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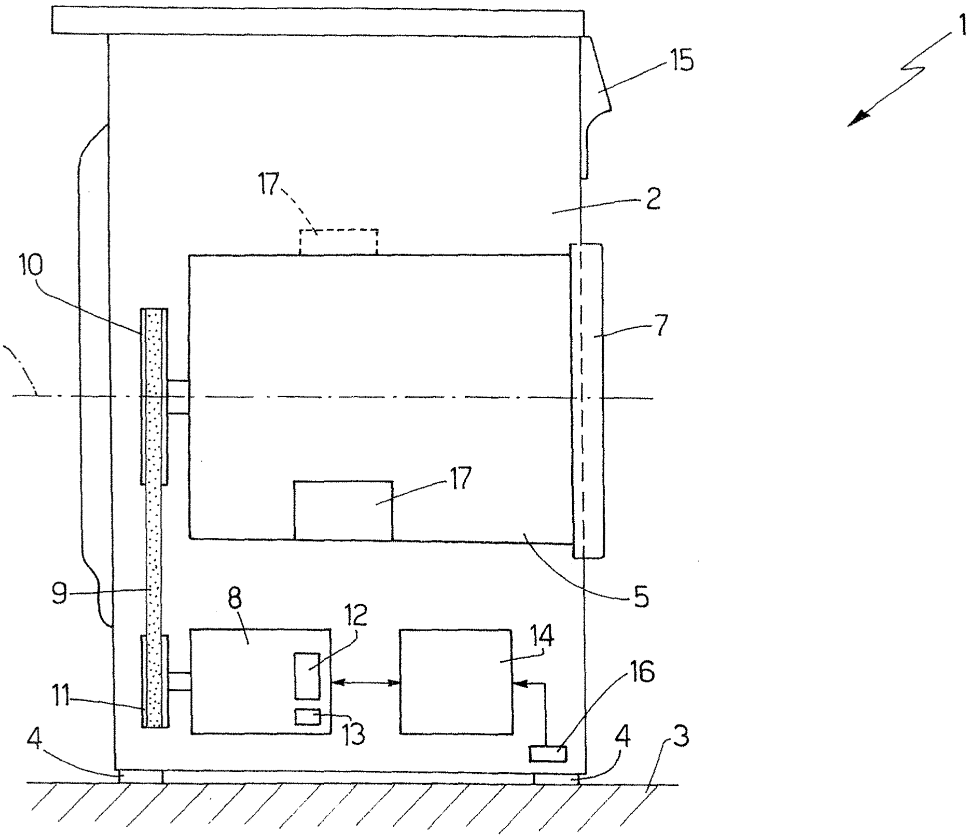
(54) **Method of installing a laundry machine**

(57) A method of installing a laundry machine (1) having a rotating drum (5); the method including the steps of: emptying the drum (5) completely; providing the empty drum (5) with a predetermined unbalance; accelerating and/or decelerating the drum (5) over a range of speeds; sensing speeds and machine vibration over the range of speeds; comparing machine vibration over the range of speeds; and determining the rotation speeds at which machine vibration is maximum and/or minimum.



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Description

TECHNICAL FIELD

[0001] The present invention relates to a method of installing a laundry machine.

[0002] The installation method according to the present invention may be used to particular advantage for a washing machine, to which the following description refers purely by way of example.

BACKGROUND ART

[0003] When a washing machine rests on a flexible floor (e.g. a wooden floor, a soft floor, or a floor resting on a thin slab), the vibration generated by the washing machine (especially during the spin cycle) may be resonance-amplified to an unacceptable noise level.

[0004] To reduce vibration of a washing machine, it is important to avoid rotating the drum at operating rotation speeds close to those at which resonance phenomena occur. Since the drum rotation speeds at which resonance phenomena occur mainly depend, however, on installation conditions, and in particular on the type of floor, optimum drum rotation speed varies from one machine to another and from one installation to another, so that it is practically impossible to determine beforehand, at the manufacturing stage, the rotation speeds at which resonance phenomena occur and which are therefore to be avoided.

[0005] As a result, it is not enough to set the washing machine controls to spin the drum (defining the wash tub) at given rotation speeds, and the optimum rotation speeds of the drum must be determined at each spin cycle to minimize machine vibration. US5930855A1 describes a method of optimizing the rotation speed of a washing machine drum to minimize vibration of the machine: the washing machine employs an accelerometer to sense machine vibration, and a computer software program monitors, records, and compares machine vibrations over a range of rotation speeds to determine a rotation speed which minimizes machine vibration.

[0006] In US5930855A1, the rotation speed optimization method is performed at each cycle. Various tests, however, have shown this to be both ineffective and inefficient.

[0007] The strategy proposed in US5930855A1 is ineffective in that, during normal operation of the machine, the load comprises items which continually change position inside the drum, thus continually changing the eccentricity of the drum and, hence, the rotation speeds at which resonance phenomena occur. As a result, during normal operation of the washing machine, determining the rotation speeds at which resonance phenomena occur accurately and fast enough is extremely difficult.

[0008] The strategy proposed in US5930855A1 is inefficient in that determining the rotation speeds at which resonance phenomena occur at each wash cycle involves performing various operations at each wash cycle, thus wasting time and resulting in a temporary increase in noise level. The temporary increase in noise is caused, in particular, by the fact that, when searching for the rotation speeds at which resonance phenomena occur, the drum must also be rotated at those speeds.

[0009] Moreover, when searching for the rotation speeds at which resonance phenomena occur, the speed of the drum varies continually (accelerates and decelerates) over a wide range, giving the user standing close to the machine the impression that the machine is "out of control", i.e. is not working properly. This invariably results in unnecessary service calls, thus increasing after-sale assistance costs and reducing customer satisfaction.

DISCLOSURE OF INVENTION

[0010] It is an object of the present invention to provide a method of installing a laundry machine, designed to eliminate the aforementioned drawbacks, and which is cheap and easy to implement.

[0011] According to the present invention, there is provided a method of installing a laundry machine, as claimed in the accompanying Claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawing, which shows a schematic side view of a washing machine implementing the installation method according to the present invention.

PREFERRED EMBODIMENTS OF THE INVENTION

[0013] Number 1 in the attached drawing indicates as a whole a washing machine comprising a casing 2 resting on a floor 3 on a number of feet 4. Casing 2 supports a revolving drum 5 (defining a wash tub) which rotates about a horizontal rotation axis 6 (in alternative embodiments not shown, rotation axis 6 may be tilted or vertical), and front access to which is closed by a door 7 hinged to casing 2.

[0014] Drum 5 is rotated about rotation axis 6 by an electric motor 8 connected to drum 5 by a transmission system, which comprises a belt 9 connecting a pulley 10, fitted to the shaft of drum 5, directly to a pulley 11 fitted to the shaft of electric motor 8. In an alternative embodiment not shown, electric motor 8 is coaxial with drum 5, and the shaft of drum 5 is connected rigidly to the shaft of electric motor 8.

[0015] Electric motor 8 is equipped with a drive system 12; and a tachometer generator 13 (or other equivalent speed-sensing device) for measuring the speed of electric motor 8 and therefore the rotation speed of drum 5. Drive system 12 of the motor is preferably operated on the basis of the difference between the command (desired) speed and the actual speed as read by tachometer generator 13.

[0016] Washing machine 1 also comprises a control unit 14, which receives user commands from a user interface 15, and controls overall operation of washing machine 1. Control unit 14 is connected to a machine vibration-sensing accelerometer 16. In the preferred embodiment shown in the attached drawing, accelerometer 16 is fixed to casing 2 of washing machine 1, close to one foot 4. In an alternative embodiment not shown, accelerometer 16 is fixed to a foot 4 of casing 2. In a further embodiment not shown, accelerometer 16 is fixed to floor 3, close to one foot 4.

[0017] Control unit 14 implements a method of installing washing machine 1 to determine the rotation speeds at which machine vibration is maximum and/or minimum, and so identify the rotation speeds at which resonance phenomena occur. During normal use, drum 5 is obviously rotated at different speeds from those at which resonance phenomena occur.

[0018] The method of installing washing machine 1 comprises the steps of emptying drum 5 completely; providing the empty drum 5 with a predetermined unbalance; and then accelerating and/or decelerating drum 5 over a range of speeds. During acceleration and/or deceleration of drum 5, control unit 14 senses the rotation speeds of drum 5 by means of tachometer generator 13, and senses machine vibration by means of accelerometer 16 over the range of speeds (in an alternative embodiment, vibration-sensing accelerometer 16 is replaced by a different type of motion sensor). Following acceleration and/or deceleration of drum 5, control unit 14 compares machine vibration over the range of speeds, and determines the rotation speeds at which machine vibration is maximum and/or minimum.

[0019] In a first embodiment shown by the continuous line in the attached drawing, the predetermined unbalance of drum 5 is only added to determine the rotation speeds at which machine vibration is maximum and/or minimum, and is therefore defined by a calibrated mass 17 which is fixed temporarily in a predetermined position to an inner surface of drum 5 before accelerating and/or decelerating drum 5, and which is removed after accelerating and/or decelerating drum 5.

[0020] In a second embodiment shown by the dotted line in the attached drawing, the predetermined unbalance of drum 5 is intrinsic and permanent (i.e. is always present, even during normal use), and is defined by a calibrated mass 17 fixed to an outer surface of drum 5. In this case, calibrated mass 17 is much lighter than the nominal working load of drum 5, and is for example more than 50 g and between 50 g and 100 g.

[0021] In one possible embodiment, the step of accelerating and/or decelerating drum 5 over a range of speeds comprises accelerating drum 5 steadily from zero to maximum rotation speed with a spinning ramp (for example a linear spinning ramp), and then decelerating drum 5 steadily from maximum rotation speed to zero with a spinning ramp (for example a linear spinning ramp).

[0022] It should be pointed out that the above installation method is only performed once, after the washing machine is actually installed, and is designed to determine actual installation conditions (in particular, the real conditions of floor 3).

[0023] The above installation method has numerous advantages, by being easy to implement and highly effective and efficient.

[0024] The above installation method is highly effective by accurately and quickly determining real installation conditions using a predetermined unbalance of known position and weight.

[0025] The above installation method is efficient by only being performed once, after the washing machine is actually installed, and by not having to be repeated at each wash cycle.

[0026] Though particularly advantageous in a washing machine, the above installation method also applies to any other kind of laundry machine, such as a drier.

Claims

1. A method of installing a laundry machine (1) having a rotating drum (5); the method comprising the steps of:

    accelerating and/or decelerating the drum (5) over a range of speeds;
    sensing rotation speeds of the drum (5) and machine vibration over the range of speeds;
    comparing machine vibration over the range of speeds; and
    determining the rotation speeds at which machine vibration is maximum and/or minimum;
    the method being **characterized by** comprising the further steps of:

        emptying the drum (5) completely before accelerating and/or decelerating the drum (5) over a range of speeds; and
        providing the empty drum (5) with a predetermined unbalance before accelerating and/or decelerating the drum (5) over a range of speeds.

2. A method as claimed in Claim 1, wherein the predetermined unbalance of the drum (5) is intrinsic and permanent.

3. A method as claimed in Claim 2, wherein the predetermined unbalance of the drum (5) is defined by a calibrated mass (17) fixed to an outer surface of the drum (5).

4. A method as claimed in Claim 3, wherein the cali-

brated mass (17) is much lighter than the nominal working load of the drum (5).

5. A method as claimed in Claim 4, wherein the weight of the calibrated mass (17) is over 50 g.

6. A method as claimed in Claim 4, wherein the weight of the calibrated mass (17) is between 50 g and 100 g.

7. A method as claimed in Claim 1, wherein the predetermined unbalance of the drum (5) is only added to determine the rotation speeds at which machine vibration is maximum and/or minimum; the method comprising the further step of removing the unbalance of the drum (5) after determining the rotation speeds at which machine vibration is maximum and/or minimum.

8. A method as claimed in Claim 7, wherein the unbalance of the drum (5) is defined by a calibrated mass (17) which is fixed temporarily to an inner surface of the drum (5) before accelerating and/or decelerating the drum (5), and which is removed after accelerating and/or decelerating the drum (5).

9. A method as claimed in any of Claims 1 to 7, wherein machine vibration is sensed by at least one motion sensor (16).

10. A method as claimed in Claim 9, wherein the accelerometer (16) is fixed to a casing (2) of the laundry machine (1).

11. A method as claimed in Claim 10, wherein the casing (2) of the laundry machine (1) comprises a number of feet (4) resting on a floor (3); the accelerometer (16) being fixed to the casing (2), close to a foot (4).

12. A method as claimed in Claim 10, wherein the accelerometer (16) is fixed to a foot (4) of the casing (2).

13. A method as claimed in Claim 9, wherein the laundry machine (1) comprises a casing (2) having a number of feet (4) resting on a floor (3); the accelerometer (16) being fixed to the floor (3), close to a foot (4).

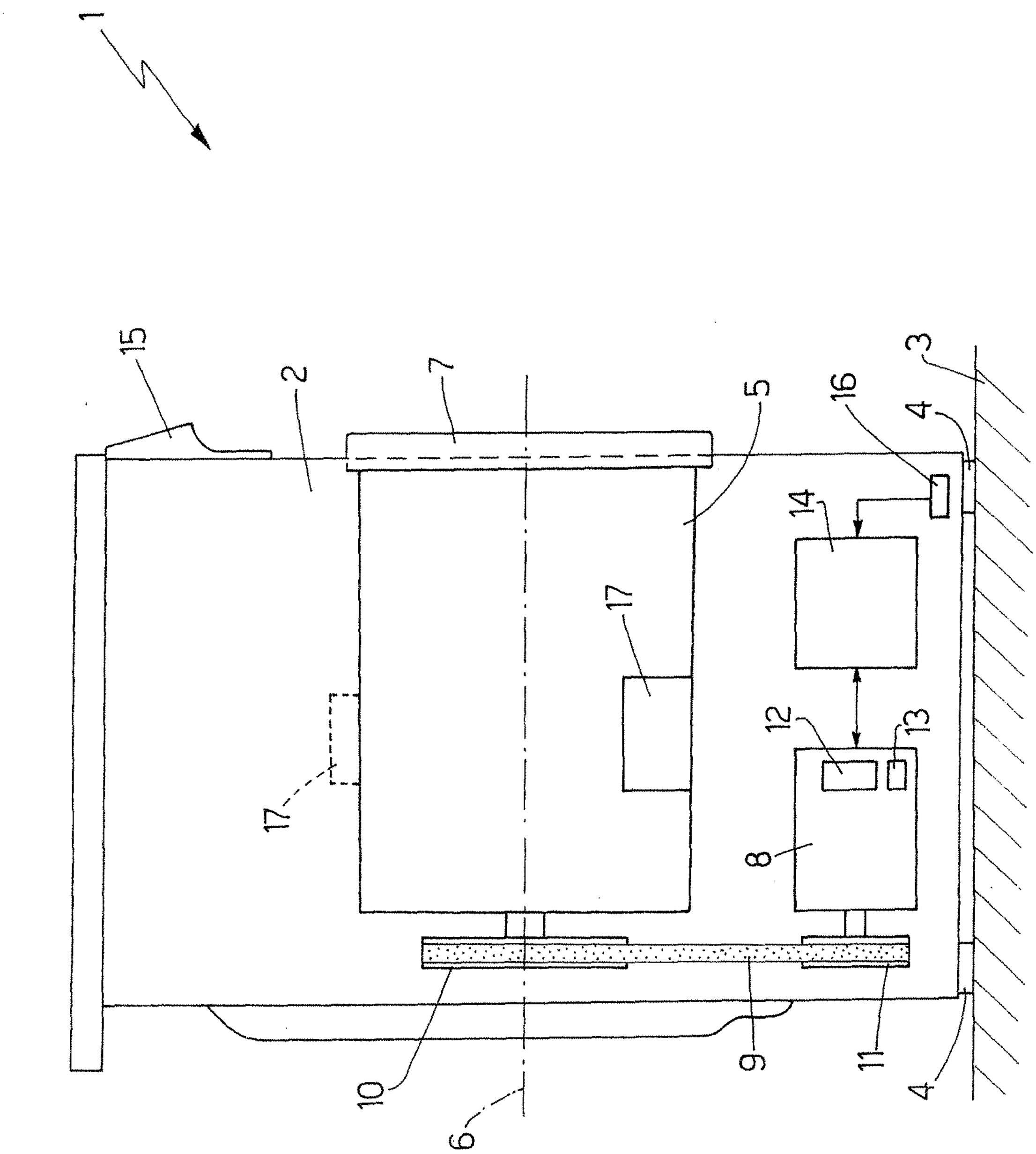
14. A method as claimed in any of Claims 1 to 13, wherein the step of accelerating and/or decelerating the drum (5) over a range of speeds comprises accelerating the drum (5) steadily from zero to a maximum rotation speed with a spinning ramp.

15. A method as claimed in any of Claims 1 to 13, wherein the step of accelerating and/or decelerating the drum (5) over a range of speeds comprises decelerating the drum (5) steadily from a maximum rotation speed to zero with a spinning ramp.

16. A method as claimed in any of Claims 1 to 15, and comprising the further step of identifying the rotation speeds at which resonance phenomena occur by determining the rotation speeds at which machine vibration is maximum.

17. A method as claimed in Claim 16, and comprising the further step of rotating the drum during normal use at rotation speeds different from the rotation speeds at which resonance phenomena occur.

18. A laundry machine (1) comprising a control unit (14) implementing the installation method as claimed in any of Claims 1 to 17.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EUROPEAN SEARCH REPORT

Application Number
EP 06 11 7836

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	US 5 692 313 A (IKEDA TOMOHIKO [JP] ET AL) 2 December 1997 (1997-12-02) * abstract * -----	1-18	
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A	EP 0 676 559 A1 (COOPER TIRE & RUBBER CO [US]) 11 October 1995 (1995-10-11) * page 5, line 18 - page 7, line 55; figures 4-8 * -----	1-18	

TECHNICAL FIELDS SEARCHED (IPC)
D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 February 2007	Lodato, Alessandra

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CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 11 7836

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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