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(54) A WASHING MACHINE COMPRISING AN AIR TRAP

WASCHMASCHINE MIT LUFTFALLE

LAVE-LINGE COMPRENANT UN SIPHON

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(73) Proprietor: **Arçelik Anonim Sirketi**
34950 Istanbul (TR)

(72) Inventors:
- **KAYA, Mehmet**
  34950 Istanbul (TR)
- **OZTURK, Emre**
  34950 Istanbul (TR)
- **SAHIN, Yavuz**
  34950 Istanbul (TR)
- **TACAN, Ilkin**
  34950 Istanbul (TR)

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Description

[0001] The present invention relates to a washing machine wherein the measurement of water level and unbalanced load is performed, known, for instance, from EP-A-1 293 595.

[0002] In washing machines, the level of the water received in the machine is determined by measuring the pressure of the air compressed inside the air trap, which is connected to the tub, as the manometric height of the water, rising in the tub, increases, and by comparing this pressure with the reference pressure value in the situation when the tub is empty.

[0003] On the other hand, in horizontal-axis washing machines, in order that the spin-drying step can be efficiently performed, the laundry is required to be distributed to the drum wall equally in every direction. In the situation that the laundry cannot be distributed equally, the vibration in the washing machine increases at high speeds in the spin-drying step and this causes the dynamic and structural system of the machine to be damaged. Therefore, in horizontal-axis washing machines, unbalanced load detection methods are present. By means of these methods, the maximum amount of unbalanced load, which can exist inside the machine in the spin-drying step, is determined and depending on the determined value, various distribution algorithms are applied for the distribution of the laundry on the drum wall if required. Furthermore, again by these methods, the situations wherein the tub gets close to the resonance frequency are determined and the spin-drying process is stopped. Thus, the risk that the tub resonates at very high speeds and as a result of this, hits the body of the washing machine is eliminated.

[0004] In the state of the art, in order to minimize the usage of additional elements for unbalanced load detection, embodiments, aimed at commonizing the elements used for water level detection and for unbalanced load detection, have been developed.

[0005] A state of the art embodiment is explained in the German Patent Application No DE19616635. In this application, a system is described, which measures the fluctuations, occurring due to the imbalance, with regard to the pressure data.

[0006] In the state of the art European Patent Application No EP0967318, a system, which measures the oscillations, that is, the imbalance occurring in the tub by means of the pressure difference, is explained. In an embodiment explained in the said application, the tube coming from the air trap and the tube coming from the vibration sensor are joined together by a T element and are connected to the pressure sensor by a single tube.

[0007] In another embodiment, the tube coming from the air trap and the tube coming from the vibration sensor are connected to the pressure sensor separately. In this embodiment, a valve, which enables the tube coming from the air trap to be cut off when desired, is situated on the tube coming from the air trap.

[0008] In another state of the art document, the European Patent Application No EP0750065, a method, which relates to the interpretation of the data, received by the pressure sensor from the air trap, to be used for unbalanced load detection, is explained.

[0009] The European patent application number EP1293595A1 discloses a method of detecting an unbalanced load in a washing machine and further of determining a rotational velocity to be provided of a tub of the washing machine in dependence of a difference of pressures measured at two different rotational velocities. In that step of determining, a particular matrix is made use of.

[0010] However, in these state of the art embodiments, while the measurement of the water level and of the unbalanced load is desired to be performed by means of a single pressure sensor, the desired level of accuracy of the unbalanced load measurements, performed as a result of commonizing, cannot be provided and therefore, the tub sometimes cannot be prevented from hitting the body of the washing machine by reaching the resonance frequency.

[0011] The aim of the present invention is the realization of a washing machine wherein the measurement of the water level and of the unbalanced load amount is performed with low cost, and the risk of which being damaged by resonating due to unbalanced load is minimized.

[0012] The washing machine realized in order to attain the aim of the present invention is explicated in the claims.

[0013] The washing machine comprises an air trap which is used for performing the water level detection, a vibration transmitter which is used for performing the unbalanced load detection, a pressure sensor which detects the pressure values created by the air that is compressed in the air trap and in the vibration transmitter, and a control unit which controls the washing algorithms in accordance with the data received from the pressure sensor. The control unit, used in the washing machine of the present invention, increases the drum speed step by step during spin-drying. The control unit calculates the ratio of the pressure value, transmitted from the vibration transmitter to the pressure sensor at each speed, to the pressure value, transmitted at the previous speed, and, by comparing the calculated ratio with the threshold ratio saved to its memory by the manufacturer, foresees the amount of displacement the tub will perform while resonating.

[0014] If the foreseen amount of displacement is equal to, or greater than the amount of displacement which causes the tub to hit the body, the control unit stops the spin-drying process. However, if the calculated amount of displacement is smaller than the displacement which causes the tub to hit the body, the spin-drying process is continued.

[0015] In an embodiment of the present invention, a single threshold ratio is saved in the control unit memory for all speeds whereat a comparison is performed be-

tween the ratio and the threshold ratio.

[0016] In an embodiment of the present invention, a different threshold ratio is saved in the control unit memory for each speed whereat a comparison is performed between the ratio and the threshold ratio. Thus, the risk of hitting is provided to be prevented more effectively.

[0017] In an embodiment of the present invention, since the pressure ratio is not possible to be calculated as no previously performed measurement is present at the first speed whereat a measurement will be performed, the amount of displacement that corresponds to the first pressure value transmitted from the vibration transmitter to the pressure sensor is compared with the maximum amount of displacement that can be allowed for the tub to perform. Thus, beginning from the first speed, the unbalanced load conditions, wherein excessive displacement occurs, are prevented from being overlooked.

[0018] The model embodiments that relate to the washing machine realized in order to attain the aim of the present invention are illustrated in the attached figures, where:

[0019] Figure 1 - is the front schematic view of a washing machine.

[0020] The elements illustrated in the figures are numbered as follows:

1. Washing machine
2. Drum
3. Tub
4. Air trap
5. Vibration transmitter
6. Pressure sensor
7. Control unit

[0021] The washing machine (1) comprises a drum (2) wherein laundry is disposed, a tub (3) wherein the drum (2) moves, an air trap (4) wherein the air is compressed as the amount of water taken into the tub (3) increases, a vibration transmitter (5) wherein the air is compressed depending on the vibration of the tub (3), a pressure sensor (6) which reads the pressure that is created by the air compressed in the air trap (4) and in the vibration transmitter (5), and a control unit (7) which determines the water level and the unbalanced load amount by interpreting the data it receives from the pressure sensor (6) (Figure 1).

[0022] The washing machine (1) of the present invention applies a washing algorithm which preferably comprises water intake, washing, discharge and spin-drying steps.

[0023] The control unit (7) increases the drum (2) speed (n) step by step in the spin-drying step and calculates the ratio ($d_i = P_i / P_{i-1}$) of the pressure value (P_i), transmitted from the vibration transmitter (5) to the pressure sensor (6) at each speed (n_i), to the pressure value (P_{i-1}) transmitted at the previous speed (n_{i-1}). If the calculated ratio (d_i) is equal to, or greater than a threshold ratio (d_{tr}) predetermined by the manufacturer, the control unit (7) stops the spin-drying process by deciding that the amount of displacement (Δx_r) the tub (3) will perform when the resonance is reached, is equal to, or greater than the maximum amount of displacement (Δx_{tr}) which is determined by the manufacturer and which can be allowed for the tub (3) to perform.

[0024] If the calculated ratio (d_i) is smaller than a threshold ratio (d_{tr}) predetermined by the manufacturer, the control unit (7) continues the spin-drying process by deciding that the amount of displacement (Δx_r) the tub (3) will perform when the resonance is reached, is smaller than the maximum amount of displacement (Δx_{tr}) which is determined by the manufacturer and which can be allowed for the tub (3) to perform.

[0025] Thus, the decision, given for stopping the spin-drying process, is provided to be given independently of the noise which occurs in the pressure values as a result of reading the data, received both from the vibration transmitter (5) and from the air trap (4), by a single pressure sensor (6) .

[0026] Since the transmission of the vibration increases as the resonance speed is approached (n_r), the calculated ratio (d_i), also, increases gradually. The failures, which are present in the pressure values (P_{i-1}, $P_{i,\ldots}$) that are read by the pressure sensor (6) due to the pressure sensor (6) also being connected to the air trap (4) when the ratio (d_i) is used for determining the hitting condition, are prevented from affecting the decision to be given.

[0027] In an embodiment of the present invention, a single threshold ratio (d_{tr}) is saved in the control unit (7) memory for all speeds (n_{i-1}, $n_{i,\ldots}$) whereat a comparison is performed between the ratio (d_i) and the threshold ratio (d_{tr}).

[0028] In an embodiment of the present invention, a different threshold ratio (d_{tri}) is saved in the control unit (7) memory for each speed (n_i) whereat a comparison is performed between the ratio (d_i) and the threshold ratio (d_{tr}). Thus, the risk of hitting is provided to be prevented more effectively.

[0029] Since no previously performed measurement is present at the first speed (n_1) whereat a measurement is performed, the ratio (d_i) cannot be calculated to be compared with the threshold ratio (d_{tr}). In an embodiment of the present invention, at the first speed (n_1), the amount of displacement (Δx) that corresponds to the first pressure value (P_1) transmitted from the vibration transmitter (5) to the pressure sensor (6) is compared with the maximum amount of displacement (Δx_{tr}) which is saved in the control unit (7) memory and which can be allowed for the tub (3) to perform. Thus, beginning from the first speed, also the unbalanced load conditions, wherein excessive displacement is encountered, are provided to be detected and the risk of hitting, which will be encountered right at the beginning of the spin-drying step, is minimized.

[0030] By means of the present invention, in washing machines (1) wherein a single pressure sensor (6) is used for water level detection and for unbalanced load detec-

tion, the damages, which will occur as a result of not accurately determining the tub speed whereat the resonance condition will occur, are prevented.

[0031] It is to be understood that the present invention is not limited to the embodiments disclosed above and a person skilled in the art can easily introduce different embodiments.

Claims

1. A washing machine (1) comprising a drum (2) wherein laundry is disposed, a tub (3) wherein the drum (2) moves, an air trap (4) wherein the air is compressed as the amount of water taken into the tub (3) increases, a vibration transmitter (5) wherein the air is compressed depending on the vibration of the tub (3), a pressure sensor (6) which reads the pressure that is created by the air compressed in the air trap (4) and in the vibration transmitter (5), and a control unit (7) which determines the water level and the unbalanced load amount by interpreting the data it receives from the pressure sensor (6), **characterized in that** the control unit (7) is adapted to initiate a spin-drying process in which it increases the drum (2) speed (n) step by step and calculates the ratio $d_i = P_i / P_{i-1}$ of the pressure value (P_i), transmitted from the vibration transmitter (5) to the pressure sensor (6) at each speed (n_i), to the pressure value (P_{i-1}) transmitted at the previous speed (n_{i-1}), and which compares the calculated ratio (d_i) with a threshold ratio (d_{tr}) that is saved to its memory by the manufacturer, and that said control unit (7) is further adapted to stop the spin-drying process if the calculated ratio (d_i) is equal to, or greater than the threshold ratio (d_{tr}), by deciding that the amount of displacement (Δx_r) the tub (3) will perform when the resonance is reached, is equal to, or greater than the maximum amount of displacement (Δx_{tr}) that is determined by the manufacturer and that can be allowed for the tub (3) to perform, and else to continue the spin-drying process.

2. A washing machine (1) as in Claim 1 , **characterized by** the control unit (7), in the memory of which a single threshold ratio (d_{tr}) is saved for all speeds ($n_{i-1,ni,...}$) whereat a comparison is performed between the ratio (d_i) and the threshold ratio (d_{tr}) .

3. A washing machine (1) as in Claim 1, **characterized by** the control unit (7), in the memory of which a different threshold ratio (d_{tri}) is saved for each speed (n_i) whereat a comparison is performed between the ratio (d_i) and the threshold ratio (d_{tr}).

4. A washing machine (1) as in any one of the above Claims, **characterized by** the control unit (7) which, at the first speed (n_1) whereat a measurement is performed, compares the amount of displacement (Δx) that corresponds to the first pressure value (P_1) transmitted from the vibration transmitter (5) to the pressure sensor (6) with the maximum amount of displacement (Δx_{tr}) that is saved in the control unit (7) memory and that can be allowed for the tub (3) to perform.

Patentansprüche

1. Waschmaschine (1), **umfassend** eine Trommel (2), in die Wäsche gegeben wird, einen Waschbehälter (3), in dem sich die Trommel (2) bewegt, eine Luftfalle (4), in der mit zunehmender Menge des in den Waschbehälters (3) aufgenommenen Wassers die Luft verdichtet wird, einen Vibrationsüberträger (5), in dem die Luft abhängig von der Vibration des Waschbehälters (3) verdichtet wird, einen Drucksensor (6), der den Druck ausliest, der von der in der Luftfalle (4) und im Vibrationsüberträger (5) verdichteten Luft erzeugt wird, und eine Steuereinheit (7), die den Wasserpegel und die Menge unausgeglichener Beladung bestimmt, indem sie die Daten interpretiert, die sie vom Drucksensor (6) empfängt, und **dadurch gekennzeichnet, dass** die Steuereinheit (7) dazu ausgebildet ist, einen Schleudertrocknungsvorgang einzuleiten, wobei sie die Drehzahl (n) der Trommel (2) Schritt für Schritt erhöht und das Verhältnis $d_i = P_i / P_{i-1}$ des Druckwertes (P_i), der bei einer jeweiligen Drehzahl (n_i) von dem Vibrationsüberträger (5) an den Drucksensor (6) übertragen wird, zu dem Druckwert (P_{i-1}) berechnet, der bei der vorherigen Drehzahl (n_{i-1}) übertragen wurde, und die das berechnete Verhältnis (d_i) mit einem Schwellenverhältnis (d_{tr}) vergleicht, das vom Hersteller in ihrem Speicher gespeichert wurde, wobei die Steuereinheit (7) ferner dazu ausgebildet ist, den Schleudertrocknungsvorgang anzuhalten, wenn das berechnete Verhältnis (d_i) gleich oder größer als das Schwellenverhältnis (d_{tr}) ist, indem sie feststellt, dass die Menge der Verdrängung (Δx_r), die der Waschbehälter (3) ausführt, wenn die Resonanz erreicht wird, gleich oder größer als die maximale Verdrängungsmenge (Δx_{tr}) ist, die vom Hersteller festgelegt wird und die für einen Betrieb des Waschbehälters (3) zugelassen werden kann, und den Schleudertrocknungsvorgang anderenfalls fortzusetzen.

2. Waschmaschine (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** im Speicher der Steuereinheit (7) ein einzelnes Schwellenverhältnis (d_{tr}) für die alle Drehzahlen ($n_{i-1,ni,...}$) gespeichert ist, wobei ein Vergleich zwischen dem Verhältnis (d_i) und dem Schwellenverhältnis (d_{tr}) durchgeführt wird.

3. Waschmaschine (1) nach Anspruch 1, **dadurch ge-**

kennzeichnet, dass im Speicher der Steuereinheit (7) ein jeweils anderes Schwellenverhältnis (d_{tri}) für die jeweiligen Drehzahlen (n_i) gespeichert ist, wobei ein Vergleich zwischen dem Verhältnis (d_i) und dem Schwellenverhältnis (d_{tr}) durchgeführt wird.

4. Waschmaschine (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Steuereinheit (7) bei der ersten Drehzahl (n_i), bei der eine Messung durchgeführt wird, die Menge der Verdrängung (Δx), die dem ersten Druckwert (P_1) entspricht, der von dem Vibrationsüberträger (5) an den Drucksensor (6) übertragen wird, mit der maximalen Verdrängungsmenge (Δx_{tr}) vergleicht, die im Speicher der Steuereinheit (7) gespeichert ist und die für einen Betrieb des Waschbehälters (3) zugelassen werden kann.

Revendications

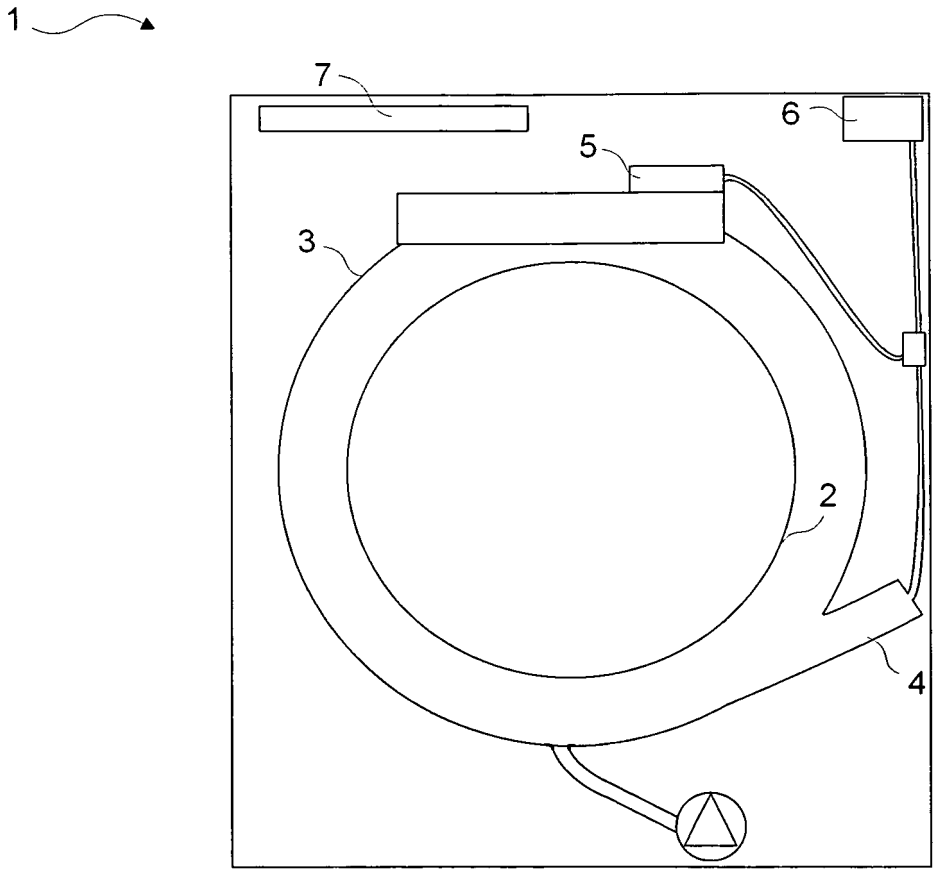
1. Une machine à laver (1) **comprenant** un tambour (2) où le linge est placé, une cuve (3) où le tambour (2) se déplace, un piège à air (4) où l'air est comprimé en tant que la quantité d'eau prise dans la cuve (3) augmente, un transmetteur de vibrations (5) où l'air est comprimé selon la vibration de la cuve (3), un capteur de pression (6) qui détecte la pression générée par l'air comprimé dans le piège à air (4) et dans le transmetteur de vibrations (5), et une unité de commande (7) qui détermine le niveau d'eau et la quantité de la charge déséquilibrée en évaluant les données reçues du capteur de pression (6), **caractérisée en ce que** l'unité de commande (7) est adaptée à commencer un processus d'essorage dans lequel elle augmente la vitesse (n) du tambour (2) pas à pas et calcule le rapport $d_i=P_i/ P_{i-1}$ de la valeur de pression (P_i), transmise par le transmetteur de vibrations (5) au capteur de pression (6) à chaque vitesse (n_i), à la valeur de pression (P_{i-1}) transmise à la vitesse précédente (n_{i-1}), en comparant le rapport calculé (d_i) avec un rapport de seuil (d_{tr}) qui est enregistré dans sa mémoire par le fabricant, et que ladite unité de commande (7) est en outre adaptée à arrêter le processus d'essorage si le rapport calculé (d_i) est égal au ou supérieur au rapport de seuil (d_{tr}) en décidant que la quantité de déplacement (Δx_r), que la cuve (3) se produira lorsque la résonance est atteinte, est égale à ou supérieure à la quantité maximale de déplacement (Δx_{tr}) déterminée par le fabricant et que la cuve (3) peut faire, et adaptée à continuer le processus d'essorage.

2. Une machine à laver (1) selon la Revendication 1, **caractérisée par** l'unité de commande (7), dans la mémoire de laquelle un seul rapport de seuil (d_{tr}) est enregistré pour toutes les vitesses ($n_{i-1,ni,...}$), où une comparaison est effectuée entre le rapport (d_i) et le rapport de seuil (d_{tr}) .

3. Une machine à laver (1) selon la Revendication 1, **caractérisée par** l'unité de commande (7), dans la mémoire de laquelle un rapport de seuil différent (d_{tri}) est enregistré pour chaque vitesse (n_i), où une comparaison est effectuée entre le rapport (d_i) et le rapport de seuil (d_{tr}).

4. Une machine à laver (1) selon l'une quelconque des revendications précédentes, **caractérisée par** l'unité de commande (7) qui, à la première vitesse (n_1) où une mesure est effectuée, compare la quantité de déplacement (Δx) qui correspond à la première valeur de pression (P_1) transmise du transmetteur de vibrations (5) au capteur de pression (6) avec la quantité maximale de déplacement (Δx_{tr}) qui est enregistrée dans la mémoire de l'unité de commande (7) et que la cuve (3) est permise de réaliser.

Figure 1



REFERENCES CITED IN THE DESCRIPTION

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