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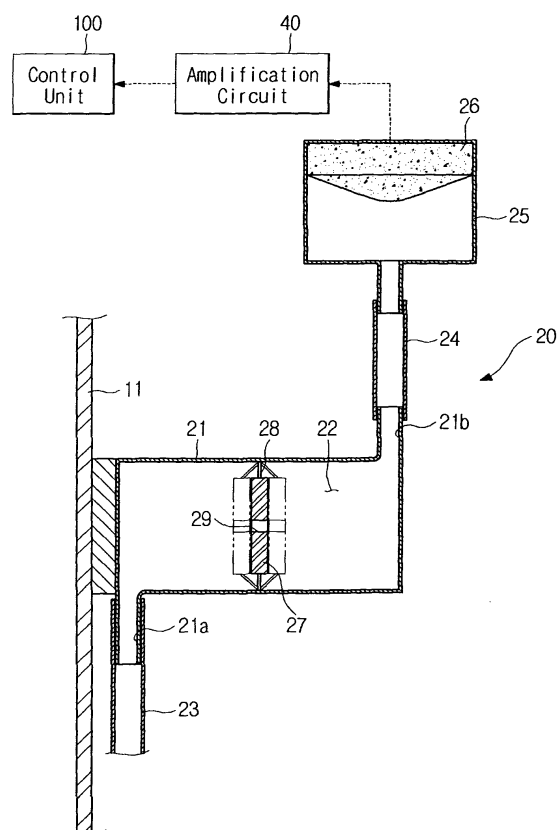
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(54) **Washing machine with detection device**

(57) A washing machine including a combined detecting device (20) adapted to detect both a water level and vibration of the washing machine. The washing machine includes a water tub (11) adapted to contain wash water, a washing device adapted to wash laundry contained in the water tub, and a combined detecting device (20) which detects both a water level and vibration of the water tub (11). The combined detecting device includes a case (21) coupled to the water tub and having an inlet (21a) for use in the passage of air, a pressure pipe (23) connected between a lower portion of the water tub (11) and the inlet of the case, a pressure sensor (26) which detects pressure variation in the case and a vibrator member (27) reciprocally installed in the case (21) and which induces the pressure variation in the case during generation of the vibration.

FIG. 2



Description

[0001] The present invention relates to a washing machine including a washing tub and a combined water level and vibration detecting device comprising a housing defining a space, means to cause a variation in air pressure in said space in response to a change in water level in the tub and a pressure sensor operable to detect said pressure variations.

[0002] A conventional washing machine generally comprises a water level sensor to detect the level of wash water supplied to a water tub during both wash and rinse cycles, and a vibration sensor to detect the vibration generated by the water tub during a high speed spin dry cycle. The water level sensor enables the supply of water to the washing machine to be controlled dependent on the detected water level in the water tub, and the vibration sensor controls the washing machine such that the operation is stopped when excessive vibration is detected by the vibration sensor. In such a conventional washing machine however, since the water level sensor and the vibration sensor are individual components and are mounted separately in the washing machine, the number of overall parts of the washing machine increases together with the number of manufacturing steps resulting in lower price competitiveness.

[0003] Recently, in an attempt to solve the above problem, a sensor has been developed to detect not only the water level but also the vibration in a washing machine. An example of such a sensor is disclosed by Korean Patent No. 10-338262 (published on May 27, 2002). To detect the water level this sensor comprises a diaphragm, a core, a housing, and a coil. The diaphragm is deformable due to the variation of air pressure which is dependent on the water level in the washing machine and the core is displaceable according to the variation in the shape of the diaphragm. The housing is configured to enclose the diaphragm and a core holder, and the coil is installed in the housing to surround the core such that it can detect the displacement of the core. In a conventional sensor configured as stated above, when the diaphragm is deformed according to the variation of the water level, the core is displaced inside the coil, thereby enabling detection of the water level through inductance variation.

[0004] The disclosed sensor further includes vibration detecting elements comprising a vibration detector which defines a predetermined space in one side of the coil and has an inclined surface and a rolling member movably installed in the vibration detector. When vibration is generated by the washing machine, the rolling member installed in the vibration detector moves along the inclined surface of the vibration detector to cause inductance variation in the coil thereby enabling detection of the vibration.

[0005] In the case of the above described sensor, although it takes the form of a single unit capable of detecting both the water level and vibration of the washing

machine, it comprises two independent systems within the unit, the diaphragm, core, coil, etc., used only to detect the water level, and the vibration detector comprising an inclined surface and rolling member used only to detect the vibration. This arrangement results in an increase in the number of overall elements and a complicated structure. A conventional sensor as described above is difficult to manufacture and exhibits high manufacturing costs. Further, in principle, it is difficult to detect the presence and magnitude of fine vibrations as the vibration of the washing machine is detected only through movement of the rolling member induced when the vibration is generated.

[0006] The present invention seeks to provide a system which overcomes or substantially alleviates the problems discussed above.

[0007] A drum type washing machine according to the present invention is characterised by a vibration sensitive member disposed in the housing and movable relative thereto in response to vibration of the washing machine to cause variation in air pressure in the housing detectable by the pressure sensor.

[0008] In a preferred embodiment, the means to cause a variation in air pressure in the housing comprises a pressure pipe having an inlet connected to the housing and the other end to the lower portion of a washing machine tub such that the level of water in the pressure pipe changes in relation to the level of water in the tub.

[0009] Advantageously, the vibration sensitive member has a prescribed weight and is mounted in the housing by means of a resiliently deformable connecting element that connects the vibration sensitive device to an inner peripheral surface of the housing in an air tight manner.

[0010] Preferably, the vibration sensitive member is mounted between the inlet of the pressure pipe and the pressure sensor.

[0011] In a preferred embodiment, the vibration sensitive member includes means to allow air to pass from one side of the housing to the other through the vibration sensitive member.

[0012] The means to allow air to pass through the vibration sensitive member may be a hole.

[0013] Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a sectional view illustrating a washing machine in accordance with a first embodiment;

Figure 2 is a sectional view illustrating a combined detecting device for use in the washing machine;

Figure 3 is a graph illustrating pressure variation of the combined detecting device depending on the vibration generated in the washing machine;

Figure 4 is a graph illustrating pressure variation of the combined detecting device depending on the rising of a water level in the washing machine;

Figure 5 is a sectional view illustrating a second embodiment of the combined detecting device of the washing machine; and

Figure 6 is a sectional view illustrating an example wherein an embodiment of the combined detecting device is applied to a drum type washing machine.

[0014] Referring to the drawings, there is shown in Figure 1 a washing machine of a first embodiment comprising a water tub 11 to contain wash water installed in a body 10 and a washing tub 12 rotatably installed in the water tub 11. The water tub 11 is supported at a lower exterior side by means of suspension devices 13. The washing machine further comprises a water supply device 14 having a water supply pipe 14a and a water supply valve 14b mounted to supply the wash water into the water tub 11 through an upper portion and a drainage device 15 having a drainage pipe 15a and a drainage valve 15b mounted to a lower portion of the water tub 11 to discharge the wash water in the water tub 11 to the outside. A pulsator 16 is installed inside the washing tub 12 and is rotatable in forward and reverse directions to produce wash water streams. In order to rotate both the washing tub 12 and the pulsator 16, a driving device is provided below the water tub 11. Such a driving device comprises a driving motor 17 for generating rotational power upon receiving a power supply voltage, a power transmission mechanism 18 for selectively transmitting the rotational power of the driving motor 17 to one or both of the pulsator 16 and the washing tub 12 and a belt 19 used as a power transmission medium connected between the driving motor 17 and the power transmission mechanism 18.

[0015] The washing machine of the first embodiment further comprises a combined detecting device 20 which is adapted to detect the water level in the water tub 11 in order to keep the water level at an appropriate value conforming to the amount of laundry contained in the washing tub 12 during a wash cycle and to detect the level of vibration of the water tub 11.

[0016] Referring to Figures 1 and 2, the combined detecting device 20 comprises a housing 21 mounted to an upper exterior side of the water tub 11, the housing 21 internally defining a pressure space 22 with an inlet 21a and an outlet 21b formed at opposite sides of the housing 21 and a pressure pipe 23 connected between a lower portion of the water tub 11 and the inlet 21a of the housing 21. The lower end of the pressure pipe 23 is connected to the lower portion of the water tub 11 such that it communicates with the interior of the water tub 11 to allow the wash water in the water tub 11 to be introduced into the pressure pipe 23. With such a configuration, as the interior space of the water tub 11 is filled with the wash water, the water level inside the pressure pipe 23 is correspondingly raised causing the internal air pressure of the pressure pipe 23 to increase. Such an increased air pressure in the pressure pipe 23 can be transmitted to the pressure space 22 of the housing 21.

[0017] The combined detecting device 20 further comprises a sensor case 25 connected to the outlet 21b of the housing 21 by means of a connection pipe 24 and a pressure sensor 26 installed in the sensor case 25. With this configuration, as the internal pressure of the housing 21 is transmitted to the sensor case 25 through the connection pipe 24, the pressure sensor 26 can detect variation in the water level of the water tub 11. The pressure sensor 26 is preferably, but not limited to, a conventional piezoelectric element adapted to convert pressure variation into electric signals such that a control unit 100 of the washing machine can recognize a detected pressure from the electric signals. The electric signals outputted from the pressure sensor 26 are amplified through an amplification circuit 40 and then transmitted to the control unit 100.

[0018] In addition to the detection of the pressure variation in the housing 21 according to the variation of the water level in the water tub 11, the combined detecting device 20 can detect a vibration transmitted from the water tub 11 to the housing 21. For this, the combined detecting device 20 further comprises a vibrator member 27, which is reciprocally installed in the pressure space 22 of the housing 21. The vibrator member 27 may have a prescribed weight and can take the form of a disk having an outer diameter smaller than an inner diameter of the housing 21. The vibrator member 27 is supported in the housing 21 using a connector member 28. The connector member 28 is flexibly deformable to such an extent that it connects an outer periphery of the vibrator member 27 to an inner peripheral surface of the housing 21 in an air tight manner and that it permits reciprocating movements of the vibrator member 27. The vibrator member 27 is centrally perforated with a through-hole 29 to allow the internal pressure of the housing 21 generated by the variation of the water level in the water tub 11 to be transmitted to the pressure sensor 26. The vibrator member 27 is preferably, but not necessarily, made of rubber or resin having a prescribed thickness and the connector member 28 may be made of a thin rubber film exhibiting a good flexibility.

[0019] In the combined detecting device 22 configured as stated above, when the housing 21 shakes due to the vibration of the water tub 11, the vibrator member 27 installed inside the housing 21 reciprocates causing pressure variation in the pressure space 22 of the housing 21. The pressure sensor 26 thereby detects a pressure variance and hence detects the vibration of the water tub 11. That is, since the amplitude and vibration frequency of the vibrator member 27 is proportional to the vibration of the water tub 11 and the pressure variance in the housing 21 is proportional to the amplitude and vibration frequency of the vibrator member 27, the pressure sensor 26 detects the pressure variance inside the housing 21 and is thereby capable of detecting the vibration of the water tub 11. During vibration, the pressure variance inside the housing 21 is generated as shown in Figure 3. That is, during generation of the vi-

bration, the pressure variance inside the housing 21 according to the reciprocation of the vibrator member 27 increases resulting in an excessive change of the electric signals outputted from the pressure sensor 26. This enables the pressure sensor 26 to accurately detect the presence and magnitude of the vibration. In addition, the electric signals outputted from the pressure sensor 26 are transmitted to the control unit 100 of the washing machine after being amplified by the amplification circuit 40 enabling a more accurate detection of the vibration.

[0020] Further, in the aforementioned combined detecting device 20 the centre through hole 29 of the vibrator member 27 allows the interior spaces of the housing 21 divided by the vibrator member 27 to communicate with each other. Thus, the internal pressure of the housing 21, which is variable according to the water level in the water tub 11, is transmitted to the pressure sensor 26 through the through hole 29 such that the pressure sensor 26 can detect the water level in the water tub 11. In the procedure of detecting the water level, as shown in Figure 4, the internal pressure of the housing 21 is raised in proportion to the rising of the water level and the electric signals outputted from the pressure sensor 26 are proportionally raised enabling detection of the water level.

[0021] A second embodiment of the combined detecting device of the washing machine is shown in Figure 5. This embodiment comprises a pressure sensor 32 adapted to detect the internal pressure of a housing 31. The pressure sensor 32 is installed in the housing 31 at a position opposite to an inlet 31a of the housing 31. The configuration of a vibrator member 33 and a pressure pipe 34 as well as a principle for detecting both the water level and the vibration of the washing machine are the same as the above embodiment thus a description thereof will be omitted.

[0022] Figure 6 illustrates an example wherein an embodiment of the combined detecting device according to the present invention is applied in a conventional drum type washing machine. In this housing, the combined detecting device which is designated as reference numeral 40, comprises a housing 41 installed on a drum type water tub 52 and a sensor case 43 fixed to an inner top surface of a body housing 51 of the drum type washing machine and having a pressure sensor 42. A pressure pipe 44 is connected between a bottom of the drum type water tub 52 and the housing 41 installed on the drum type water tub 52 such that a lower end of the pressure pipe 44 communicates with the interior of the drum type water tub 52 and an upper end thereof communicates with the interior of the housing 41. Other configurations and a principle of detecting both the vibration and the water level of the washing machine are the same as the above embodiments and thus will be omitted hereinafter.

[0023] Although embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that changes may be

made in these embodiments without departing from the principles of the invention, the scope of which is defined in the claims and their equivalents and the foregoing description should be regarded as a description of a preferred embodiment.

Claims

1. A washing machine including a water tub (11) and a combined water level and vibration detecting device (20) comprising a housing (21) defining a space, means to cause a variation in air pressure in said space in response to a change in water level in the tub (11) and a pressure sensor (26) operable to detect said pressure variations **characterised by** a vibration sensitive member (27) disposed in the housing (21) and movable relative thereto in response to vibration of the washing machine to cause variation in air pressure in the housing (21) detectable by the pressure sensor (26).
2. A washing machine according to claim 1 wherein the means to cause a variation in air pressure in the housing (21) comprises a pressure pipe (23) having an inlet (21a) connected to the housing (21) and the other end to the lower portion of a washing machine tub (11) such that the level of water in the pressure pipe (23) changes in relation to the level of water in the tub (11).
3. A washing machine according to claim 1 wherein the vibration sensitive member (27) has a prescribed weight and is mounted in the housing (21) by means of a resiliently deformable connecting element (28) that connects the vibration sensitive member (27) to an inner peripheral surface of the housing (21) in an air tight manner.
4. A washing machine according to claim 2 or 3 wherein the vibration sensitive member (27) is mounted between the inlet of the pressure pipe (21a) and the pressure sensor (26).
5. A washing machine according to claim 4 wherein the vibration sensitive member (27) includes means to allow air to pass from one side of the housing (21) to the other through the vibration sensitive member (27).
6. A washing machine according to claim 5 wherein the means to allow air to pass through the vibration sensitive member (27) is a hole (29).
7. A washing machine comprising a water tub adapted to contain wash water, a washing device adapted to wash laundry contained in the water tub and a combined detecting device which detects both a

water level and vibration of the water tub, the combined detecting device comprising a housing coupled to the water tub and having an inlet for use in the passage of air, a pressure pipe connected between a lower portion of the water tub and the inlet of the case, a pressure sensor which detects pressure variation in the case and a vibrator member reciprocally installed in the housing and which induces the pressure variation in the case during generation of the vibration.

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8. The washing machine according to claim 7 wherein the pressure sensor is installed at an opposite side of the inlet of the housing.
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9. The washing machine according to claim 8 wherein the vibrator member includes a flexible connector member which connects an outer periphery of the vibrator member to an inner peripheral surface of the housing in a substantially air tight manner and to permit reciprocation of the vibrator member and a through hole perforated through the vibration member.
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10. The washing machine according to claim 9 wherein the vibrator member is installed in the housing between the inlet of the housing and the pressure sensor.
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11. The washing machine according to claim 8 wherein the combined detecting device further comprises an outlet formed at the case at an opposite side of the inlet and a connection pipe connected between the outlet and the pressure sensor and which allows the pressure sensor to detect the pressure variation transmitted through the outlet.
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12. The washing machine according to claim 11 wherein the vibrator member includes a flexible connector member which connects an outer periphery of the vibration member to an inner peripheral surface of the housing in a substantially air tight manner and to permit reciprocation of the vibrator member and a through hole perforated through the vibrator member.
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13. The washing machine according to claim 12 wherein the vibrator member is installed in the housing between the inlet and the outlet.
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14. The washing machine according to claim 8 wherein the pressure sensor comprises a piezoelectric element.
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15. The washing machine according to claim 8 wherein the combined detecting device further comprises an amplification circuit which amplifies electric signals outputted from the pressure sensor.

FIG. 1

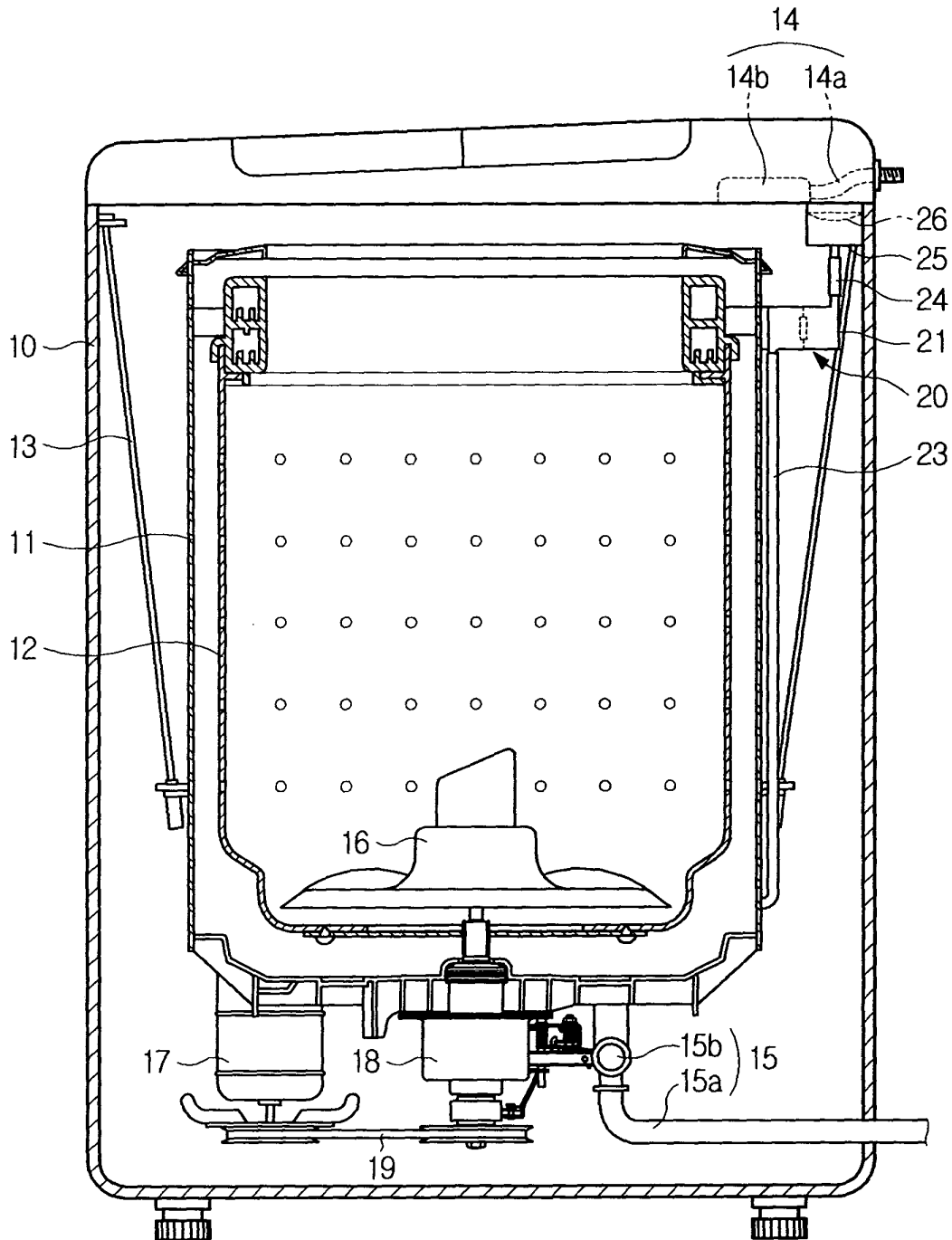


FIG. 2

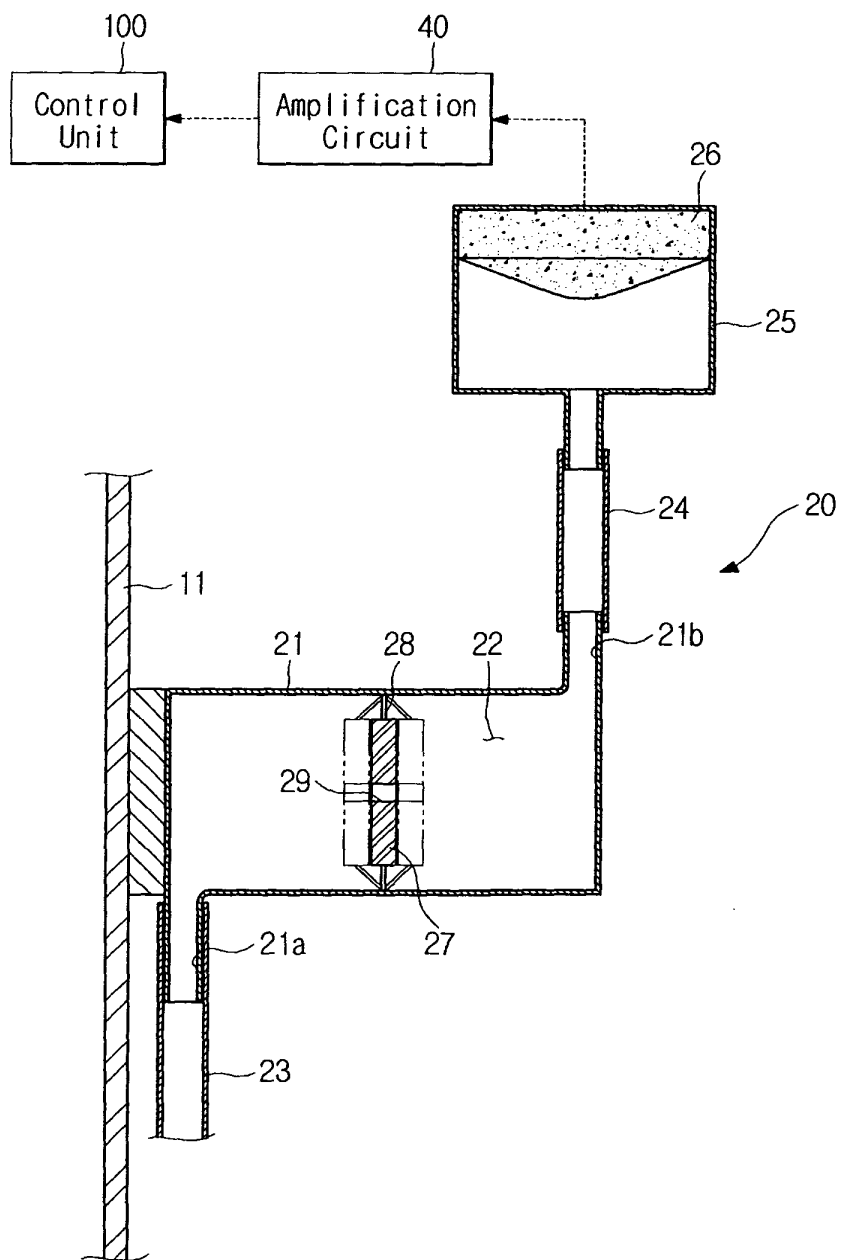


FIG. 3

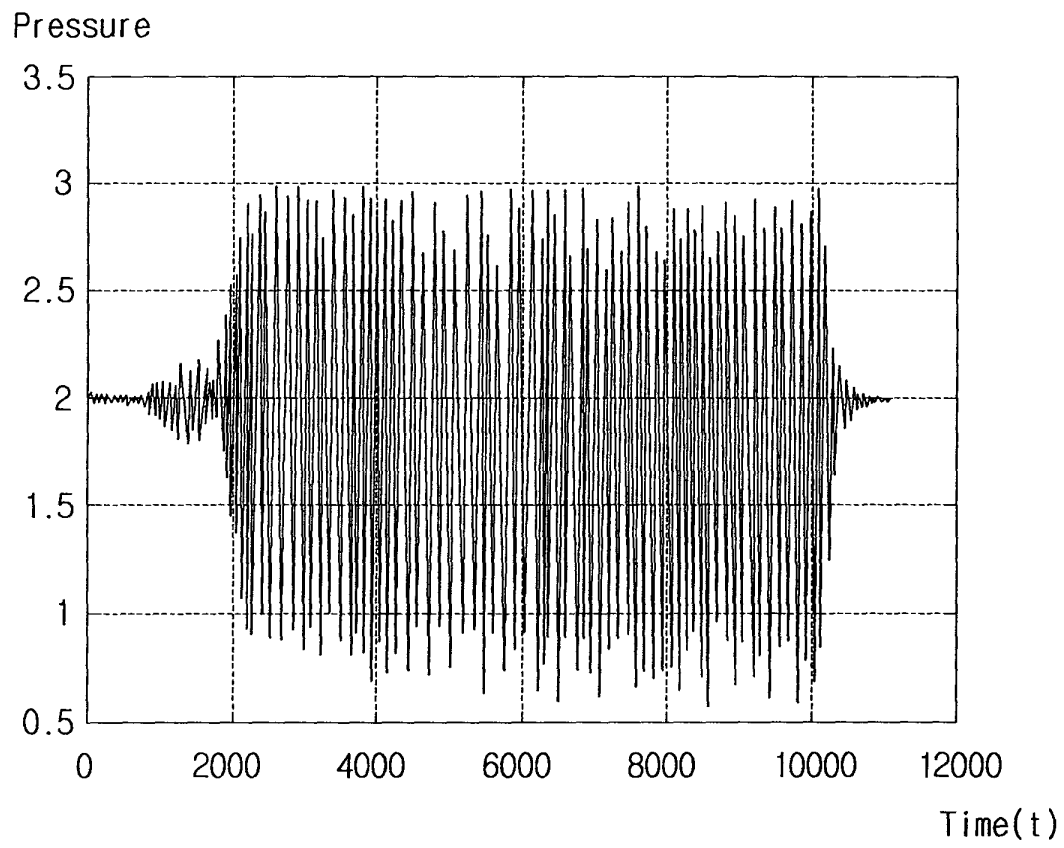


FIG. 4

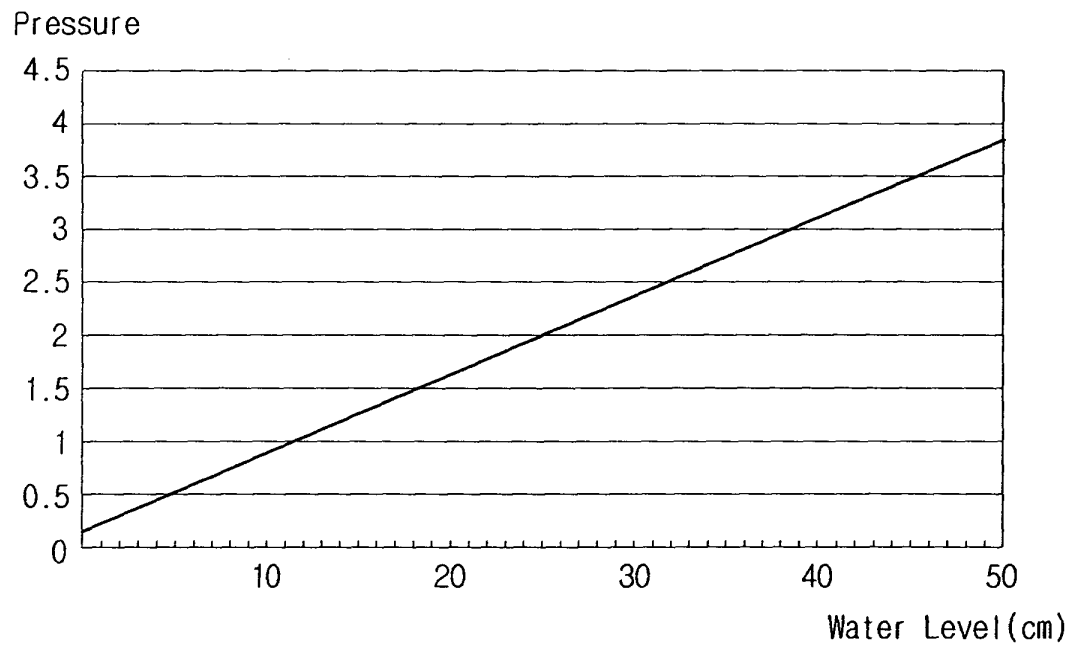


FIG. 5

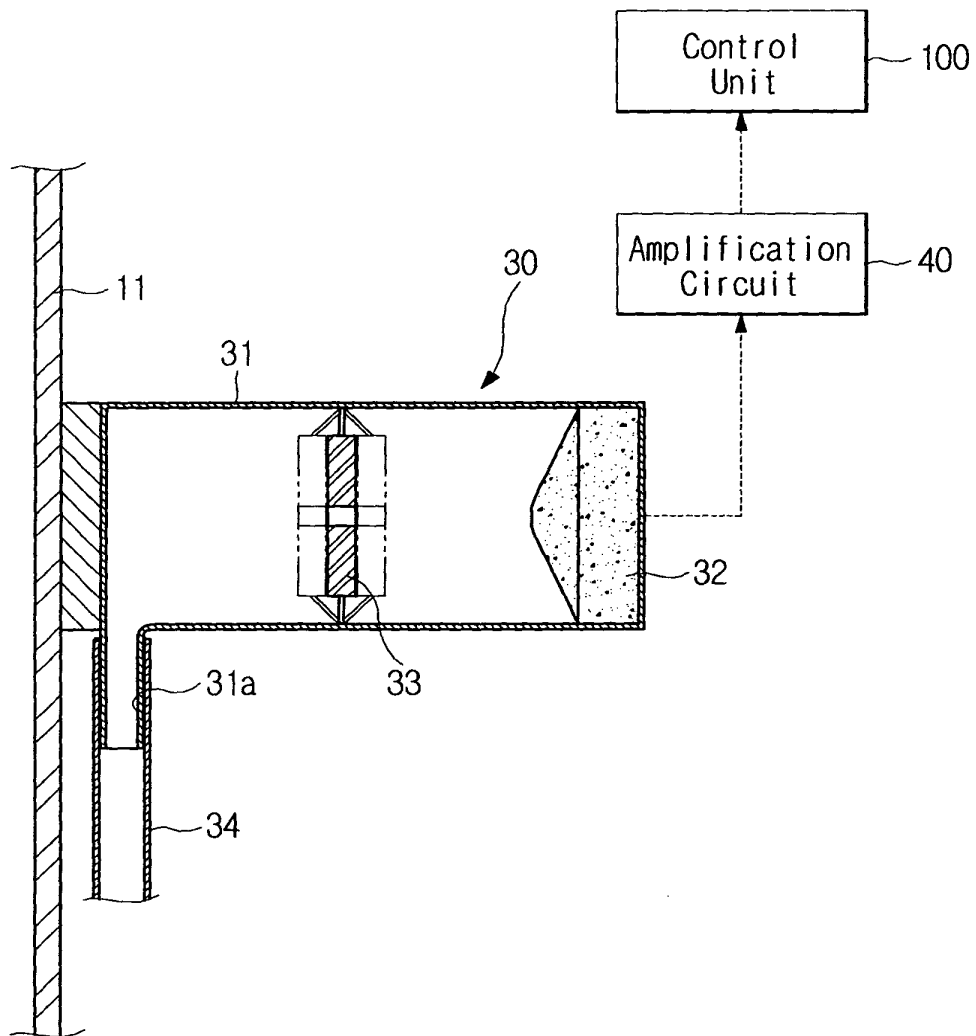
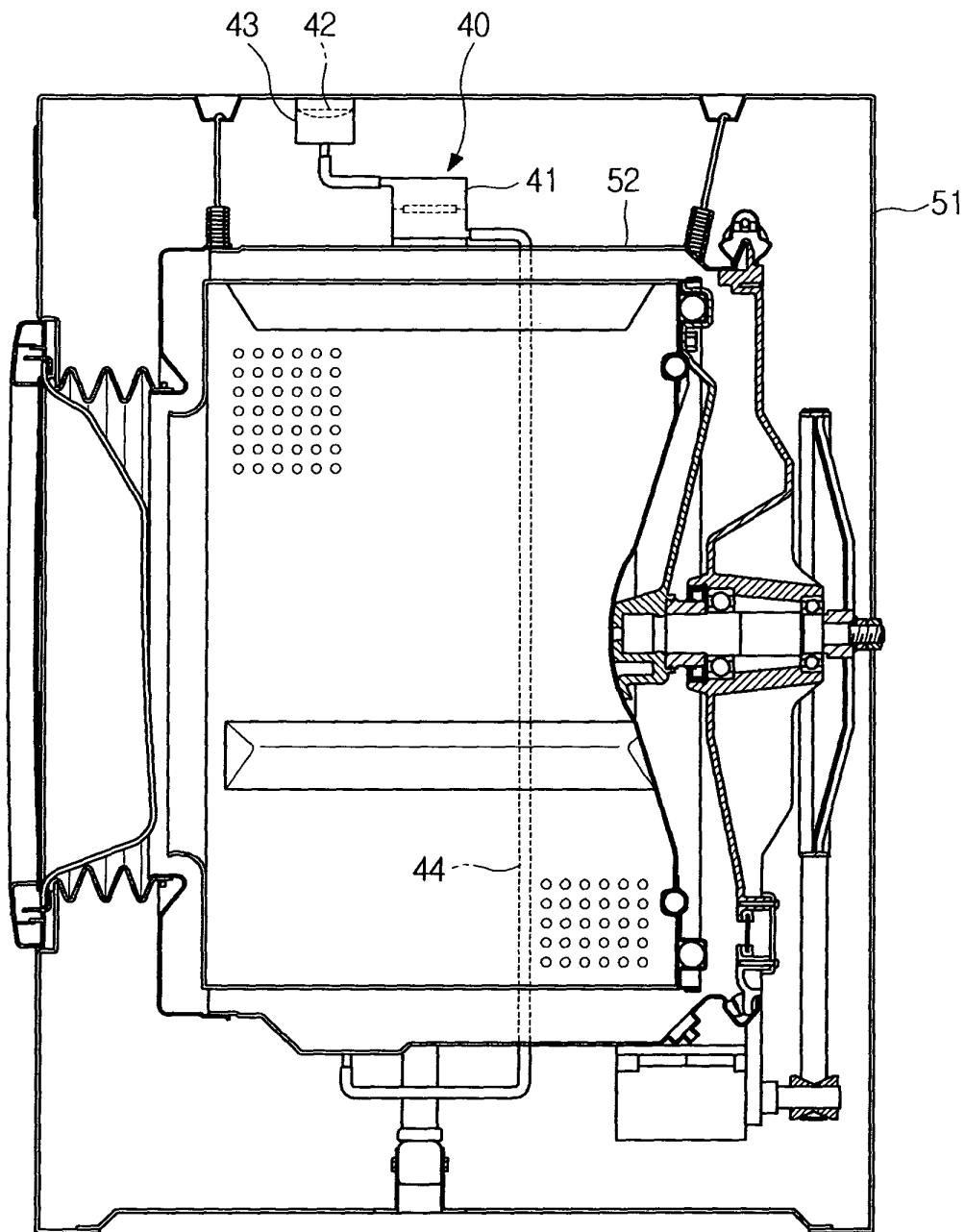


FIG. 6





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Application Number
EP 05 25 0889

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Place of search Munich		Date of completion of the search 16 August 2005	Examiner Falkentoft, C
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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