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(54) A WASHING MACHINE WHEREIN SAFE SPEED CONTROL IS PERFORMED

WASCHMASCHINE MIT SICHERHEITSBEZOGENER GESCHWINDIGKEITSKONTROLLE

MACHINE À LAVER À COMMANDE DE VITESSE SÛRE

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(56) References cited:
GB-A- 2 087 103
GB-A- 2 174 513
US-B2- 6 393 918

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Description

[0001] The present invention relates to a washing machine wherein the speed control is performed according to the unbalanced load amount.

[0002] Washing machines comprise a drum wherein laundry is disposed, a motor providing the drum to rotate, a pump providing water to be delivered to the drum, a heater providing the water to be heated, and a control unit which arranges the operations of the elements such as motor, pump and heater according to the washing programs installed in its memory. The control unit, also, provides the unbalanced load amount occurring in the drum to be detected and the speed control of the drum to be performed according to this data. For the compliance with the standard of IEC 60335-1-7 Ed.4.1, the aim of which is to form a standard in order that household appliances do not threaten user safety, the control unit is divided into two parts being safety module and algorithm module. Critical processes in terms of user safety such as unbalanced load detection and whether the elements operate properly or not are performed in the safety module. In the algorithm module, processes, which relate mainly to performing the washing programs such as the target speed the drum is required to reach and the required temperature of the water, are performed. While the speed data is received from the algorithm module when the speed the drum can reach according to the unbalanced load amount is desired to be controlled, the safety cannot be provided if a wrong data is received from the algorithm module due to an error that occurs in the algorithm module.

[0003] In the state of the art United States of America Patent Document No US7000436, a washing machine is explained that has a controller, which enables the high speed spin mode to be continued if the unbalanced load amount, controlled by a controller, is less than the unbalanced load amount that is stored in the memory during the rotation of the washing basket at normal speed, while a high speed-spin mode is performed.

[0004] In the state of the art United States of America Patent Document No US6393918, a washing machine, wherein the speed control is performed according to the unbalanced load amount, is described.

GB 2087103A discloses the features of the preamble of claim 1.

[0005] The aim of the present invention is the realization of a washing machine wherein the speed control is provided in a safe manner.

[0006] The washing machine realized in order to attain the aim of the present invention is claimed in the independent claim 1.

[0007] In the safety module, the unbalanced load amount is detected and the maximum speed that can be reached according to the unbalanced load amount is calculated. The algorithm module provides the drum to reach a target speed which is required by the program stored in the memory of the algorithm module. Testing the speed of the drum and comparing it with the maximum speed are performed in the safety module since they relate to safety.

[0008] In an embodiment of the present invention, the speed of the drum is measured in the safety module and compared with the determined maximum speed. If the speed is greater than the maximum speed, the motor is stopped by detecting that there is an error in the algorithm module, in the control unit or in the motor.

[0009] In another embodiment of the present invention, the speed, measured in the safety module, is compared with the absolute surplus of the determined maximum speed in a certain ratio, and the error condition is controlled. If the speed, which is measured while the drum accelerates in the manner the program requires, exceeds the determined maximum speed more than a certain ratio, and if the speed, which is measured while the drum decelerates, is greater than the determined ratio, the motor is stopped by concluding that there is an error.

[0010] In an embodiment of the present invention, when the maximum speed is exceeded, the safety module stops the motor but does not turn off the machine. After stopping the motor, the safety module waits for a certain period of time and then provides the program to be resumed. If the maximum speed is exceeded again while the same program continues, the safety module again stops the motor but does not turn off the machine. Preferred embodiments are claimed in dependent claims 2 to 4.

[0011] However, if this error is repeated a few times, the safety module terminates the program and turns off the machine. Thus, the safety module obliges the user to call for maintenance and thus, provides the error to be detected and corrected.

[0012] By means of the embodiment of the present invention, the speed control is performed in a safe manner. The processes of the control unit are divided such that the program steps will be in the algorithm module and the control of the safety will be in the safety module, and the data that can create a safety risk are not received to the safety module and thus, speed control is provided.

[0013] The washing machine realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

[0014] Figure 1 - is the schematic view of a washing machine.

[0015] The elements illustrated in the figures are numbered as follows:

1. Washing machine
2. Drum
3. Motor
4. Algorithm module
5. Safety module
6. Control unit

[0016] A washing machine (1) comprises a body, a

drum (2) wherein the laundry to be washed is disposed and which provides washing and spin-drying by rotating around an axis, a motor (3) which provides the drum (2) to be activated, and a control unit (6) that has

- an algorithm module (4) wherein the washing, rinsing and spin-drying steps and their durations are controlled, and
- a safety module (5) wherein diagnostic checks relating to unbalanced load, door lock, operation of the pump, and temperature are performed.

[0017] In the washing machine (1), the tests that perform the error detection of the elements such as door and pump, the error-free operations of which are required in terms of safety, are performed in the safety module (5) compatibly with the safety standard. In the algorithm module (4), programs that are not critical in terms of safety are installed and the operation of the program steps is controlled.

[0018] In the washing machine (1) of the present invention, the control unit (6), furthermore, comprises

- a safety module (5) which, throughout the washing program, measures the speed (V) of the drum (2), calculates the unbalanced load (Dy) amount and the maximum speed (Vmax) the drum (2) can reach according to the unbalanced load (Dy) amount and which compares the measured speed (V) with the maximum speed (Vmax) and detects that there is an error if the speed (V) is greater than the maximum speed (Vmax), and
- the algorithm module (4) wherein a target speed (Vh), required by the washing program, is stored for each washing program and whereto the data of the maximum speed (Vmax) is transmitted from the safety module (5), and which compares the maximum speed (Vmax) with the target speed (Vh) that belongs to the washing program being performed, and which provides the target speed (Vh) to be reached if the target speed (Vh) is less than the maximum speed (Vmax) and which provides the maximum speed (Vmax) to be reached if the target speed (Vh) is greater than the maximum speed (Vmax).

[0019] In the control unit (6) of the washing machine (1), controlling the drum (2) spin-drying speed (V), performed at high speeds, is important. By determining the maximum speed (Vmax) according to the unbalanced load (Dy) amount, the spin-drying is allowed to be performed at a high speed (revolution) when the amount of the unbalanced load (Dy) in the drum (2) is small and the spin-drying is allowed to be performed at a low speed (revolution) when the amount of the unbalanced load (Dy) in the drum (2) is large. While adjusting the maximum speed (Vmax) according to the unbalanced load (Dy) amount reduces the sensation of the vibrations occurring in the washing machine (1) as a result of the unbalanced load (Dy), correctly detecting and transmitting the unbalanced load (Dy) amount prevent the speed (V) from rising to undesired values. Thus, the drum (2) is allowed to reach the target speed (Vh), which is stored in the algorithm module (4), only if the target speed (Vh) is smaller than the maximum speed (Vmax) which is determined for the unbalanced load (Dy) amount.

[0020] In the control unit (6) of the washing machine (1), as well as detecting the unbalanced load (Dy) amount, also controlling the speed (V) adjusted according to the unbalanced load (Dy) amount is a requirement for providing safety and is performed in the safety module (5). Thus, according to the data of the unbalanced load (Dy) amount detected in the safety module (5), in the algorithm module (4), it is checked whether the target amount (Vh) required by the performed program can be reached, and again in the safety module (5), it is controlled whether the reached speed (V) exceeds the maximum speed (Vmax), determined in the safety module (5), or not, that is, whether there is an error or not. Since the reached speed (V) is tested also in the safety module (5), no data is transmitted to the safety module (5) from the algorithm module (4) and thus, the safety is improved. In the algorithm module (4), the programs installed by the producer are provided to be performed and therefore, some data are received from the safety module (5). While different programs are added to the algorithm module (4) for different models of washing machines (1), no change is made in the safety module (5) and thus, with the same safety module (5), different models of washing machines (1) compatible with the safety standard can be produced.

[0021] In an embodiment of the present invention, if the speed (V), measured by the safety module (5), is greater than the maximum speed (Vmax) that can be reached which is calculated according to the unbalanced load (Dy) amount, the safety module (5) stops the motor (3) by detecting that there is an error. The error can occur due to conditions such as short-circuiting of a switch that provides the motor (3) to be driven, determining erroneous target speed (Vh) in the algorithm module (4), and faults occurring in the software, all of which cause the motor (3) to accelerate in an uncontrolled manner.

[0022] In another embodiment of the present invention, if the speed (V), measured by the safety module (5), is absolutely greater than the speed $|Vmax + \lambda|$ which is greater than the maximum speed (Vmax) by a certain amount (λ), the safety module (5) stops the motor (3) by detecting that there is an error. Since the absolute increase $|Vmax + \lambda|$ of the maximum speed (Vmax), which is determined according to the unbalanced load (Dy) amount, is controlled in the safety module (5), the accuracy of the present speed (V) is not required to be controlled in the algorithm module (4) by examining whether the speed (V) is increasing or decreasing.

[0023] In an embodiment of the present invention, if the speed (V), measured by the safety module (5) of the control unit (6), is greater than the maximum speed (Vmax), the safety module (5) stops the motor (3) for a

while by determining that there is an error and then provides the program to be resumed, and when the number of successive error detections exceeds the determined amount, the safety module (5) terminates the program and transmits an error message to the user.

[0024] By means of the embodiment of the present invention, the speed (V), which is reached under the control of the algorithm module (4) according to the unbalanced load (Dy) amount determined in the safety module (5), is compared with the maximum speed (Vmax) determined in the safety module (5) and thus, a safe speed control is performed. All processes relating to safety are performed in the safety module (5) and only program processes are performed in the algorithm module (4). Thus, while the algorithm module (4) uses the data it receives from the safety module (5), the safety module (5) does not receive any data from the algorithm module (4) and thus, a safety risk is prevented from occurring.

[0025] It is to be understood that the present invention is not limited by the embodiments disclosed above and a person in the art can easily introduce different embodiments. These should be considered within the scope of the protection postulated by the claims of the present invention.

Claims

1. A washing machine (1) **comprising** a body, a drum (2) wherein the laundry to be washed is disposed and which provides washing and spin-drying by rotating around an axis, a motor (3) which provides the drum (2) to be activated, and a control unit (6), **characterized in that** the control unit (6) has

   - a safety module (5) wherein the data such as unbalanced load detection and abnormal condition detection, that relate to safety, are controlled, and
   - an algorithm module (4) wherein the washing, rinsing and spin-drying steps and their durations are controlled,
   - whereby the safety module (5), throughout the washing program, measures the speed (V) of the drum (2), calculates the unbalanced load (Dy) amount and the maximum speed (Vmax) the drum (2) can reach according to the unbalanced load (Dy) amount, compares the measured speed (V) with the maximum speed (Vmax) and detects that there is an error if the speed (V) is greater than the maximum speed (Vmax), and whereby
   - the algorithm module (4) wherein a target speed (Vh), required by the washing program, is stored for each washing program and whereto the data of the maximum speed (Vmax) is transmitted from the safety module (5), compares the maximum speed (Vmax) with the target speed (Vh) that belongs to the washing program being performed, and provides the target speed (Vh) to be reached if the target speed (Vh) is less than the maximum speed (Vmax) and provides the maximum speed (Vmax) to be reached if the target speed (Vh) is greater than the maximum speed (Vmax).

2. A washing machine (1) as in Claim 1, **characterized by** the control unit (6) that has a safety module (5) which stops the motor (3) by detecting that there is an error if the measured speed (V) is greater than the determined maximum speed (Vmax).

3. A washing machine (1) as in any one of the above Claims, **characterized by** the control unit (6) that has a safety module (5) which stops the motor (3) for a while by determining that there is an error if the speed (V), measured by the safety module (5), is greater than the maximum speed (Vmax), and which then provides the program to be resumed, and which terminates the program and transmits an error message to the user when the number of successive error detections exceeds the determined amount.

4. A washing machine (1) as in any one of the above Claims, **characterized by** the control unit (6) that has a safety module (5) which stops the motor (3) by detecting that there is an error if the speed (V) is absolutely greater than the speed $|Vmax + \lambda|$ being greater than the maximum speed (Vmax) by a certain amount (λ).

Patentansprüche

1. Waschmaschine (1), **umfassend** einen Gehäusekörper, eine Trommel (2), in die die zu waschende Wäsche gelegt wird und die durch Drehen um eine Achse Waschen und Schleudertrocknen vorsieht, einen Motor (3), der das Aktivieren der Trommel (2) vorsieht, und eine Steuereinheit (6), **dadurch gekennzeichnet, dass** die Steuereinheit (6) Folgendes aufweist:

   - ein Sicherheitsmodul (5), in dem die Daten im Zusammenhang mit der Sicherheit wie etwa Erkennung von unausgeglichener Beladung und Erkennung von abnormalen Zuständen gesteuert werden, und
   - ein Algorithmusmodul (4), in dem die Wasch-, Spül- und Schleudertrocknungsschritte und ihre jeweilige Dauer gesteuert werden,
   - wobei das Sicherheitsmodul (5) im Verlaufe des Waschprogramms die Geschwindigkeit (V) der Trommel (2) misst, die Menge der unausgeglichenen Beladung (Dy) und die maximale Geschwindigkeit (Vmax) berechnet, die die Trom-

mel (2) entsprechend der Menge der unausgeglichenen Beladung (Dy) erreichen kann, die gemessene Geschwindigkeit (V) mit der maximalen Geschwindigkeit (Vmax) vergleicht und erkennt, dass ein Fehler vorliegt, wenn die Geschwindigkeit (V) höher als die maximale Geschwindigkeit (Vmax) ist und wobei
- das Algorithmusmodul (4), in dem eine Zielgeschwindigkeit (Vh), die das Waschprogramm benötigt, für die einzelnen Waschprogramme gespeichert ist, und an das die Daten zur maximalen Geschwindigkeit (Vmax) vom Sicherheitsmodul (5) übertragen werden, die maximale Geschwindigkeit (Vmax) mit der Zielgeschwindigkeit (Vh) vergleicht, die zu dem ausgeführten Waschprogramm gehört, und vorsieht, dass die Zielgeschwindigkeit (Vh) erreicht wird, wenn die Zielgeschwindigkeit (Vh) geringer als die maximale Geschwindigkeit (Vmax) ist, und vorsieht, dass die maximale Geschwindigkeit (Vmax) erreicht wird, wenn die Zielgeschwindigkeit (Vh) höher als die maximale Geschwindigkeit (Vmax) ist.

2. Waschmaschine (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Steuereinheit (6) ein Sicherheitsmodul (5) aufweist, das den Motor (3) anhält, indem es erkennt, dass ein Fehler vorliegt, wenn die gemessene Geschwindigkeit (V) höher als die bestimmte maximale Geschwindigkeit (Vmax) ist.

3. Waschmaschine (1) nach einem der vorangehenden Ansprüche**" dadurch gekennzeichnet, dass** die Steuereinheit (6) ein Sicherheitsmodul (5) aufweist, das den Motor (3) vorübergehend anhält, indem es bestimmt, dass ein Fehler vorliegt, wenn die vom Sicherheitsmodul (5) gemessene Geschwindigkeit (V) höher als die maximale Geschwindigkeit (Vmax) ist, und das dann eine Wiederaufnahme des Programms vorsieht, und das das Programm abbricht und eine Fehlermeldung an den Benutzer übermittelt, wenn die Anzahl aufeinanderfolgender Fehlererkennungen die bestimmte Menge übersteigt.

4. Waschmaschine (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Steuereinheit (6) ein Sicherheitsmodul (5) aufweist, das den Motor (3) anhält, indem es erkennt, dass ein Fehler vorliegt, wenn die Geschwindigkeit (V) absolut höher als die Geschwindigkeit |Vmax + λ| ist, die um eine bestimmte Größe (λ) höher ist als die maximale Geschwindigkeit (Vmax).

Revendications

1. Une machine à laver (1) **comprenant** un corps, un tambour (2) dans lequel le linge à laver est disposé et qui assure le lavage et l'essorage en tournant autour d'un axe, un moteur (3) qui permet l'activation du tambour (2), et une unité de commande (6), **caractérisée en ce que** l'unité de commande (6) a

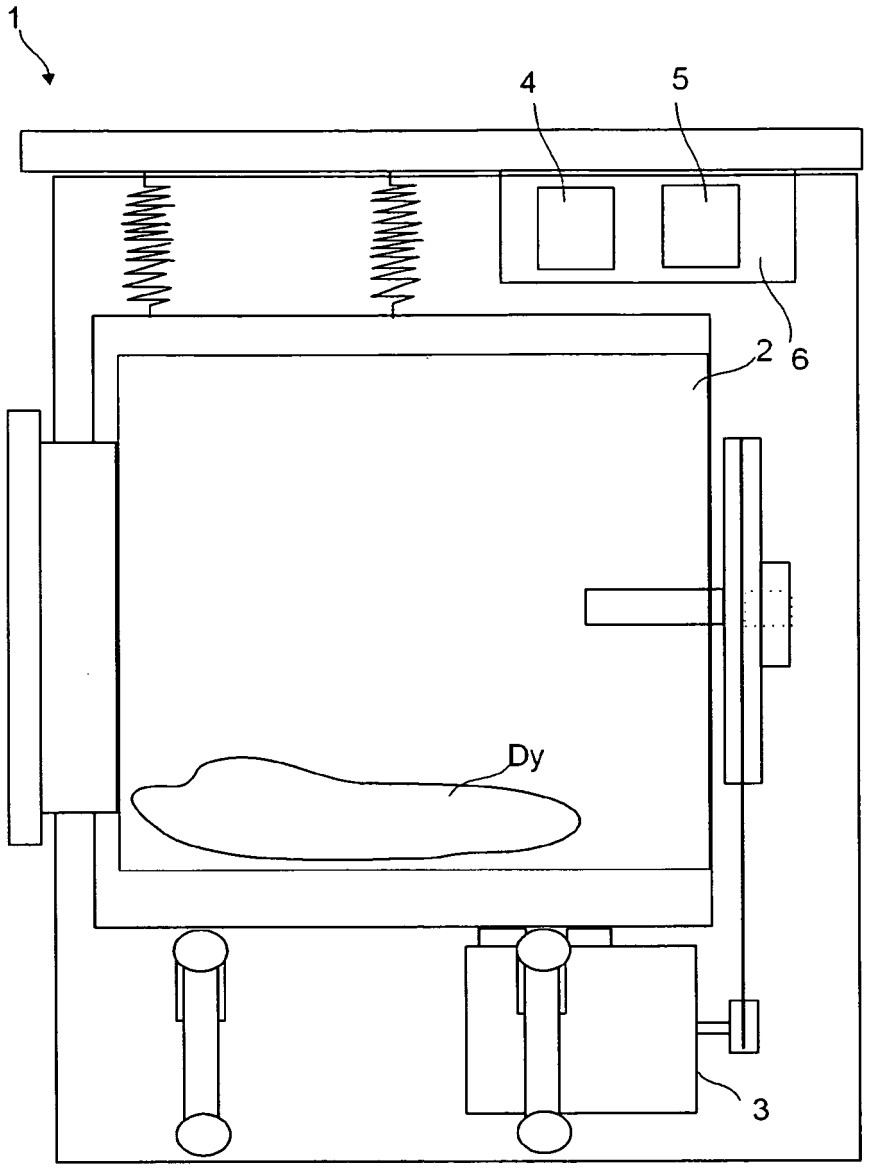
- un module de sécurité (5) dans lequel les données telles que la détection de charge déséquilibrée et la détection de condition anormale, qui se rapportent à la sécurité, sont commandées, et
- un module d'algorithme (4) dans lequel les étapes du lavage, rinçage et essorage et leurs durées sont commandées,
- où le module de sécurité (5), durant le programme de lavage, mesure la vitesse (V) du tambour (2), calcule la quantité de la charge déséquilibrée (Dy) et la vitesse maximale (Vmax) à laquelle le tambour (2) peut atteindre en fonction de la quantité de la charge déséquilibrée (Dy), compare la vitesse (V) mesurée avec la vitesse maximale (Vmax) et détecte que il y a une erreur si la vitesse (V) est supérieure à la vitesse maximale (Vmax), et où
- le module d'algorithme (4), dans lequel une vitesse cible (Vh), requise par le programme de lavage, est stockée pour chaque programme de lavage et auquel les données de la vitesse maximale (Vmax) sont transmises du module de sécurité (5), compare la vitesse maximale (Vmax) avec la vitesse cible (Vh) qui appartient au programme de lavage effectué pour le moment, et permet à la vitesse cible (Vh) d'être atteinte si la vitesse cible (Vh) est inférieure à la vitesse maximale (Vmax) et permet à la vitesse maximale (Vmax) d'être atteinte si la vitesse cible (Vh) est supérieure à la vitesse maximale (Vmax).

2. Une machine à laver (1) selon la Revendication 1, **caractérisée par** l'unité de commande (6) qui a un module de sécurité (5) qui arrête le moteur (3) tout en détectant que il y a une erreur si la vitesse (V) mesurée est supérieure à la vitesse maximale (Vmax) déterminée.

3. Une machine à laver (1) selon l'une quelconque des revendications précédentes, **caractérisée par** l'unité de commande (6) qui a un module de sécurité (5) qui arrête le moteur (3) un moment en déterminant que il y a une erreur si la vitesse (V) mesurée par le module de sécurité (5) est supérieure à la vitesse maximale (Vmax), et qui par la suite permet au programme d'être repris, et qui met fin au programme et transmet un message d'erreur à l'utilisateur lorsque le nombre de détections d'erreur successives surpasse la quantité déterminée.

4. Une machine à laver (1) selon l'une quelconque des revendications précédentes, **caractérisée par** l'unité de commande (6) qui a un module de sécurité (5) qui arrête le moteur (3) tout en détectant que il y a une erreur si la vitesse (V) est absolument supérieure à la vitesse |Vmax + λ| qui est supérieure à la vitesse maximale (Vmax) d'une certaine quantité (λ).

Figure 1



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 7000436 B **[0003]**
- US 6393918 B **[0004]**
- GB 2087103 A **[0004]**