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(54) **SYSTEM TO BALANCE ROTATING INERTIA FORCES DURING CENTRIFUGATION IN A WASHING MACHINE**

SYSTEM ZUR BALANCE VON ROTIERENDEN TRÄGHEITSKRÄFTEN WÄHREND DER ZENTRIFUGIERUNG IN EINER WASCHMASCHINE

SYSTÈME POUR ÉQUILIBRER DES FORCES D'INERTIE DE ROTATION PENDANT UNE CENTRIFUGATION DANS UNE MACHINE À LAVER

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Description

[0001] The present Invention relates to a system to balance rotating inertia forces generated by poor distribution of laundry in a rotating drum in a washing machine having the drum placed in a tub, the system including a vibration measuring system, a controlling system and a system to generate counteracting forces and provided to regulate the Intensity thereof, in order to take into account progressive dewatering of the laundry during a centrifugation phase, the measuring system including a sensor, the control system comprising an electronic circuit and processor, and the system of generation of counteracting forces of variable intensity comprising a system of pockets open at the minimum radius, or watertight pockets, located at a circumference of the drum.

[0002] It is well known that washing machines Including a tub for holding washing and rinsing liquid, systematically termed "water" herein, and a rotatable drum for holding laundry to be treated in washing, rinsing, end centrifugation phases, often vibrate during the centrifugation phase, sometimes quite heavily, and this is because of an uneven distribution of the laundry In the drum, which produces a system of forces on the washing machine. This system of forces, however, may gradually decreases in intensity as the laundry expels the water due to the said centrifugation, or possibly change due to different absorption characteristics of individual items.

[0003] At present, on the one hand, these vibrations force manufacturers to make washing machines heavier by adding additional masses, and on the other hand, may require to reduce the diameter of the drum so that the tub containing it does not hit the outer structure including the casing of the washing machine, the tub being connected to the casing by a damping spring system. But the said limitation of the drum diameter is considered a negative factor, as it reduces the amount of laundry that can be washed per cycle.

[0004] A system to balance a rotating inertia forces generated by a poor distributed laundry in a drum of a washing machine is disclosed in US 5,829,084 A or US 3,088,522 A. These systems comprise pockets mounted at the circumference of drum and fillable with water to generate counteracting forces and provided to regulate the intensity thereof. The system further comprises a control system which control vales for dewatering the pockets wherein the vales are operated by a mechanical force generated by a movement of the drum. US 5,829,084 A further disclose a system wherein the valves are controlled electrically by solenoids which generate a force if electrical contact will be closed due to said drum movement.

[0005] Apart from that, new special rates for nighttimes use of household electrical appliances available or considered to be made available in certain countries Including Italy provide a further stimulus in the reduction/elimination of the said vibrations, to enable use of washing machines during nighttimes without causing considera-

ble noise.

[0006] The goal of the present invention is therefore to provide a system that makes its possible to minimise or even completely eliminate the said vibrations. In prior art it has been considered to implement a system based on the use of shafts with eccentric masses whose radiuses could be varied. This system, however, is flawed in that it requires too extensive changes to the current architecture of a washing machine, and so it has been determined to propose a new system that obtains the same effects with fewer structural modifications.

[0007] In accordance with the present invention there is provided a system to control vibrations during centrifugation in a domestic washing machine in accordance with the independent claim. Preferred embodiments of the invention are subjects of dependent claims or are exhibited in the subsequent description and the attached drawing.

[0008] Accordingly there is provided, in accordance with the invention, a system to balance rotating inertia forces generated by poor distribution of laundry in a rotating drum in a washing machine having the drum placed in a tub, the system including a vibration measuring system, a controlling system and a system to generate counteracting forces and provided to regulate the intensity thereof, in order to take into account progressive dewatering of the laundry during a centrifugation phase, the measuring system including a sensor, the control system comprising an electronic circuit and processor, and the system of generation of counteracting forces of variable intensity comprising a system of pockets open at the minimum radius, or watertight pockets, located at a circumference of the drum, which may be filled with water via first valves controlled by the control system, and then selectively emptied via second valves also controlled by the control system, so as to generate a rotary force of equal intensity to that produced by the laundry but in the opposite direction and of variable intensity.

[0009] The basic idea is to generate two toroidal cavities located laterally inside the drum, divided with dividers or by other suitable means into a series of pockets which may be filled with water, and may be selectively emptied in order to generate inertia forces able to offset those generated by a poor distribution of the laundry. Now these pockets can be constructed as integral elements of the drum and located inside or outside the circumference of the drum, or may even consist of additional plastic or metal elements installed in the drum. These pockets can be open at their respective minimum radius, or watertight and located internally, but with first valves for filling, located at the top, inside. Second valves, located in peripheral positions must be present however and must be used for the controlled drainage of the said pockets. Of course, it is clear that the first and second valves should be carefully controlled. Opening and closing can be controlled externally, by means - for example, but not exclusively - of the activation of solenoids located outside the tub, which generate electromagnetic forces

when the first and second valves to be actuated are passed along. For the opening and closing of the first and second valves, there may be purely mechanical cam systems, present in the solenoids (although not part of the invention and particularly not preferable due to noise possibly produced by the inevitable impacts), or shutters made of ferromagnetic material, or - better still - permanent magnets, which can be attracted or repelled by appropriately reversing the current in the solenoids. An angle encoder can control the position of the drum, in order to detect when a particular valve will be in the right position to be actuated. However, the encoder could be replaced by analysers of the accelerations, possibly with the addition of field sensors (Hall effect or otherwise).

[0010] It is noted that, by positioning the pockets on both sides of the drum, it is also easy to eliminate not only any directional force resulting from the system of centrifugal forces, but also any resulting momentum, with the further advantage of reducing the stress on the bearings that support the drum, as the latter would become intrinsically balanced.

[0011] In the event of use of pockets outside the circumference of the drum and open at the minimum radius, a small water supply conduit will be provided at the opening, which will deliver the water when the centrifugation cycle starts, so that all the pockets contain the same amount of water. At this point accelerometers assess the poor distribution and the said drainage valves can be opened with the systems mentioned above, thereby obtaining balance.

[0012] In the event of an arrangement of intrinsically watertight pockets (which is more complex to actuate and therefore perhaps less preferable than the solution described above), the system may operate as follows: During a rinse phase preceding a centrifugation phase the drum is brought, in sequence, into positions with each pocket centred at the lowest point. The respective first valve is then opened until the pocket is completely full, and then the system moves on to the subsequent pocket. Then, when the centrifugation phase starts, it may initially be at low speed, in order to ascertain generation of low mechanical stress. But this makes it possible to determine the angular positions in which there are imbalances. Having done this, the additional useful imbalance can be calculated and water outlets can be activated from the pockets not needed to balance the rotating drum, leaving just enough water to obtain the desired result. This will be achieved by activating the drainage solenoids when the corresponding second valves pass along, all of which is controlled by the control device using the angle gauge, and however it is implemented. Of course, the second valves will have to be further actuated to offset the loss of weight of the laundry during the centrifugation phase.

[0013] In accordance with a particularly preferred embodiment of the invention, the basic concept is to fill the pockets in the drum selectively at the beginning of the centrifugation phase, utilising first valves controlled in a timed fashion by the control system, after determining

the position and entity of the unbalancing mass using appropriate sensing means like accelerometers. In this way the second valves can be operated solely to correct minor errors and to gradually decrease the forces of inertia as the laundry is dewatered. In particular, the geometry of the washing machine and the drum may remain as described above, in the case of the pockets open at the inner radius filled from both sides, but what varies is the filling, which takes place in timed fashion after determining, by measurement, the entity and direction of the imbalance. It may be necessary to control the flow of water with appropriate first valves (one per side), filling the pockets in the first half of a round and then interrupting the supply during the second half of the round, so as to drain the mass of water strictly necessary to balance out the imbalance into the pockets. The second valves will still be useful to adjust any supply error, but above all to gradually decrease the balancing mass as the laundry is dewatered.

[0014] Note that, given the possibility of supplying the pockets located at the ends of the drum in a differential manner, in this case it is preferable to use two vibrometers or accelerometers as sensors, in order to balance the forces both tangentially and axially, so that the main axis of inertia of the rotating laundry/drum system coincides with the rotation axis, as tyre fitters do when positioning small balancing masses in different positions inside and outside of automobile wheels. However it is still possible to utilise a single vibrometer and settle for balancing solely the main component of the rotating forces.

[0015] Preferred embodiments of the invention will now be described with reference to the Figures of the attached drawing. In particular, there are shown:

Fig. 1 is diagram representing the drum of the washing machine;

Fig. 2 is a frontal view of solenoids controlling first valves;

Fig. 3 shows solenoids arranged in a straight line instead of around a circumference;

Fig. 4 shows second valves located axially rather than radially;

Fig. 5 shows a first valve;

Fig. 6 shows a magnetically actuated first valve;

Fig. 7 shows a diagram that represents the drum in a frontal and lateral semi-section view; and

Fig. 8 shows the drum open at the lesser radius with several valve and control components and the tub.

[0016] Moving on to a more detailed description, Figure 1 features a diagram that represents the drum in a frontal

and lateral semi-section view and, in the event of pockets open at the minimum radius, shows the division of the toruses into pockets 1, the drainage valve shutter with axial actuation 2, the relative openings at the minimum radius 3, and in the lateral semi-section view, the water supply conduits 4 that are part of the tub containing the drum 5, and the actuation solenoids for the drainage valves 6.

[0017] In the event of sealed pockets, Figure 2 features a frontal view of both the solenoids that control the opening of the lower first valves 7, for the filling, and of the upper second valves 8 to allow air to be released, which are located on the top of the pockets, inside, and the solenoids that control the second valves in the event of radial control 9, while on the left-hand side of the semi-section view the shutters of the first valves 10 can be seen, and on the right-hand side the outside of the circumference of the drum is shown, with the radial second valves 11 visible.

[0018] Note that the second valves 11 can obviously be actuated both radially and axially, and applied to both open pockets and sealed ones; it has simply been decided to show the possible positions of the solenoids in the two Figures, without this rendering the use of one or the other type of actuation obligatory according to the chosen pocket type.

[0019] Moving on to how the second valves 11 can be realised, a purely magnetic actuation method could be used, as illustrated in Figure 3, wherein the solenoids 12 are shown arranged in a straight line instead of around a circumference, as will actually occur, and incorporated into the valve shutter 13 is a permanent magnet, which is repulsed by a strong magnetic field generated by a series of solenoids located in parallel along the surface of the tub and provided with a soft iron core 14, so that the surfaces do not come into direct contact, as all they do is repulse the shutters so as to open the second valves 11, thereby activating solely the solenoids 12 located at the passage of each respective second valve 11 to open. Obviously, these second valves 11 can be actuated both in a radial direction (but in this case the forces necessary for actuation will have to be much greater to overcome the centrifugal force) and in a direction parallel to the drum axis. Just as obviously, a ferromagnetic element could simply be incorporated into the shutter 13, which would open towards the outside because it was attracted thereto, rather than inwards because it was repulsed, but in the first case a higher current intensity would be required.

[0020] In the event of second valves 11 located axially rather than radially, this would result in the need to house the solenoids 12 outside the tub, but actuating them would require a much lower current. All this is shown in Figure 4, where 15 denotes the drum open at the lesser radius, 16 denotes the solenoid, 17 is the shutter and the permanent magnet therefor, 18 is a rocker, 19 a stainless steel spring, 20 is the valve support and 21 is the tub. The axis of the drum is not shown as it is horizontal, but

very distant. If use of the permanent magnet 17 is not desirable (even though these magnets 17 do not risk losing their magnetisation characteristics as the maximum temperatures reached by a washing machine during washing are well below the Curie temperature), opening will have to occur by attracting the shutter 134 instead of repelling it, which is more complex, unless the water is drained towards the inside of the drum instead of outwards, and in this case the solenoid 12 could only act by solely attracting the ferromagnetic stainless steel spring 19, but in a less efficient manner from an energy consumption viewpoint.

[0021] As far as the first valves are concerned, these can be realized as shown, for example, in Figure 5, by way of a non-limiting example of a preferred embodiment. On the left, the valve is closed; on the right it is open. Note that in this case, the opening is controlled by the solenoid 22 located on the tub 23, which acts from outside the drum 24, by pressing directly on the valve stem 25, since - in this case - the drum is stationary, while the valve is open towards the inner surface of the bag 26.

[0022] Figure 6 shows a magnetically actuated first valve, therefore without a contact, where the presence of a permanent magnet 27 can be seen.

[0023] As to a particularly preferred embodiment of the invention, Figure 7 features a diagram that represents the drum in a frontal and lateral semi-section view and, in the event of pockets 1 open at the minimum radius, shows the division of the toruses into pockets 1, the second valve shutter with axial actuation 2, the relative openings at the minimum radius 3, and in the lateral semi-section view, the accelerometer 28, the water supply conduits 29 that are part of the tub containing the drum 5, the actuation solenoids for the second valves 30, the solenoid valves for incoming flow controlling and timing 31, and the auxiliary pump for the injection of the balancing water 32.

[0024] Moving on to explain how the drainage valves with radial actuation can be realised, this is shown in Figure 8, where 33 denotes the drum open at the lesser radius, 34 denotes the solenoid, 35 is the shutter and the permanent magnet therefor, 36 is a rocker, 37 a stainless steel spring, 38 the valve support and 39 is the tub. The axis of the drum is not shown as it is horizontal, but very distant. If use of the permanent magnets 35 is not desirable (even though these magnets 35 do not risk losing their magnetisation characteristics as the maximum temperatures reached by a washing machine during washing are well below the Curie temperature), opening will have to occur by attracting the shutter 35 instead of repelling it, which is more complex, unless the water is drained towards the inside of the drum instead of outwards, and in this case the solenoid 34 could only act by solely attracting the ferromagnetic stainless steel spring 37, but in a less efficient manner from an energy consumption viewpoint.

Claims

1. System to balance rotating inertia forces generated by poor distribution of laundry in a rotating drum (5, 15, 24) in a washing machine having the drum (5, 15, 24) placed in a tub (21, 23, 39), the system including a vibration measuring system, a controlling system and a system to generate counteracting forces and provided to regulate the intensity thereof, in order to take into account progressive dewatering of the laundry during a centrifugation phase, the measuring system including a sensor (28), and the system of generation of counteracting forces of variable intensity comprising a system of pockets (1) open at the minimum radius (3, 33), or watertight pockets, located at a circumference of the drum (5, 15, 24), which may be filled with water (32) via first valves (7, 10) controlled by the control system, and then selectively emptied via second valves (8, 11, 30) also controlled by the control system, so as to generate a rotary force of equal intensity to that produced by the laundry but in the opposite direction and of variable intensity, wherein the opening and closing of the valves (8, 11, 30) are controlled by means of the activation of solenoids (12, 16, 22) which generate electromagnetic forces when the first and second valves (7, 8, 10, 11, 30) to be actuated are passed along and the first and second valves (7, 8, 10, 11, 30) are shutters (13, 17, 35, 134) incorporating ferromagnetic material or permanent magnets (17, 27), which can be attracted or repelled by appropriately reversing the current in the solenoids (12, 16, 22) **characterised in that** the control system comprising an electronic circuit and processor and a series of said solenoids (12, 16, 22) are located in parallel along the surface of the tub (21, 23, 39).
2. System according to claim 1, wherein the shutter (13, 17, 35, 134) is repulsed by a strong magnetic field by said series of solenoids (12, 16, 22) provided with a soft iron core (14), so that the surfaces of the shutter (13, 17, 35, 134) and the soft iron core (14) do not come into direct contact, as all they do is to repulse shutters so as to open the second valves (11).
3. System in accordance with one of claims 1 and 2, wherein the sensor includes at least one of a vibrometer, an accelerometer (28), and a solenoid which measures the motion either in the tub or in the washing machine structure.
4. System to balance rotating inertia forces generated by poor distribution of the laundry in a washing machine, in accordance with any previous claim, wherein the system of pockets (1) is an integral part of the drum (5, 15, 24).
5. System to balance rotating inertia forces generated by poor distribution of the laundry in a washing machine, in accordance with any previous claim, wherein the pockets (1) are open at a minimum radius (3, 33) and located outside the circumference of the drum (5, 15, 24).
6. System to balance rotating inertia forces generated by poor distribution of the laundry in a washing machine, in accordance with any of claims 1 to 4, wherein the watertight pockets are located inside the circumference of the drum (5, 15, 24).
7. System to balance rotating inertia forces generated by poor distribution of the laundry in a washing machine, in accordance with any previous claim, wherein the first valves (7, 10) are positioned on respective inner surfaces of the pockets (1), at a distance from the rotational axis, and wherein the first valves (7, 10) are controlled from outside the tub by suitable electronically controlled actuation systems of the control system, for filling the pockets with water (32) as they are in their respective lowest positions upon rotating the drum (5, 15, 24).
8. System in accordance with claim 7, wherein the actuation systems comprise solenoids (12, 16, 22) for acting on the first valves through one of cams (25) and magnetic means (27).
9. System in accordance with one of claims 7 and 8, wherein the first valves may open in either axial or radial directions by one of attraction and repulsion of ferromagnetic material included in the respective actuation systems.
10. System to balance rotating inertia forces generated by poor distribution of the laundry in a washing machine in accordance with any previous claim, wherein electronically controlled actuation devices are provided for the second valves (8, 11, 30) to actuate the second valves (8, 11, 30) in a timely and appropriate fashion during drum rotation.
11. System in accordance with claim 10, wherein the actuation systems for the second valves (8, 11, 30) comprise solenoids (34) for acting on the second valves (8, 11, 30) through one of cams and magnetic means.
12. System in accordance with one of claims 10 and 11, wherein the second valves (8, 11, 30) may open in either axial or radial directions by one of attraction and repulsion of ferromagnetic material included in the actuation systems.
13. System in accordance with any previous claim, wherein the control device is programmed so as to only fill the pockets (1) positioned opposite any un-

balancing mass detected by the controlling system with water (32), and then selectively emptied via the second valves (8, 11, 30) so as to generate a rotary force of equal intensity to that produced by the laundry but in the opposite direction and of variable intensity.

Patentansprüche

1. System zum Ausgleichen rotierender Trägheitskräfte, die durch schlechte Verteilung von Wäsche in einer rotierenden Trommel (5, 15, 24) in einer Waschmaschine erzeugt werden, bei der die Trommel (5, 15, 24) in einem Laugenbehälter (21, 23, 39) angeordnet ist, wobei das System ein Schwingungsmesssystem, ein Steuerungssystem und ein System zum Erzeugen von Gegenkräften, das außerdem dafür ausgelegt ist, deren Stärke zu regeln, um die zunehmende Entwässerung der Wäsche während einer Schleuderphase zu berücksichtigen, umfasst, wobei das Messsystem einen Sensor (28) aufweist und das System zur Erzeugung von Gegenkräften variabler Stärke ein System von Taschen (1), die am minimalen Radius (3, 33) offen sind, oder von wasserdichten Taschen, die an einem Umfang der Trommel (5, 15, 24) angeordnet sind, umfasst, welche mit Wasser (32) über erste Ventile (7, 10) gefüllt werden können, die von dem Steuerungssystem gesteuert werden, und danach selektiv über zweite Ventile (8, 11, 30) entleert werden können, die ebenfalls von dem Steuerungssystem gesteuert werden, um eine rotierende Kraft von gleicher Stärke wie diejenige, die von der Wäsche erzeugt wird, die jedoch entgegengesetzt gerichtet und von variabler Stärke ist, zu erzeugen, wobei das Öffnen und das Schließen der Ventile (8, 11, 30) mittels der Aktivierung von Magnetspulen (12, 16, 22) gesteuert werden, welche elektromagnetische Kräfte erzeugen, wenn eine Vorbeibewegung an den ersten und zweiten Ventilen (7, 8, 10, 11, 30) erfolgt, die zu betätigen sind, und die ersten und zweiten Ventile (7, 8, 10, 11, 30) Verschlusschieber (13, 17, 35, 134) sind, die ferromagnetisches Material oder Permanentmagnete (17, 27) enthalten, welche angezogen oder abgestoßen werden können, indem der Stromfluss in den Magnetspulen (12, 16, 22) in geeigneter Weise umgekehrt wird, **dadurch gekennzeichnet, dass** das Steuerungssystem eine elektronische Schaltung und einen Prozessor umfasst und eine Reihe von den Magnetspulen (12, 16, 22) parallel entlang der Oberfläche des Laugenbehälters (21, 23, 39) angeordnet ist.
2. System nach Anspruch 1, wobei der Verschlusschieber (13, 17, 35, 134) durch ein starkes Magnetfeld durch die Reihe von Magnetspulen (12, 16, 22) abgestoßen wird, die mit einem weichen Eisenkern

(14) versehen sind, so dass die Oberflächen des Verschlusschiebers (13, 17, 35, 134) und des weichen Eisenkerns (14) nicht in direkten Kontakt kommen, da sie lediglich Verschlusschieber abstoßen, um die zweiten Ventile (11) zu öffnen.

3. System nach einem der Ansprüche 1 und 2, wobei der Sensor einen Schwingungsmesser, einen Beschleunigungsmesser (28) und/oder eine Magnetspule, welche die Bewegung entweder im Laugenbehälter oder in der Waschmaschinenstruktur misst, aufweist.
4. System zum Ausgleichen rotierender Trägheitskräfte, die durch schlechte Verteilung der Wäsche in einer Waschmaschine erzeugt werden, nach einem der vorhergehenden Ansprüche, wobei das System von Taschen (1) ein integraler Bestandteil der Trommel (5, 15, 24) ist.
5. System zum Ausgleichen rotierender Trägheitskräfte, die durch schlechte Verteilung der Wäsche in einer Waschmaschine erzeugt werden, nach einem der vorhergehenden Ansprüche, wobei die Taschen (1) an einem minimalen Radius (3, 33) offen sind und außerhalb des Umfangs der Trommel (5, 15, 24) angeordnet sind.
6. System zum Ausgleichen rotierender Trägheitskräfte, die durch schlechte Verteilung der Wäsche in einer Waschmaschine erzeugt werden, nach einem der Ansprüche 1 bis 4, wobei die wasserdichten Taschen innerhalb des Umfangs der Trommel (5, 15, 24) angeordnet sind.
7. System zum Ausgleichen rotierender Trägheitskräfte, die durch schlechte Verteilung der Wäsche in einer Waschmaschine erzeugt werden, nach einem der vorhergehenden Ansprüche, wobei die ersten Ventile (7, 10) an jeweiligen Innenflächen der Taschen (1) in einem Abstand von der Drehachse positioniert sind, und wobei die ersten Ventile (7, 10) von außerhalb des Laugenbehälters durch geeignete, elektronisch gesteuerte Betätigungssysteme des Steuerungssystems gesteuert werden, um die Taschen mit Wasser (32) zu füllen, wenn sie sich beim Drehen der Trommel (5, 15, 24) an ihren jeweiligen niedrigsten Positionen befinden.
8. System nach Anspruch 7, wobei die Betätigungssysteme Magnetspulen (12, 16, 22) zum Einwirken auf die ersten Ventile entweder durch Nocken (25) oder durch magnetische Mittel (27) umfassen.
9. System nach einem der Ansprüche 7 und 8, wobei die ersten Ventile durch entweder Anziehen oder Abstoßen von ferromagnetischem Material, das in den jeweiligen Betätigungssystemen enthalten ist, in ent-

weder axialer oder radialer Richtung öffnen können.

10. System zum Ausgleichen rotierender Trägheitskräfte, die durch schlechte Verteilung der Wäsche in einer Waschmaschine erzeugt werden, nach einem der vorhergehenden Ansprüche, wobei elektronisch gesteuerte Betätigungsvorrichtungen für die zweiten Ventile (8, 11, 30) vorgesehen sind, um die zweiten Ventile (8, 11, 30) während der Trommeldrehung rechtzeitig und auf geeignete Weise zu betätigen.
11. System nach Anspruch 10, wobei die Betätigungssysteme für die zweiten Ventile (8, 11, 30) Magnetspulen (34) zum Einwirken auf die zweiten Ventile (8, 11, 30) entweder durch Nocken oder durch magnetische Mittel umfassen.
12. System nach einem der Ansprüche 10 und 11, wobei die zweiten Ventile (8, 11, 30) durch entweder Anziehen oder Abstoßen von ferromagnetischem Material, das in den Betätigungssystemen enthalten ist, in entweder axialer oder radialer Richtung öffnen können.
13. System nach einem der vorhergehenden Ansprüche, wobei die Steuerungsvorrichtung dafür programmiert ist, nur die Taschen (1), die gegenüber einer eventuellen Unwucht erzeugenden Masse positioniert sind, die von dem Steuerungssystem erkannt wurde, mit Wasser (32) zu füllen, und sie danach über die zweiten Ventile (8, 11, 30) selektiv zu entleeren, um eine rotierende Kraft von gleicher Stärke wie diejenige, die von der Wäsche erzeugt wird, die jedoch entgegengesetzt gerichtet und von variabler Stärke ist, zu erzeugen.

Revendications

1. Système pour équilibrer des forces d'inertie de rotation générées par une mauvaise répartition du linge dans un tambour rotatif (5, 15, 24) d'une machine à laver comprenant le tambour (5, 15, 24) placé dans une cuve (21, 23, 39), le système comprenant un système de mesure de vibrations, un système de commande et un système pour générer des forces antagonistes et prévu pour réguler l'intensité de ceux-ci, afin de tenir compte de la déshydratation progressive de la lessive pendant une phase de centrifugation, le système de mesure comprenant un capteur (28), et le système de génération de forces antagonistes d'intensité variable comprenant un système de poches (1) ouvert à un rayon minimum (3, 33), ou des poches étanches à l'eau, situées à une circonférence du tambour (5, 15, 24), qui peuvent être remplies avec de l'eau (32) via des premières soupapes (7, 10) commandées par le système de commande, puis vidées sélectivement par l'inter-

médiaire de secondes soupapes (8, 11, 30) également commandées par le système de commande, de manière à générer une force de rotation d'intensité égale à celle produite par le linge mais dans la direction opposée et d'intensité variable, dans lequel l'ouverture et la fermeture des soupapes (10, 11, 30) sont commandées par l'intermédiaire de l'activation de solénoïdes (12, 16, 22) lesquels génèrent des forces électromagnétiques lorsque les premières et les secondes soupapes (7, 8, 10, 11, 30) à actionner sont passées le long et les premières et secondes soupapes (7, 8, 10, 11, 30) sont des obturateurs (13, 17, 35, 134) incorporant un matériau ferromagnétique ou des aimants permanents (17, 27), qui peuvent être attirés ou repoussés par une inversion appropriée du courant dans les solénoïdes (12, 16, 22), **caractérisé en ce que** le système de commande comportant un circuit électronique et un processeur et une série desdits solénoïdes (12, 16, 22) sont positionnés en parallèle le long de la surface de la cuve (21, 23, 39).

2. Système selon la revendication 1, dans lequel l'obturateur (13, 17, 35, 134) est repoussé par un champ magnétique puissant par ladite série de solénoïdes (12, 16, 22) munis d'un noyau en fer doux (14), de sorte que les surfaces de l'obturateur (13, 17, 35, 134) et le noyau en fer doux (14) ne viennent pas en contact direct, étant donné qu'il se contentent de repousser les obturateurs de manière à ouvrir les secondes soupapes (11).
3. Système selon l'une quelconque des revendications 1 et 2, dans lequel le capteur comprend au moins l'un d'un vibromètre, d'un accéléromètre (28), et d'un solénoïde qui mesure le mouvement dans la cuve ou dans la structure de la machine à laver.
4. Système pour équilibrer des forces d'inertie de rotation générées par une mauvaise répartition du linge dans un lave-linge, selon l'une quelconque des revendications précédentes, dans lequel le système de poches (1) fait partie intégrante du tambour (5, 15, 24).
5. Système pour équilibrer des forces d'inertie de rotation générées par une mauvaise répartition du linge dans un lave-linge, selon l'une quelconque des revendications précédentes, dans lequel les poches (1) sont ouvertes à un rayon minimum (3, 33) et situées à l'extérieur de la circonférence du tambour (5, 15, 24).
6. Système pour équilibrer des forces d'inertie de rotation générées par une mauvaise répartition du linge dans un lave-linge, selon l'une quelconque des revendications 1 à 4, dans lequel les poches étanches à l'eau sont situées à l'intérieur de la circonférence

du tambour (5, 15, 24).

7. Système pour équilibrer des forces d'inertie de rotation générées par une mauvaise répartition du linge dans un lave-linge, selon l'une quelconque des revendications précédentes, dans lequel les premières soupapes (7, 10) sont positionnées sur des surfaces intérieures respectives des poches (1), à une distance de l'axe de rotation, et dans lequel les premières soupapes (7, 10) sont commandées depuis l'extérieur de la cuve par des systèmes d'actionnement appropriés commandés électroniquement du système de commande, pour le remplissage des poches avec de l'eau (32) étant donné qu'ils sont dans leurs positions respectives les plus basses lors de la rotation du tambour (5, 15, 24). 5
10
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8. Système selon la revendication 7, dans lequel les systèmes d'actionnement comprennent des solénoïdes (12, 16, 22) destinés à agir sur les premières soupapes à travers l'une des cames (25) et des moyens magnétiques (27). 20

9. Système selon l'une quelconque des revendications 7 et 8, dans lequel les premières soupapes peuvent s'ouvrir dans des directions axiale ou radiale, soit par une d'attraction ou une répulsion d'un matériau ferromagnétique inclus dans les systèmes d'actionnement respectifs. 25
30

10. Système pour équilibrer des forces d'inertie de rotation générées par une mauvaise répartition du linge dans un lave-linge selon l'une quelconque des revendications précédentes, dans lequel des dispositifs d'actionnement commandés électroniquement sont prévus pour les secondes soupapes (8, 11, 30) pour actionner les secondes soupapes (8, 11, 30) d'une manière appropriée et en temps utile pendant la rotation du tambour. 35
40

11. Système selon la revendication 10, dans lequel les systèmes d'actionnement pour les secondes soupapes (8, 11, 30) comporte des solénoïdes (34) destinés à agir sur les secondes soupapes (8, 11, 30) à travers l'une des cames et des moyens magnétiques. 45

12. Système selon l'une quelconque des revendications 10 et 11, dans lequel les secondes soupapes (8, 11, 30) peuvent s'ouvrir dans des directions axiale ou radiale soit par une d'attraction ou une répulsion d'un matériau ferromagnétique inclus dans les systèmes d'actionnement. 50

13. Système selon l'une quelconque des revendications précédentes, dans lequel le dispositif de commande est programmé de manière à remplir uniquement les poches (1) positionnées en face de tout balourd dé-

tecté par le système de commande avec de l'eau (32), et vidées ensuite sélectivement par l'intermédiaire des secondes soupapes (8, 11, 30) de façon à générer une force de rotation d'intensité égale à celle produite par le linge mais dans la direction opposée et d'intensité variable.

Fig. 1

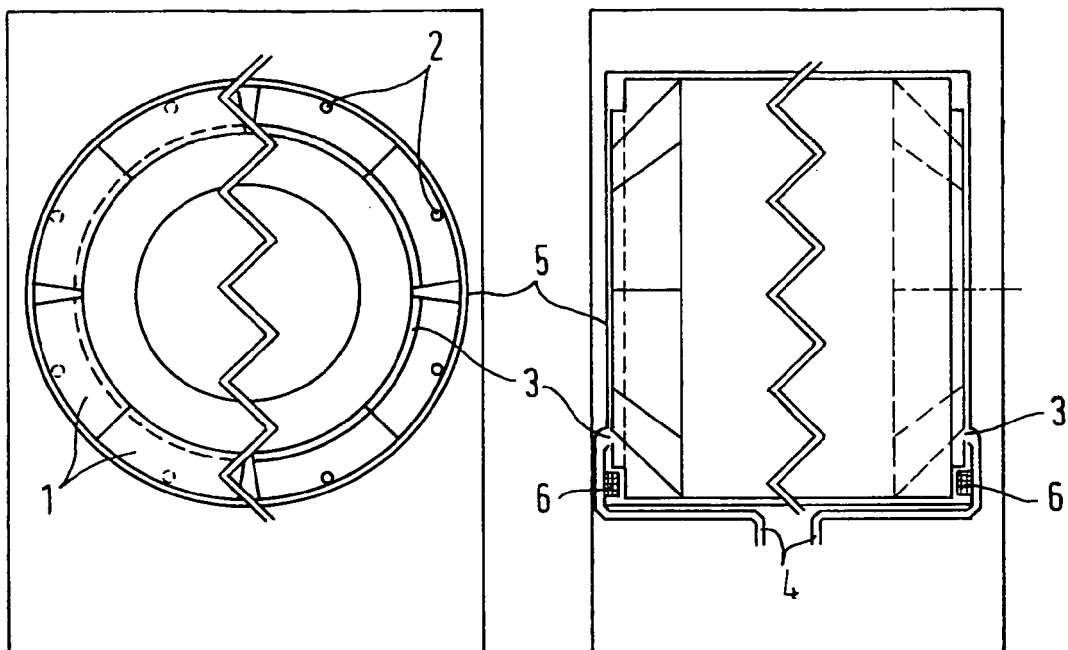


Fig. 2

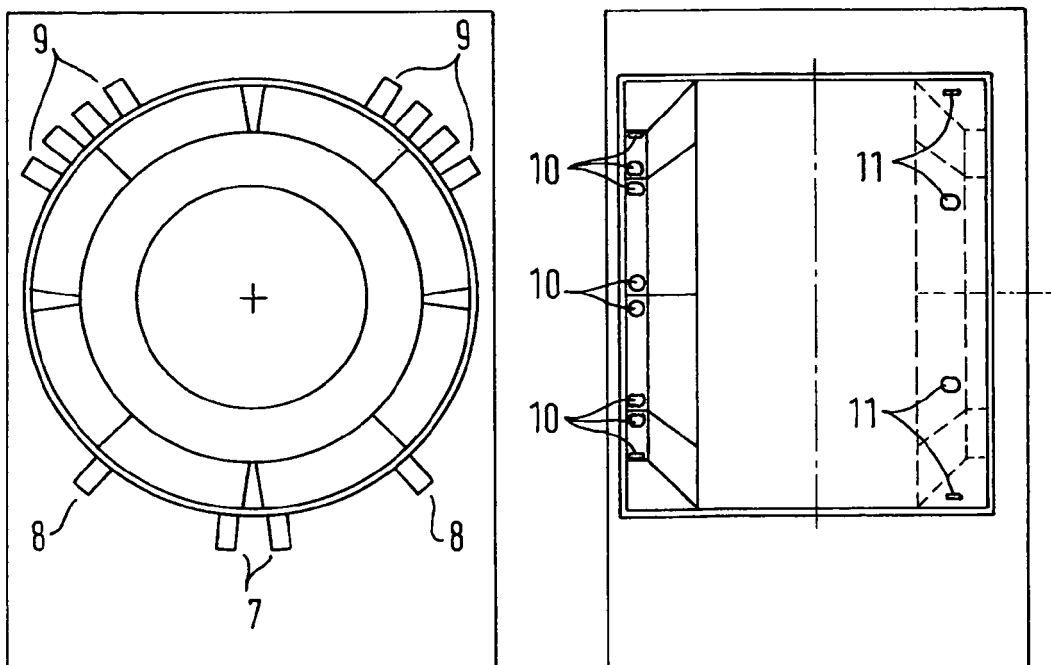


Fig. 3

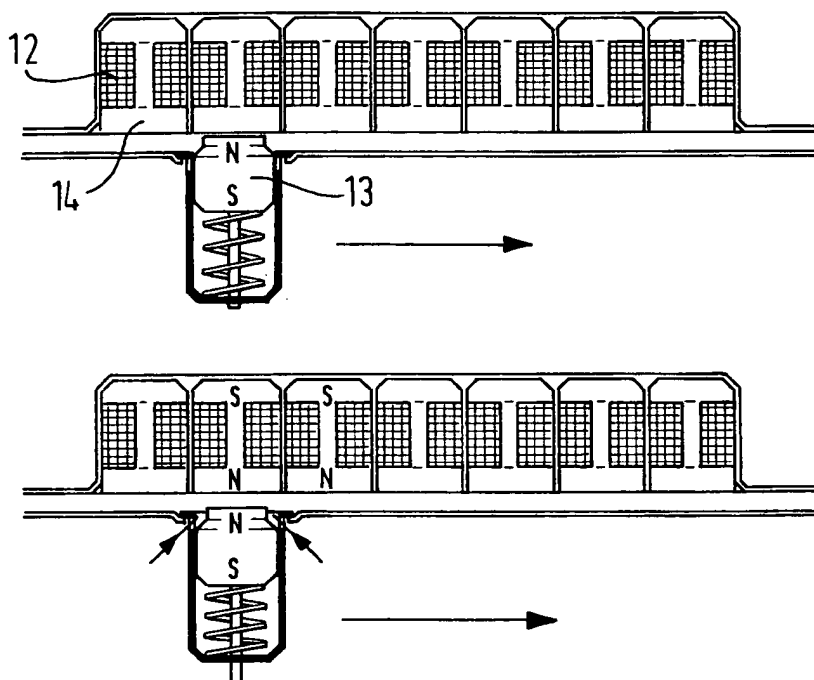


Fig. 4

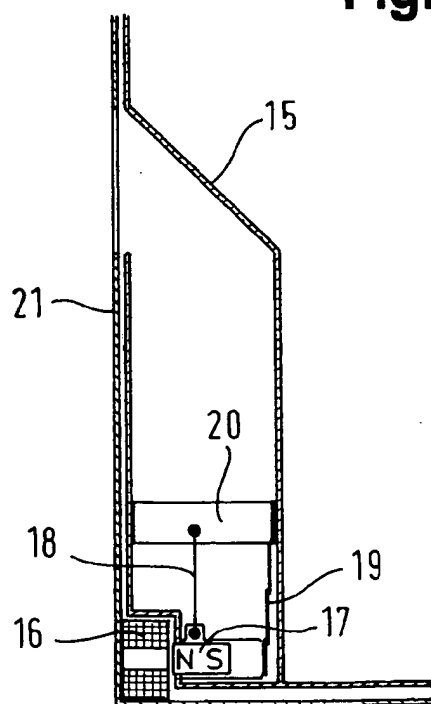


Fig. 5

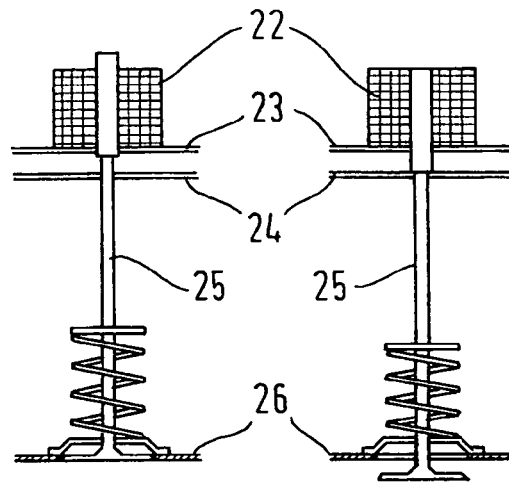


Fig. 6

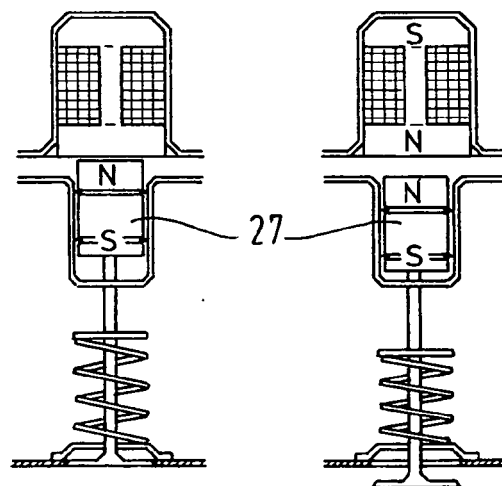


Fig. 7

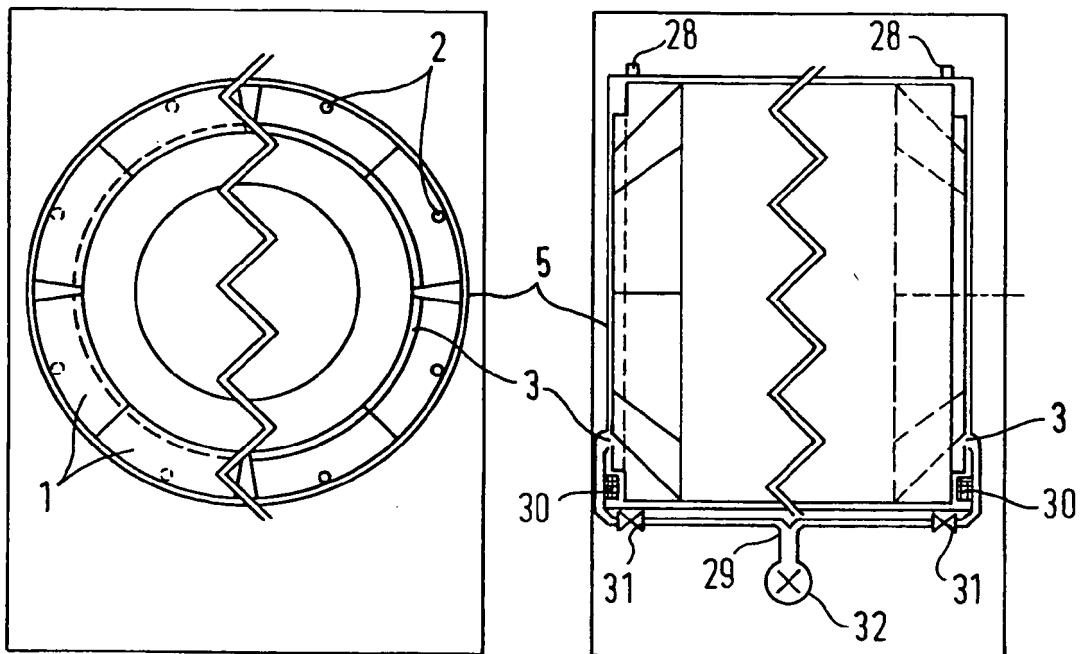
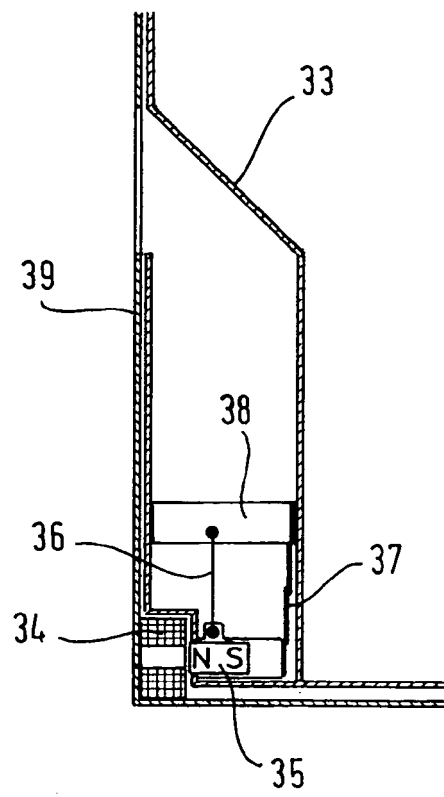


Fig. 8



REFERENCES CITED IN THE DESCRIPTION

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