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(72) Inventors:
• **Shen, Linjie**
214000 Wuxi Jiangsu (CN)
• **Song, Zhangying**
210000 Nanjing Jiangsu (CN)
• **Wang, Chaoyang**
210046 Nanjing Jiangsu (CN)
• **Xia, Chaoping**
225117 Yangzhou Jiangsu (CN)

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(71) Applicant: **BSH Bosch und Siemens Hausgeräte GmbH**
81739 München (DE)

(54) **Laundry treatment appliance and control method thereof**

(57) A laundry treatment appliance 1 and a control method thereof are provided. The laundry treatment appliance 1 includes a cabinet system 2, a vibration system 3, a driving system 4, a transmission system 5 and a control system 6. The vibration system 3 is disposed in the cabinet system 2. The control system 6 controls the driving system 4 that drives the vibration system 3 to work through the transmission system 5. The laundry treat-

ment appliance 1 further includes a transmission detecting system 7 for determining whether an abnormality occurs in the transmission system 5 or not by detecting the transmission system 5, thereby effectively avoiding the disadvantage that the appliance 1 and the laundry being processed therein are damaged or the actual washing or drying effect is not satisfactory since the appliance 1 continues performing a program after the abnormality occurs in the transmission system 5.

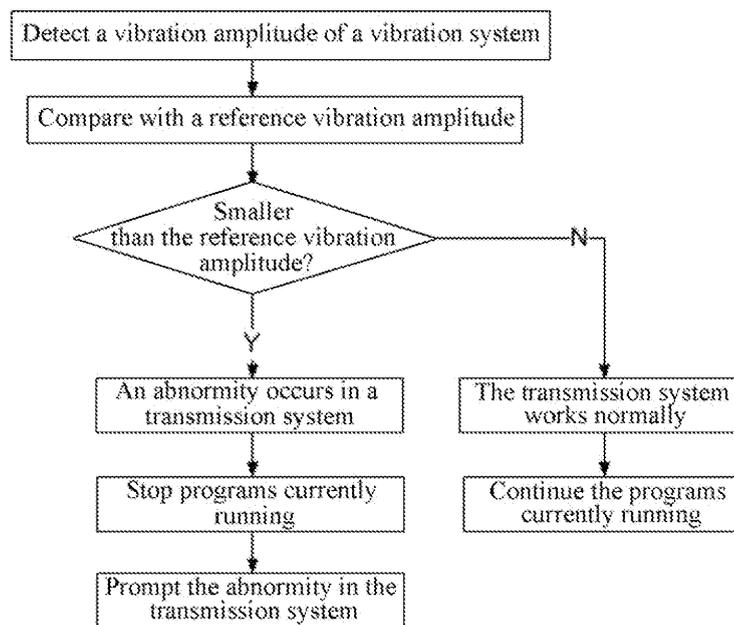


FIG. 2

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Description

[0001] The present invention relates to a laundry treatment appliance and a control method thereof, and more particularly to a laundry treatment appliance and a control method thereof capable of detecting whether an abnormality occurs in a transmission system or not.

[0002] A conventional household laundry treatment appliance, no matter if it is a washing machine, or a laundry washing and drying machine combining a laundry drying function with the washing function, or a dryer only with a laundry drying function, may include a cabinet system formed by a cabinet, a door and a control panel, a vibration system formed by a drum, a tub and a balance module, a transmission system formed by a belt and a belt roller, a driving system for driving the drum to rotate at a high speed through the transmission system, and a control system for controlling operation of the laundry treatment appliance. The drum is connected with a motor of the driving system through the belt of the transmission system. When the laundry treatment appliance works normally, the drum rotates at the high speed under the drive of the motor, and therefore, the belt and even the whole transmission system are very important for the normal operation of the laundry treatment appliance. However, in the actual operation, it is found that the motor transmission belt may drop or break after being used for a period of time, and in this situation, the drum of the laundry treatment appliance cannot be driven by the motor to run, that is, the drum is in a static status, so that the laundry treatment appliance fails to work normally.

[0003] While in a user's house, once the situation occurs, the laundry treatment appliance itself cannot detect the abnormality, and instead of reporting to the user or taking a relevant protecting action, the laundry treatment appliance still continues working according to selected programs. However, since the drum does not run normally, the laundry is not cleaned while resources are wasted. Moreover, if the laundry treatment appliance is in a drying process, the uneven distribution of temperature caused by the static status of the drum may damage the laundry, or even lead to the danger that the laundry treatment appliance is burnt.

[0004] In order to detect whether the transmission belt breaks during work, International Patent Application WO 2008/077968 A1 discloses a laundry washing and drying machine using a temperature sensor to detect whether the transmission belt breaks or not. According to that patent application, the temperature sensor near a heating pipe of the laundry washing and drying machine determines whether the transmission belt breaks or not according a detected temperature rise. When the temperature of the heating pipe rises to a particular value, it is determined that the transmission belt breaks, and thus the power supply is cut off. Although the temperature rise of the heating pipe reflects the working status of the transmission belt to a certain extent, the temperature rise of the heating pipe is attributed to many factors, for exam-

ple, the temperature detected by the temperature sensor of the heating pipe surely rises gradually when the laundry is almost dried, or when the laundry is not so much, or when an external temperature is high and a moisture content of the laundry is low. Therefore, determining whether the abnormality occurs in the transmission belt by using the temperature sensor to detect the temperature rise of the heating pipe has relatively low reliability, and is easily affected by other interfering factors.

[0005] In view of the above problems, the present invention is directed to an improved laundry treatment appliance, which is capable of accurately determining whether a working abnormality occurs in a transmission system, thereby ensuring normal operation of the laundry treatment appliance and avoiding possible damages caused by the abnormality of the transmission system.

[0006] To achieve the above objective, the present invention is implemented as follows. A laundry treatment appliance is provided, which includes a cabinet system, a vibration system, a driving system, a transmission system, and a control system. The vibration system is disposed in the cabinet system, the control system controls the driving system to drive the vibration system to work through the transmission system. The laundry treatment appliance further includes a transmission detecting system for determining whether an abnormality occurs in the transmission system or not by detecting the vibration system.

[0007] As a preferred embodiment of the present invention, the control system determines whether the abnormality occurs in the transmission system or not by the transmission detecting system detecting a displacement of the vibration system relative to the cabinet system.

[0008] As another preferred embodiment of the present invention, the control system determines whether the abnormality occurs in the transmission system or not by the transmission detecting system detecting a vibration amplitude of the vibration system.

[0009] As a further preferred embodiment of the present invention, the transmission system includes a belt, and the abnormality occurring in the transmission system includes belt breaking.

[0010] As yet another preferred embodiment of the present invention, the transmission detecting system includes a displacement sensing device.

[0011] As yet a further preferred embodiment of the present invention, the transmission detecting system includes a first sensing element and a second sensing element; the first sensing element is disposed on the vibration system, and the second sensing element is disposed on the cabinet system.

[0012] As still another preferred embodiment of the present invention, the first sensing element is a magnet, and the second sensing element is a 3D sensor.

[0013] As still a further preferred embodiment of the present invention, the vibration amplitude is reflected by a magnetic field variance of the first sensing element.

[0014] The present invention is further directed to a

control method for a laundry treatment appliance. Through the control method, the transmission system of the appliance can be detected, and therefore when an abnormality occurs in the transmission system, a user is prompted of corresponding abnormality information, so that the user takes measures in time, thus avoiding the damage of the machine or laundry caused by the abnormality in the transmission system.

[0015] The above objective of the present invention is achieved as follows. A control method for a laundry treatment appliance is provided. The laundry treatment appliance includes a cabinet system, a vibration system, a driving system, a transmission system and a control system. The vibration system is disposed in the cabinet system, and the control system controls the driving system to drive the vibration system to work through the transmission system. The laundry treatment appliance further includes a transmission detecting system for determining whether an abnormality occurs in the transmission system or not by detecting the vibration system. The control method includes a step of the control system detecting a vibration amplitude of the vibration system through the transmission detecting system; a step of comparing the vibration amplitude of the vibration system with a preset reference vibration amplitude in the control system; and a step of determining whether an abnormality occurs in the transmission system or not according to a comparison result.

[0016] As a preferred embodiment of the present invention, when the vibration amplitude of the vibration system is smaller than the reference vibration amplitude, it is determined that the abnormality occurs in the transmission system; otherwise, it is determined that the transmission system works normally.

[0017] As another preferred embodiment of the present invention, the control method further includes stopping programs currently running on the laundry treatment appliance, and prompting a user of corresponding abnormality information.

[0018] The beneficial effects of the present invention include that the displacement sensor disposed on the cabinet system and the vibration system can be used for detecting the displacement of the vibration system relative to the cabinet system or the vibration amplitude of the vibration system, and by comparing the relative displacement or the vibration amplitude of the vibration system, the working status of the vibration system can be accurately determined, thereby determining whether the abnormality occurs in the transmission system or not. The detecting method is simple and reliable, and is not easily affected by other interfering factors, thus effectively ensuring the normal operation of the appliance. When the abnormality occurs in the transmission system, the user is prompted in time, thereby avoiding disadvantages that the appliance fails to complete washing or the drying effect is not satisfactory since the abnormality occurs in the transmission system, or that the appliance or laundry is unnecessarily damaged since the appliance continues

performing the programs currently running.

FIG. 1 is a schematic view of a laundry treatment appliance according to an embodiment of the present invention; and

FIG. 2 is a flow chart of a control method for the laundry treatment appliance shown in FIG. 1.

[0019] As shown in FIG. 1, a laundry treatment appliance 1 may be a drum washing machine with only the washing function, or a drum laundry washing and drying machine with a washing function and a drying function, or a dryer with only the drying function. The drum laundry washing and drying machine 1 is taken as an example, which includes a relatively static cabinet system 2, a vibration system 3 suspended in the cabinet system 2, a driving system 4 for driving the vibration system 3, a transmission system 5 for transmitting power of the driving system 4 to the vibration system 3, and a control system 6 for controlling the operation of the appliance; the vibration system 3 is connected with the driving system 4 through the transmission system 5. Further referring to FIG. 1, the cabinet system 2 includes a cabinet 10, a glass door 11 for a user to put laundry to be washed or dried, and a control panel 12 for the user to select an operation program. The vibration system 3 includes a drum 13 for the user to put the laundry to be washed or dried, a tub 14 for accommodating the drum 13 and washing water, a balance module 15 disposed on the tub 14 for ensuring that the vibration system 3 is in balance when rotating at a high speed, and a suspension and support system 16 disposed at an upper part and a lower part of the tub 14 for suspending the vibration system 3 inside the cabinet 10. The driving system 4 includes a motor 17 for driving the drum 13 to rotate at the high speed. The transmission system 5 includes a transmission belt 18 connecting the motor 17 and the drum 13 for rotating at the high speed under the drive of the motor 17, and a belt roller combination 19 for installing the transmission belt 18. During work, the control system 6 drives the motor 17 according to a program instruction selected by the user through the control panel 12 to drive the drum 13 to rotate at the high speed through the transmission belt 18. The drum 13 continuously lifts and drops the laundry put into the drum 13 by the user, and at the same time implements the washing or drying function by combining effects of water flows or heated air. To detect whether an abnormality occurs when the transmission system 5 works, the laundry treatment appliance 1 further includes a transmission detecting system 7. During work, the control system 6 detects the vibration system 3 through the transmission detecting system 7; when the abnormality occurs in the vibration system 3, the control system 6 prompts the user of corresponding abnormality information according to abnormality information detected by the transmission detecting system 7, so that the user takes corresponding measures in time, and at the same time the

control system 6 controls the driving system to stop working, so as to prevent the appliance and the laundry from being damaged or prevent a normal washing or drying program from being interrupted because the vibration system 3 continues working when the abnormality occurs in the transmission system 5. Preferably, the transmission detecting system 7 is a displacement sensing device 19 including a first sensing element 20 disposed on the vibration system 3 and a second sensing element 21 disposed on the cabinet system 2. The second sensing element 21 senses a signal change of the first sensing element 20, and converts the signal change to a signal recognizable to the control system 6 and transmits the signal to the control system 6. The control system 6 determines whether the abnormality occurs in the vibration system 3 or not according to the signal transmitted by the second sensing element 21. More preferably, the displacement sensing device 19 is a 3D sensor; the first sensing element 20 is a magnet having a strong magnetic field, and the second sensing element 21 includes a sensor containing an induction electronic circuit. The control system 6 can collect an output signal of the sensor. The magnet is fixed on the vibration system 3, for example, fixed on the tub 14. The sensor containing the induction electronic circuit is fixed on the cabinet system 2, for example, fixed on the cabinet 10. When the laundry treatment appliance 1 works, the power of the motor 17 drives the connected drum 13 to rotate at a high speed through the transmission belt 18. Due to the function of the center of gravity and inertia, the high-speed rotation of the drum 13 drives the whole vibration system 3 to vibrate at a high frequency. At this time, the magnet fixed on the tub 14, as a magnetic field source, vibrates along with the vibration of the vibration system, and the sensor containing the induction electronic circuit fixed on the cabinet 10 may sense a changing magnetic field at this time. The sensor converts a magnetic field variance to the signal recognizable to the control system 6 for the control system 6 to collect. The control system 6 analyzes the signal, so as to obtain a vibration amplitude of the vibration system 3. When the abnormality occurs in the transmission system 5, for example, a transmission belt breaking, the motor 17 fails to normally drive the drum 13 to rotate, and therefore, the drum 13 and the whole vibration system 3 have very small vibration, and are almost static. Thus, whether the abnormality occurs in the transmission system 5 or not is determined according to the detected vibration amplitude of the vibration system 3. However, during the actual operation of the appliance, as long as the motor runs normally, the vibration system 3 generates a certain degree of vibration. To improve the accuracy of the transmission detecting system, the vibration amplitude of the vibration system 3 under various possible normal operation statuses can be detected through experiments, and a minimum vibration amplitude can be found to serve as a reference vibration amplitude to determine whether the abnormality occurs in the transmission system. Then, in the actual operation, if the detected vibration amplitude

is smaller than the reference vibration amplitude, it is determined that the vibration amplitude of the vibration system is small and already lower than the minimum vibration amplitude of the normal operation, that is, the abnormality occurs in the transmission system. The accuracy of the determination can be improved by performing the determination for more times.

[0020] The control method for the laundry treatment appliance 1 is briefly described below with reference to FIG. 2. A user selects corresponding washing or drying programs through a control panel. The control system controls the appliance to perform the corresponding programs according to an instruction input by the user. When performing the washing or drying programs, the control system detects a vibration amplitude of the vibration system through the transmission detecting system, and then compares the detected vibration amplitude of the vibration system with a preset reference vibration amplitude in the system; when the actually detected vibration amplitude is smaller than the reference vibration amplitude, it is determined that an abnormality occurs in the transmission system; otherwise, when the actually detected vibration amplitude is higher than or equal to the reference vibration amplitude, it is determined that the transmission system works normally. When it is determined that the abnormality occurs in the transmission system, the control system cuts off power supply of the driving system, that is, making the appliance stop working, so as to prevent the situation that the abnormality occurs in the transmission system while the motor still continues operating and heating, and all the washing or drying programs are still performed, which burns the appliance, or causes a waste of resources; or although the appliance completes the corresponding washing or drying programs, the washing or drying effect is not satisfactory, or the corresponding washing or drying programs are not actually performed. Meanwhile, the control system prompts the user of corresponding abnormality information through error codes or alarm sounds, so that the user takes the corresponding measures in time to stop the machine, or to ask maintenance personnel to exchange the belt.

[0021] The above embodiments are merely preferred embodiments of the present invention. The present invention may have many other embodiments. Any equivalent replacement made by persons of ordinary skill in the art shall fall within the scope of the present invention.

Claims

1. A laundry treatment appliance (1), comprising a cabinet system (2), a vibration system (3), a driving system (4), a transmission system (5), and a control system (6), wherein the vibration system (3) is disposed in the cabinet system (2), the control system (6) controls the driving system (4) to drive the vibration system (3) to work through the transmission system (5), **characterized in that** the laundry treatment

- appliance (1) further comprises a transmission detecting system (7) for determining whether an abnormality occurs in the transmission system (5) or not by detecting the vibration system (3).
2. The laundry treatment appliance (1) according to claim 1, **characterized in that** the control system (6) determines whether the abnormality occurs in the transmission system (5) or not by the transmission detecting system detecting (7) a displacement of the vibration system (3) relative to the cabinet system (2).
 3. The laundry treatment appliance (1) according to claim 2, **characterized in that** the control system (6) determines whether the abnormality occurs in the transmission system (5) or not by the transmission detecting system (7) detecting a vibration amplitude of the vibration system (3).
 4. The laundry treatment appliance (1) according to any one of claims 1 to 3, **characterized in that** the transmission system (5) comprises a belt (18), and the abnormality occurred in the transmission system (5) comprises breaking the belt (18).
 5. The laundry treatment appliance (1) according to any one of claims 1 to 4, **characterized in that** the transmission detecting system (7) comprises a displacement sensing device (19).
 6. The laundry treatment appliance (1) according to claim 5, **characterized in that** the transmission detecting system (7) comprises a first sensing element (20) and a second sensing element (21), wherein the first sensing element (20) is disposed on the vibration system (3), and the second sensing element (21) is disposed on the cabinet system (2).
 7. The laundry treatment appliance (1) according to claim 6, **characterized in that** the first sensing element (20) is a magnet (20), and the second sensing element (21) is a 3D sensor (21).
 8. The laundry treatment appliance (1) according to claim 6, **characterized in that** the vibration amplitude is reflected by a magnetic field variance of the first sensing element (20).
 9. A control method of a laundry treatment appliance (1) according to any one of claims 1 to 8, comprising:
 - detecting a vibration amplitude of the vibration system (3) by the control system (6) through the transmission detecting system (7);
 - comparing the vibration amplitude of the vibration system (3) with a reference vibration amplitude preset in the control system (6); and
 10. The control method according to claim 9, **characterized in that** when the vibration amplitude of the vibration system (3) is smaller than the reference vibration amplitude, it is determined that the abnormality occurs in the transmission system (5); otherwise, it is determined that the transmission system (5) works normally.
 11. The control method according to one of claims 9 and 10, further comprising stopping a program currently running on the laundry treatment appliance (1), and prompting a user of corresponding abnormality information.
- determining whether the abnormality occurs in the transmission system (5) or not according to a comparison result.



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EUROPEAN SEARCH REPORT

Application Number
EP 10 19 6388

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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