is schematically indicated by dot-and-dash lines 12a in FIG. 1. Instead of making the drum bearing 5 radially unreplaceable, it may also be mounted on housing 3 by means of elastic material 15, which acts by a bushing of rubber or synthetic material, so that the shaft 6 and the drum 12 are capable of tilting motion relative to the housing 3 as is indicated in FIG. 2 by the dot-and-dash...
lines 125, this machine being otherwise identical with the one illustrated in FIG. 1.

As apparent from FIG. 3, the compensating containers 13 are accommodated within the hollow space of inwardly protruding ribs or bulges 16 of the drum 12. Since such bulges 16 are usually provided for improving the entraining action upon the articles being laundered, the compensating containers 13 according to the invention do not require additional space, and the necessary change in machine design is extremely simple. As a rule, three or four entrainer bulges 16 are provided as is shown for three entrainers in FIG. 3 and for four entrainers in FIG. 4.

During washing operation, the lower portion of the drum housing 3 is filled with laundering water 17 (FIG. 3) up to a desired level, and the lower portion of the perforated drum 12, during rotation, is immersed in, and passes through, the liquid. During such washing operation, the compensating containers 13 fill themselves uniformly with liquid. During slow rotation of the drum 12, as occurring during washing operation, the compensating containers 13 in the embodiments described will empty themselves when they are being turned upwardly with the rotating drum 12. Such emptying however does not occur when the speed of drum 12 is increased beyond the value at which the centrifugal force exceeds the effect of gravity. Consequently at higher speed the uniformly distributed containers 13 remain uniformly filled with liquid as is indicated in FIG. 4.

The filling operation of the compensating containers 13 is apparent from the machine portion illustrated on larger scale in FIG. 5. When the drum 12 rotates within the housing 3 in the direction denoted by an arrow, a scooping action takes place due to the shape given to the container 13. This scooping action causes water to pass upwardly through a channel 15a and through the top opening 20, 23 of the container 13. When the centrifugal force exceeds a given limit, the container 13 remains continuously filled as long as the drain valve 14 at the outer, peripheral side of the drum 12 remains closed. Consequently, after the compensating containers 13 are filled and the rotating speed of the drum 12 is increased to a given value, the quantity of laundering liquid 17 contained in the housing 3 can be drained or pumped off, and the drying operation by centrifuging can then be initiated by further increase in rotating speed.

The valve 14 located on the outer side of the drum 12 in each of the compensating containers comprises a conical closure member which preferably consists of a single integral piece together with a valve tappet 14a which passes through the conical valve seat and protrudes outwards from the periphery of the drum. If the drum is uniformly loaded and hence unbalanced, the one or two valve tappets 14a located near the center of unbalance can glide along a circular surface member which in the present case is constituted by the cylindrical wall of housing 3 at the bottom portion of that housing. This forces the tappet 14a upwardly and opens the drain valve so that part or all of the liquid is flung out of the compensating chamber by centrifugal force until the balance of the drum is restored sufficiently to make the tappets run free of the housing wall. A spring 18 held in position by means of a bracket 20 tends to hold the conical valve member in closing position upon the valve seat 19.

Since the tappet 14a must be accurately guided to prevent it from being broken, and for securing a subsequent satisfactory closing of the valve when the tappet glides at high drum speed along the housing wall, it is in some cases preferable to provide a rotatable structure, such as a circular frame or another cylindrical drum, which is rotatably mounted in coaxial relation to the drum 12 but whose axis of rotation is fixed relative to the housing 3 and the stationary components of the structure does not participate in any unbalance-responsive deflection of the drum 12. Such an additional circular or cylindrical structure, having a fixed axis of rotation, is shown at 23 in FIG. 9. The structure 23 forms the surface member to be engaged by the tappets 14a between the laundering drum and the stationary housing 3. When in this case a tappet touches the surface member, the member can participate in the rotation of the laundering drum so that the tappet is subjected to radial inward pressure but not to appreciable gliding movement, thus reducing the wear and stress imposed upon the valves.

As a rule however it is sufficient to use a drum housing 3 which consists at least at the travelling path of the valve tappets of smooth or noncorrosive steel or the like material, and to make the valve tappets 14a of nylon or similar material. This is sufficient for most purposes because the lubricating conditions are very favorable since washing liquid is always present and since the tappets 14a slide along the housing only for short intervals of time and at drum speeds, still far below the full centrifuging speed.

If the loaded drum 12, during centrifuging drying operation, is unbalanced toward the side of the container 13 as shown in FIG. 5 and thus is somewhat deflected downwardly in its elastic mounting, the container 13 empties itself until the loss of water compensates the unbalance due to non-uniform loading. If furthermore, during centrifuging, the unbalance of the drum load changes because of progressive water losses of the articles, this change in unbalance is automatically compensated by a corresponding release of water from the compensating containers on the opposite side of the drum. As schematically indicated in FIG. 6, the unbalance caused by the load 21 being laundered, need not necessarily act perpendicularly to the outer side of one of the compensating containers 13, but may have a resultant radial direction as indicated by the arrow 11. Nevertheless, a complete compensation of unbalance is obtained. Thus, in the example of conditions assumed in FIG. 6, the resultant unbalance U is just active in a direction between the two left compensating containers 13, so that the drum is deflected in this direction during drying operation. Then the two valve tappets of the respective two left containers 13 are simultaneously pressed into opening positions so that the two containers 13 are drained until the unbalance is compensated.

FIGS. 7 and 8 illustrate two possibilities of accommodating the compensating containers 13 in the entrainer ribs or bulges. The drum 12 of each of the compensating containers 13 is located between the two axially spaced end walls or discs of the drum 12. According to FIG. 8, each compensating container 13 protrudes on both axial sides over these two walls. Which of these two modifications is preferable depends upon the particular requirements of the machine design, such as the shape and size of the laundering drum 12, the housing 3 and other components. The protruding compensating container 13 according to FIG. 8 can be more readily filled than the one shown in FIG. 5. For example, the container 13 according to FIG. 8 may pass with its protruding end beneath a radial jet of laundering water or fresh water while the drum 12 is rotating at relatively low speed.

FIG. 9 shows one of the compensating containers 13 while being emptied of water. In the event of unbalance deflecting the laundering drum downwardly toward the ring structure 23, the valve tappet 14a engages the inner surface of structure 23 and in its own position, while the ring 23, as explained above, can rotate together with the laundering drum in the direction of the arrow A. The water then in container 13 passes through the valve and along the cylindrical surface of member 23 or along the wall of housing 3, from which it is drained or pumped off before it can reach the articles in the laundering drum as shown in FIG. 9. The schematic cross-sectional view of the machine in FIG. 10 including the ring structure 23 is shown in FIG. 12.
In the embodiment shown in FIG. 10 the compensating containers 22 are peripherally much longer than in the embodiments described above so as to form pocket-shaped water spaces. These pockets are located on one axial side of the laundering drum 12 as apparent from FIG. 11. In all other respects the operation of this embodiment is the same as that of those described above. The compensating containers 22 can readily be filled by passing their opening through a uniformly running jet of water while the drum 12 is rotating at relatively slow speed.

In all illustrated embodiments the compensation of unbalance effecting according to the invention already occurs while the laundering drum 12 is being accelerated up to the centrifuging speed required for drying or damp-drying. Consequently vigorous shaking or objectionable vibration cannot occur during any stage of the drying operation. The unbalance is rather automatically and rapidly eliminated at any location and any stage of the drying operation. At the maximum rotating speed, the laundering drum is additionally stabilized by gyroscopic action.

It will be obvious to those skilled in the art upon studying this disclosure that my invention is not limited to the illustrated embodiment but permits of various modifications of the type particularly illustrated and described herein, and that the invention can be applied not only to the illustrated type of laundering machines but is generally applicable to laundering and other machines that are equipped with centrifuging drums containing articles to be dried or subjected to centrifugal action for other purposes, without departing from the essence of my invention and within the scope of the claims annexed hereto.

I claim:

1. A machine for washing and drying laundry comprising enclosing means to contain liquid during washing operation, a perforated laundry receiving drum rotatable in said enclosing means about an axis at low and high speeds respectively for washing and thereafter centrifugally drying the laundry, a number of containers distributed over the periphery of said drum, filling means to introduce liquid into said containers during the washing operation, valve means on each of said containers for release of liquid from said container, said enclosing means including a member having a circular surface surrounding said drum and radially stationary relative to the axis about which said drum rotates, said drum being radially deflectable, valve-actuating means connected to said valves and extending radially outwardly toward said surface to contain said drum when radially deflectable by unbalanced loading and to open said valve means whereby the liquid is selectively discharged from said containers.

2. A washing machine according to claim 1, comprising a bearing in which said drum is journalled, and elastic holding means joining said drum with said housing so as to resiliently permit radial deflection of said drum.

3. In a washing machine according to claim 1, said drum having a shaft at one axial side thereof, a bearing for said shaft, said drum being yieldingly connected with said housing so as to permit tilting deflection of said drum due to unbalance.

4. In a washing machine according to claim 1, the inlet means of each of said containers communicating with the bottom portion of said housing for automatically filling said container with water from that container in said housing during washing operation.

5. A machine for washing and drying of laundry, comprising a housing to contain water during washing operation, a laundry-receiving drum rotatable in said housing at low and high speeds respectively for washing and centrifugally drying the laundry, said drum being deflectable relative to said housing due to unbalanced loading and having a number of containers uniformly distributed over the drum periphery, each of said containers having a water-inlet opening inwardly located with respect to drum rotation and communicating with the water contained in said housing whereby said container fills itself with water during washing operation, and each container having an outwardly located outlet and a normally closed valve tending to retain the water in said container during centrifugal drying operation, and control means extending radially from said valves toward said housing and adapted to be actuated during radial deflection of said drum by contact with said housing for opening said respective valves to reduce drum unbalance.

6. A machine for washing and drying of laundry, comprising an enclosing assembly to contain water during washing operation, and a laundry-receiving drum rotatable in said housing at low and high speeds respectively for washing and centrifugally drying the laundry, said drum being radially deflectable relative to said assembly due to unbalanced loading and having a number of containers uniformly distributed over the drum periphery, each of said containers having a water-inlet opening inwardly located with respect to drum rotation and communicating with the water contained in said housing whereby said container fills itself with water during washing operation, and each container having an outwardly located outlet and a normally closed valve tending to retain the water in said container, said valve having a closure member moveable inwardly to open position and a tappet extending radially outwardly, said assembly having a circular surface member normally spaced from said tappets and engageable thereby only when said drum is deflected toward said member, whereby said tappet is caused to open said valve for releasing water to reduce drum unbalance.

7. In a laundering machine according to claim 1 said drum having a number of hollow entainer bulges protruding inwardly from the drum periphery, and said containers being partially surrounded by said respective bulges.

8. In a laundering machine according to claim 6 said valve having a conical seat and having a spring biasing said closure member outwardly against said seat, said closure member and said tappet consisting of an integral piece, and said tappet extending outwardly through said seat.

9. In a laundering machine according to claim 6, said assembly having a cylindrical wall portion which forms said circular surface member for engagement with said tappets.

10. A laundering machine according to claim 6, comprising a cylindrical structure rotatable in coaxial relation to said drum and surrounding said drum, said structure having a fixed axis of rotation relative to said housing and forming said surface member.

11. A centrifuging machine comprising an enclosing assembly, a drum rotatably mounted in said assembly for receiving the articles to be centrifuged, said drum being radially deflectable, said drum having a number of containers uniformly distributed over the drum periphery, each of said containers having a liquid inlet inwardly located with respect to drum rotation and communicating with the liquid contained in said housing whereby said container fills itself with liquid at relatively slow rotating speed of said drum, and each container having an outwardly located outlet and a normally closed valve in said outlet tending to retain the liquid in said container during centrifugal operation at relatively high speed, said assembly including a radially stationary cylindrical surface surrounding said drum, and valve actuating tappet means on each of said valves extending toward said surface to contact said drum and deflected only when said drum is radially deflectable for opening said respective valves to reduce drum unbalance during centrifugal operation.

12. A washing machine for washing, rinsing and finally centrifugally extracting wash with unbalance compensation during the centrifuging operation by formation of a counterbalance, comprising a housing, a drum rotatably mounted in said housing for receiving the wash, said drum having a plurality of containers uniformly
distributed over the drum periphery, each of said containers having a liquid inlet adapted to receive water during the washing operation and a liquid outlet valve, said valves being effective to change the filling level of the chambers during the drying rotation by means of the opening of valves for releasing the liquid, said drum being mounted for elastic radial displacement; said valves including a valve seat, a conical radial tappet, means for biasing the tappet in the closed position against said valve seat; said drum housing having an interior surface surrounding said drum and facing said valve tappets to serve as a bearing layer for said valve tappets when said drum is radially displaced and thereby vary the liquid level in said container to balance said drum.

13. A machine for washing and drying laundry comprising a housing to contain liquid during washing operation, a horizontally-disposed perforated laundry-receiving drum rotatable in said housing at low and high speeds respectively for washing and centrifugally drying the laundry and adapted to be at least partially below the liquid during washing operation, resilient means mounting said drum for permitting radial deflection of said drum relative to said housing due to unbalanced loading, said drum having a number of containers uniformly distributed over the drum periphery so as to be at least partially immersed in liquid during the washing operation, each of said containers having a liquid-inlet opening inwardly located with respect to drum rotation and adapted to communicate with the liquid contained in said housing during washing operation so as to allow liquid to flow into the container, each container having an outwardly located outlet and a normally closed valve tending to retain the liquid in said container during centrifugal drying operation, and control means extending radially from said valves toward said housing and adapted to be actuated during radial deflection of said drum by contact with said housing for opening said respective valves to reduce drum unbalance.

14. A washing machine for washing, rinsing and then centrifugally extracting wash, comprising a housing, a perforated drum horizontally disposed and rotatably mounted in said housing for receiving the wash, said drum having a plurality of containers uniformly distributed over the drum periphery and adapted to be at least partially immersed in said water during the washing operation, each of said containers having a liquid inlet adapted to receive liquid during the washing operation when the containers are immersed, said inlet being adapted to travel below the surface of the liquid during the washing operation so that liquid flows into said container, each of said containers having a liquid outlet valve, said valve being effective to change the filling level of the chambers during the drying rotation by means of the opening of the valves for releasing the liquid, said drum being mounted for elastic radial displacement; a conical radial tappet, means for biasing the tappet in the closed position against the valve seat; said drum housing having an interior surface surrounding said drum and facing said valve tappets to serve as a bearing layer for said valve tappets when said drum is radially displaced and thereby vary the liquid level in said container to balance the drum.

15. A centrifuging machine comprising a perforated drum rotatably mounted about an axis for receiving articles to be centrifuged, said drum having a number of containers distributed over the drum periphery and being fillable with liquid, filling means to introduce liquid into said containers, valve means on each of said containers to discharge the liquid, a member having a circular surface surrounding said drum and radially stationary relative to the axis about which said drum rotates, said drum being radially deflectable, actuating means on said valve means extending radially outward toward said surface to contact said surface when said drum is radially deflected by unbalanced loading and to open said valve means, whereby the liquid is selectively discharged from said containers.

16. A centrifuging machine comprising a housing, a perforated drum rotatably mounted in said housing about an axis for receiving articles to be centrifuged, said drum having a number of containers distributed over the drum periphery and being fillable with liquid, filling means to introduce liquid into said containers, valve means on each of said containers to discharge the liquid, said drum housing having a circular interior surface surrounding said drum and radially stationary relative to the axis about which said drum rotates, said drum being radially deflectable, actuating means on said valve means extending radially outward toward said surface to contact said surface when said drum is radially deflected by unbalanced loading and to open said valve means, whereby the liquid is selectively discharged from said containers.

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