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(54) **Laundry machine with a motion sensor**

(57) A laundry machine (1) having: a casing (2) resting on a floor (3) on a number of feet (4); a revolving drum (5) supported by the casing (2); a control unit (14) imple-

menting a method of analysing machine vibration; and at least one motion sensor (16) connected to the control unit (14) and located close to one foot (4).

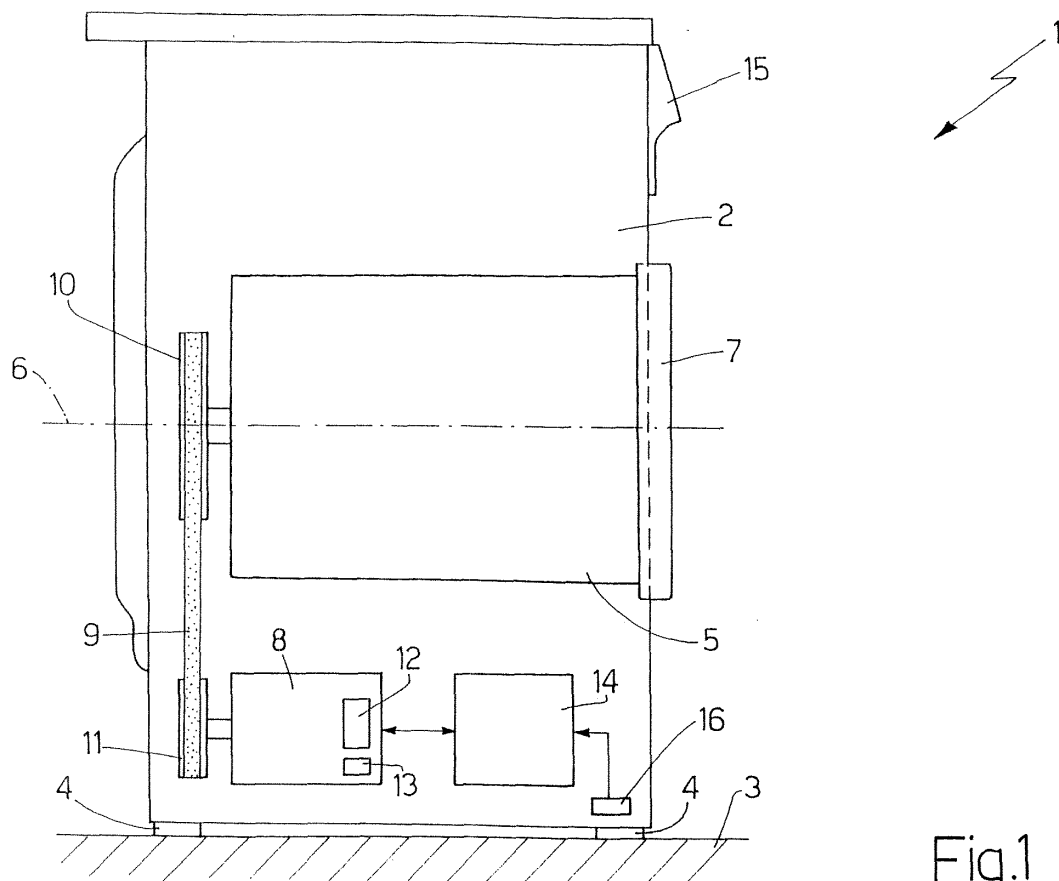


Fig.1

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**Description**TECHNICAL FIELD

**[0001]** The present invention relates to a laundry machine with a motion sensor.

**[0002]** The present invention may be used to particular advantage in 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 mounted close to the top of the casing 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]** Tests show that, in known washing machines of the type disclosed in US5930855A1, machine vibration sensing is not always entirely satisfactory, so that the rotation speeds minimizing machine vibration may not be determined as accurately as expected.

DISCLOSURE OF INVENTION

**[0007]** It is an object of the present invention to provide a laundry machine with a motion sensor, designed to eliminate the aforementioned drawbacks, and which is cheap and easy to implement.

**[0008]** According to the present invention, there is provided a laundry machine with a motion sensor, as claimed in the accompanying Claims.

BRIEF DESCRIPTION OF THE DRAWINGS

**[0009]** A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic side view of a washing machine in accordance with the present invention; Figure 2 shows a schematic side view of a portion of an alternative embodiment of the Figure 1 washing machine; and

Figure 3 shows a schematic side view of a portion of a further embodiment of the Figure 1 washing machine.

PREFERRED EMBODIMENTS OF THE INVENTION

**[0010]** Number 1 in Figure 1 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.

**[0011]** 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.

**[0012]** 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.

**[0013]** 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 at least one machine vibration-sensing accelerometer 16. In an alternative embodiment not shown, vibration-sensing accelerometer 16 is replaced by a different type of motion sensor.

**[0014]** Control unit 14 implements a known method of analysing machine vibration 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. The method of determining the rotation speeds at which machine vibration is maximum and/or minimum may be performed only once, after the washing machine is actually installed, may be performed at given periods, or may be performed at

each cycle.

**[0015]** According to the present invention, accelerometer 16 is located close to a foot 4 and therefore close to floor 3. Various tests and analyses show this to be the most effective position for high-precision sensing the most dangerous machine vibration. In fact, the worst (in particular, noisiest) situation occurs when machine vibration interacts with, causing resonance of, floor 3. Locating accelerometer 16 close to a foot 4, i.e. close to the mechanical transmission element between casing 2 and floor 3, enables high-precision sensing by accelerometer 16 machine vibration transmission between casing 2 and floor 3.

**[0016]** In the Figure 1 embodiment, accelerometer 16 is fixed (preferably screwed) to casing 2 of washing machine 1, close to a foot 4.

**[0017]** In an alternative embodiment shown in Figure 2, accelerometer 16 is fixed (preferably screwed) to a foot 4 of casing 2.

**[0018]** In a further embodiment shown in Figure 3, accelerometer 16 is fixed to floor 3, close to a foot 4. In this case, accelerometer 16 is preferably fixed rigidly to floor 3, e.g. glued to floor 3 using bi-adhesive tape 17, and is preferably located under, for mechanical protection by, casing 2.

**[0019]** Washing machine 1 as described above has numerous advantages, by being easy to implement and highly effective and efficient in sensing machine vibration, on account of the position of accelerometer 16.

**[0020]** Though particularly advantageous for a washing machine, the above structure also applies to any other kind of laundry machine, such as a drier or a washer-drier.

of the casing (2).

- 5 5. A laundry machine (1) as claimed in Claim 1 or 2, wherein the motion sensor (16) is fixed to the floor (3).
6. A laundry machine (1) as claimed in Claim 5, wherein the motion sensor (16) is fixed rigidly to the floor (3).
- 10 7. A laundry machine (1) as claimed in Claim 6, wherein the motion sensor (16) is glued to the floor (3).
8. A laundry machine (1) as claimed in Claim 7, wherein the motion sensor (16) is glued to the floor (3) using bi-adhesive tape (17).
- 15 9. A laundry machine (1) as claimed in any of Claims 5 to 8, wherein the motion sensor (16) is located under the casing (2) for mechanical protection by the casing (2).

## Claims

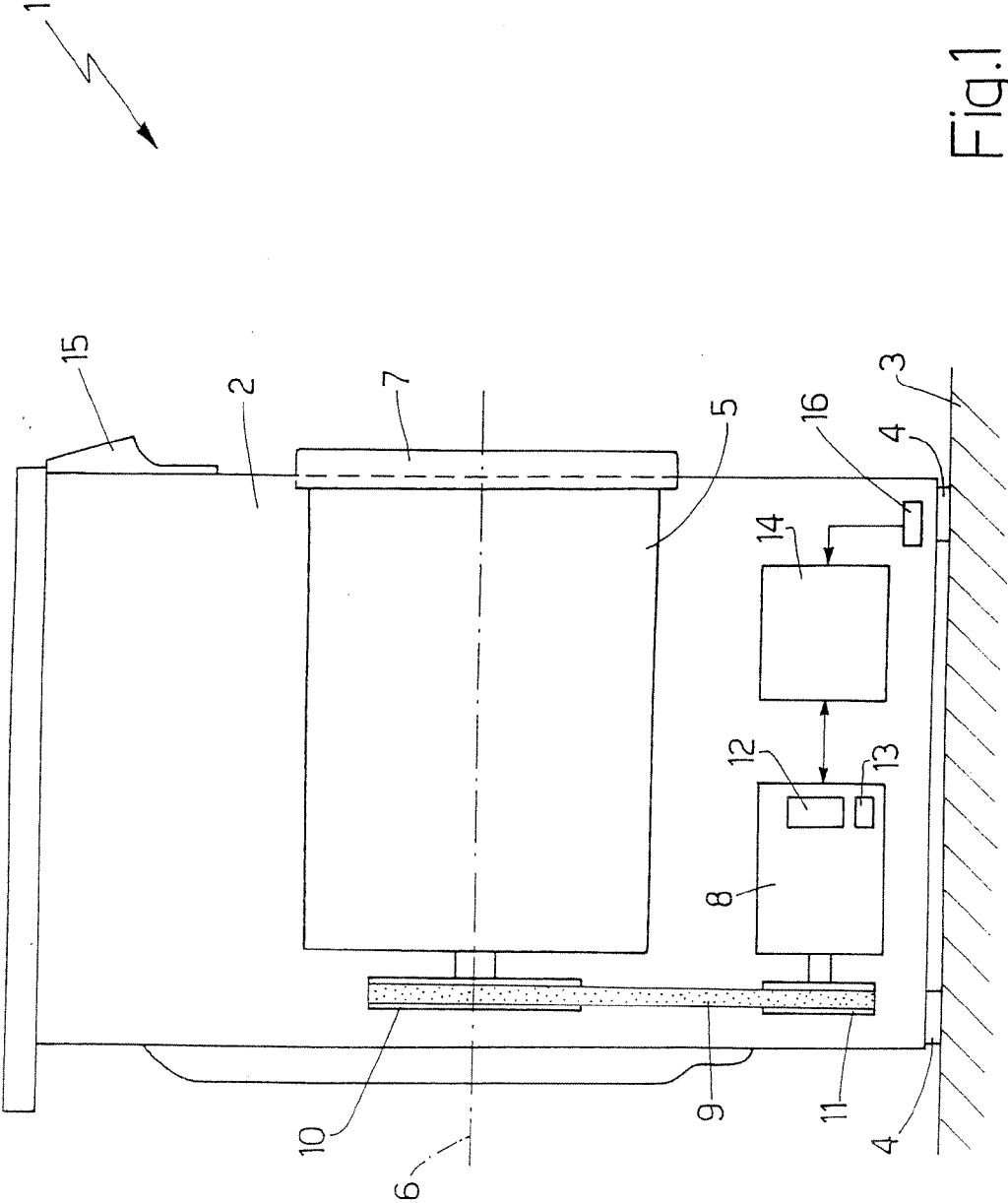
1. A laundry machine (1) comprising:

a casing (2) resting on a floor (3) on a number of feet (4);  
 a revolving drum (5) supported by the casing (2);  
 a control unit (14) implementing a method of analysing machine vibration; and  
 at least one motion sensor (16) connected to the control unit (14);  
 the laundry machine (1) being **characterized in that** the motion sensor (16) is located close to a foot (4).

2. A laundry machine (1) as claimed in Claim 1, wherein the motion sensor (16) is an accelerometer.

3. A laundry machine (1) as claimed in Claim 1 or 2, wherein the motion sensor (16) is fixed to the casing (2), close to a foot (4).

4. A laundry machine (1) as claimed in Claim 1 or 2, wherein the motion sensor (16) is fixed to a foot (4)



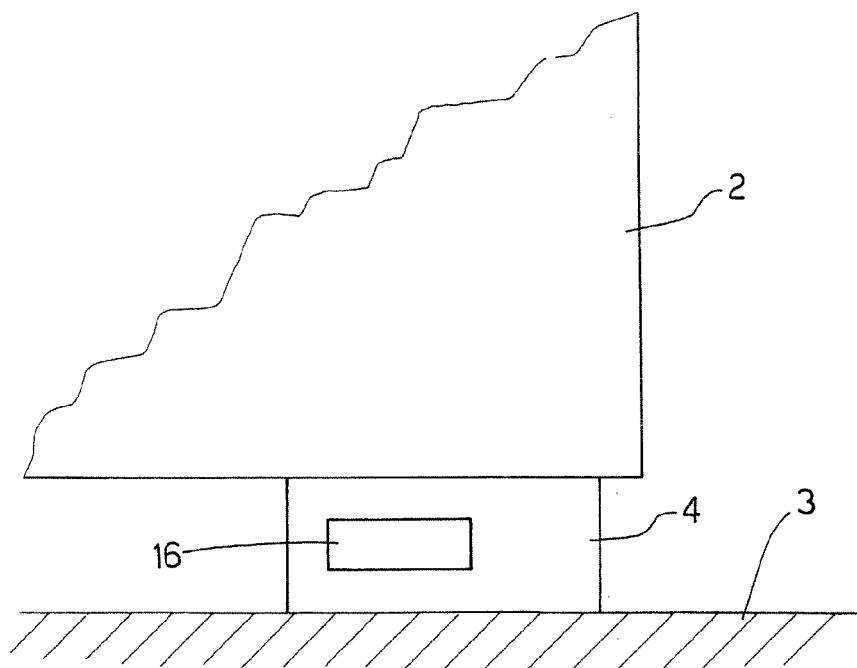


Fig.2

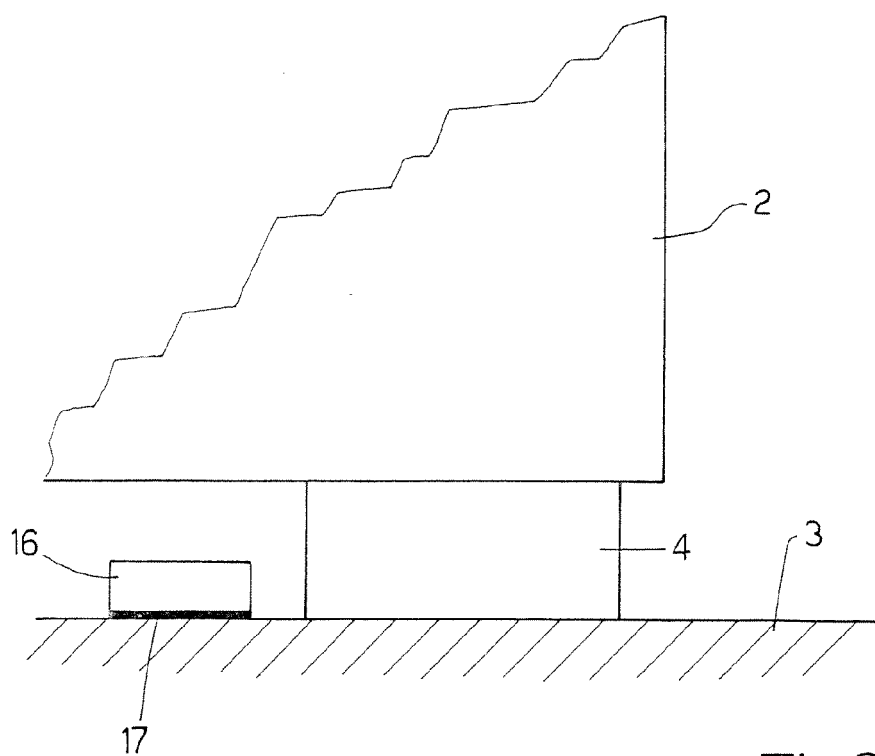


Fig.3



European Patent  
Office

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Application Number  
EP 06 11 7834

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                              |                                                     |                                         |
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| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                              |                                                     |                                         |
| Place of search<br>Munich                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                              | Date of completion of the search<br>17 January 2007 | Examiner<br>DIAZ, M                     |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                              |                                                     |                                         |

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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17-01-2007

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