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(54) Laundry treating machine comprising a pressure switch, in particular a linear pressure switch

(57) The present invention relates to a laundry treating machine of the type comprising a frame from which an oscillating assembly is suspended which comprises a tub (1) containing a drum, and wherein said machine also comprises a pressure sensor of the type fitted with at least one pressure switch (2) for measuring a level of a wash liquid in said tub (1), wherein said pressure switch (2) is associated with said oscillating assembly.

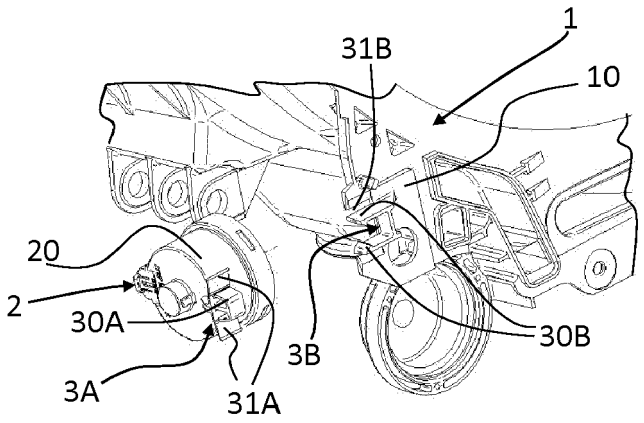

Fig. 1

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Description

[0001] The present invention relates to a laundry treating machine comprising a pressure switch, in particular a linear pressure switch.

[0002] In the present description and in the appended claims, the term "laundry treating machine" refers to a machine in which a drum housed in a tub is loaded with laundry which is then subjected to a washing treatment, a drying treatment or the like.

[0003] Some examples of such machines are washing machines, washing/drying machines and clothes dryers.

[0004] In these machines, it is a common practice to detect the quantity of wash liquid present in the tub for the purpose of correctly setting the various treatment steps or for controlling a step of supplying water from the mains or for controlling a step of draining wash liquid into a drain system.

[0005] In order to detect the quantity of wash liquid in the tub, a method known in the art employs a pressure sensor connected to the tub by means of a tube which opens, at an intake point, into the tub itself, preferably in the lowest portion thereof.

[0006] Said pressure sensor detects the pressure of the liquid column over the intake point, thus making possible to know the level of the liquid surface and therefore the tub filling level. In short, such a pressure sensor comprises a bell with an open lower edge close to the bottom of the tub; at its upper end, the bell communicates with a linear pressure switch through a tube, preferably a flexible hose.

[0007] Said linear pressure switch is a transducer device of a per se known type, in which a diaphragm is deformed by the pressure variation and causes a ferromagnetic element to move linearly, thereby altering the magnetic field of a coil associated therewith and inducing a corresponding voltage signal, which is then processed into a modulated form (per se known) by an electronic circuit associated with the coil, and is finally transmitted to a control unit.

[0008] Linear pressure switches like the one described above are commercially available in Italy from companies ITW Metalflex, Invensys and Bitron.

[0009] The measurement takes place as follows: as the wash liquid level in the tub changes, the level inside the bell changes as well, thereby determining a variation in the pressure of the air contained in the bell, which variation is then transmitted to the linear pressure switch through the tube.

[0010] The pressure switch detects pressure variations and sends a corresponding modulated voltage signal of the PWM (Pulse Width Modulation) type to the control unit. Alternatively, the output signal generated by the linear pressure switch and then sent to the control unit is a frequency-modulated signal, to do this an oscillator circuit known in the art is associated with the linear pressure switch.

[0011] In those machines equipped with such pressure sensors, the linear pressure switch is typically located at the top and is connected to the machine frame to which the tub is also coupled, and the air-filled tube which transmits pressure variations runs from the bell in the tub to the linear pressure switch by following a rather long and sometimes winding path.

[0012] The tortuosity of the path followed by the tube is due to the necessity of preventing it from touching functional elements of the machine, such as frame, motor or duct parts, so as to avoid the risk that it may wear out when subjected to normal operating vibrations. Another drawback derives from the fact that the two points where the tub is secured are subject, in operation, to different movements (the pressure switch is secured to the frame, whereas the tub is secured to the oscillating assembly by means of dampers and/or springs): the tube therefore moves and generates noise, and there is also the risk that the tube itself may get detached or damaged.

[0013] The presence of a rather long tube also implies some load losses, which may translate into an incorrect reading of the liquid level in the tub.

[0014] Furthermore, this arrangement requires quite complex assembling steps, since the tube must be positioned on and secured to both the tub and the frame: as aforementioned, the latter are subject to different movements when the machine is in operation, so that it is appropriate to pay particular attention to mounting the tube in a manner such that it will not stretch in use, while also ensuring that it is not too loose and cannot get in touch with machine parts which might wear it out by friction.

[0015] The present invention aims at overcoming these and other drawbacks by providing a laundry treating machine fitted with a frame and an associated oscillating assembly which comprises a tub that houses a drum, the machine also comprising a pressure sensor of the type fitted with at least one pressure switch, wherein the pressure sensor is associated with the oscillating assembly, preferably with the tub.

[0016] The assembly steps are thus simplified, and all the above-described problems caused by the presence of the tube are avoided.

[0017] Another advantageous feature is that the linear pressure switch is mounted to the tub in a manner such that the duct connecting it to the latter is short and straight. Any load losses are thus extremely small and the measurement is extremely accurate.

[0018] The present invention also relates to a method for detecting operating vibrations of a laundry treating machine, as per claim 9.

[0019] Further advantageous features will be set out in the appended claims.

[0020] These features as well as further advantages of the present invention will become apparent from the following description of an embodiment thereof as shown in the annexed drawings, which are supplied by way of non-limiting example, wherein:

Fig. 1 shows a perspective view of a portion of a

washing machine according to the present invention, with the pressure switch in the non-assembled condition;

Fig. 2 shows a view of the washing machine of Fig. 1 with the pressure switch in the assembled condition;

Fig. 3 shows a front view of the pressure switch and of a portion of the machine of Fig. 2;

Fig. 4 shows a sectional view along line AA of the pressure switch of Fig. 3;

Fig. 5 shows a detail of the coupling means of the pressure switch and of the machine of Fig. 3.

[0021] Referring now to Fig. 1, there is shown a portion of a tub 1 of a laundry treating machine according to the present invention.

[0022] The laundry treating machine is usually fitted with a frame (not shown) with which an oscillating assembly is associated, which comprises a tub 1 that houses a drum (not shown).

[0023] The machine frame may be provided in several forms but, for the purposes of the present invention, suffice it to say that it is that part of the machine which rests on the floor and supports the tub 1, the latter being coupled thereto by means of vibration dampers and/or springs.

[0024] The tub 1 houses the drum that contains the laundry, and has an aperture which allows the laundry to be inserted into the drum.

[0025] Both the tub and the drum belong to the same oscillating assembly, the term "oscillating assembly" referring herein to all those masses (such as the tub, the drum, possibly the motor, and the like) which are suspended from the frame by means of vibration dampers. The machine of the present invention also comprises a pressure switch 2 adapted to detect the pressure of the wash liquid in the tub and to send a signal to an electronic control unit as previously described in order to identify the liquid level.

[0026] In accordance with the teachings of the present invention, the pressure switch 2 is secured to the oscillating assembly of the machine.

[0027] More in particular, as shown in the example provided in the annexed Figs. 1 and 2, the pressure switch 2 is mounted directly to the tub 1 through fastening means 3A,3B, which will be discussed later on.

[0028] For now, suffice it to say that the pressure switch 2 thus secured allows to eliminate the tube used in the prior art, along with all the problems related thereto and discussed above.

[0029] This provides a number of advantages; first of all, this arrangement allows the pressure switch 2 to be installed into the machine in an extremely simple manner, without the vibrations of the oscillating assembly affecting the reading or impairing the connection between the pressure switch and the measuring point.

[0030] This also eliminates all those problems related to the presence of the tube in the prior art, since the machine thus obtained is advantageously quieter and simpler to manufacture and maintain.

[0031] Referring now to Figs. 3 and 4, there is shown a detail of the pressure switch 2 and a cross-section of the tub 1 at the measuring point 4.

[0032] The measuring point 4 is located in the lowest portion of the tub 1.

[0033] In the example shown, it is located at the end of a chamber that forms a bell communicating with the inside of the tub at the other end, preferably made in one piece with the tub itself.

[0034] The tub shape with a bell-shaped portion provides the additional advantage that the machine production process is further simplified.

[0035] The measuring point 4 inside the bell must not be wetted by the wash liquid contained in the tub 1 for the diaphragm of the pressure switch 2 to remain dry.

[0036] For this purpose, the tub 1 has a hole in which the intake duct 5 is inserted, and tightness is ensured between the two parts by a gasket 29 interposed at the interface thereof.

[0037] The intake duct 5 is in practice a rigid pipe, typically made of plastic material, advantageously made in one piece with the shell of the pressure switch 2 and extending perpendicularly to the diaphragm 6 for a total length being the minimum length required for said duct 5 to be able to act as a collar ensuring a hydraulic seal; preferably, said length is in the order of a few centimetres, more preferably it is shorter than 5 cm.

[0038] The gasket 29 ensures the necessary tightness between the duct 5 and the tub 1. Furthermore, aiming at advantageously prevent any load losses which might affect the reading and at making the assembly process easier, the duct 5 substantially extends in a straight line; more in particular, the straight direction of extension of the duct 5 coincides with the direction in which the pressure switch 2 must be mounted to the tub 1, so that the pressure switch can be mounted and secured with just a single move.

[0039] As far as the pressure switch 2 is concerned, it is in particular a linear pressure switch as previously described; therefore, reference should be made to the above description for further details.

[0040] In short, the diaphragm 6 is deformed through the effect of pressure variations and causes a ferromagnetic piston (not shown) to move linearly, thereby altering the magnetic field of a coil (not shown) associated therewith and inducing a corresponding voltage signal, which is then processed into a modulated form (per se known) by an electronic circuit (not shown) associated with the coil, and is finally transmitted to a control unit (not shown) of the machine.

[0041] The linear pressure switch 2 can be used for controlling the laundry treating machine whereto it is applied, in particular for the following functions:

- detecting the level of the wash liquid in the tub;
- controlling the anti-overflow device;

- detecting the presence of foam in the wash liquid;
- controlling the drain pump during the spin cycle, in order to optimise the life thereof and prevent cavitation;
- detecting any obstructions or faults in the drain pump;
- if the machine executes a steam treatment cycle, controlling the level of the wash liquid to keep it below the drum;
- if the machine has a recirculation duct, maintaining a minimum wash liquid level such as to ensure effective recirculation.

[0042] A pressure switch of this kind directly secured to the oscillating assembly or to the tub advantageously offers added functionality. According to the present invention, in fact, the linear pressure switch can be used as a sensor for detecting the balance of the oscillating assembly, in particular when the machine is operating at high drum rotation speeds (e.g. at the beginning of a spin cycle).

[0043] The deformation of the diaphragm is translated into a frequency value (e.g. by means of an oscillator circuit), a given frequency value corresponding to a given pressure value.

[0044] In the absence of any significant vibration, the pressure switch output frequency is substantially stable; on the contrary, the frequency fluctuates when the diaphragm 6 is subject to vibration.

[0045] The magnitude of such fluctuations is proportional to the unbalance of the laundry load in the drum; it follows that an unbalance value can be calculated from the extent of said fluctuations.

[0046] A plurality of frequency values are measured within a predetermined time interval. Since unbalance is due to eccentricity of the load in the drum, said eccentricity is read for a number of times such that the unbalance measurement obtained is sufficiently accurate. For example, assuming a spin cycle speed of 1,200 rpm, a time interval of 1 second may be sufficient because it allows the sampling of 20 fluctuations.

[0047] The average value among said frequency values is then calculated, followed by the value of the difference between the peak frequency value and the average value.

[0048] The average value leads to know the pressure exerted by the wash liquid onto the diaphragm 6, whereas said difference leads to know the unbalance of the load.

[0049] By detecting the frequency of the signals generated by the pressure switch, it is therefore also possible to detect any unbalance of the oscillating assembly, and possibly such data can be used to eliminate or reduce said unbalance below a limit value by stopping or slowing down the drum so as to obtain a different distribution of the laundry therein. This step may be repeated several times until the distribution of the laundry in the drum is sufficiently balanced and such as to avoid damages to the structure of the machine during the next spin cycle.

[0050] More in detail, the pressure switch 2 comprises an outer shell 20 with which a first part of a fastening means 3A is associated, the latter being snap-coupled to a matching second part 3B provided on the tub.

[0051] This snap-on engagement allows the pressure switch 2 to be easily mounted into its seat, while at the same time ensuring that the duct 5 is correctly plugged into the tub 1 and cannot come off.

[0052] In particular, the first part of the fastening means 3A comprises an eyelet 30A with two positioning fins 31A on both sides.

[0053] The second part of the fastening means 3B, associated with the tub, is provided with two teeth 30B having at their ends two wedge-shaped reliefs facing each other and adapted to snap into the eyelet 30A in the assembled condition, thus preventing it from coming off. The second part of the fastening means 3B also comprises two alignment slots 31B which allow the two positioning fins 31A to slide as the pressure switch 2 is being mounted to the tub 1, so that the duct 5 is properly inserted into the tub hole and cannot be damaged during the assembly step.

[0054] For this purpose, in fact, the fins 31A slide in the alignment slots 31B in a direction parallel to the direction of insertion of the intake duct 5 into the hole of the tub 1; the slots 31B are provided in the form of through apertures between the teeth 30B and a support structure or bracket 10 integral with the tub and adapted to support the pressure switch 2.

[0055] The relative motion between 3A and 3B occurring as the pressure switch 2 being installed is parallel to the straight direction of extension of the tube 5; in this manner, the pressure switch can be installed and secured in position in one move without damage. As far as the bracket 10 is concerned, it may advantageously be moulded as one piece with the tub 1.

[0056] The slots 31B have a substantially rectangular shape and are open on the side not facing the tub 1 to allow for the insertion of the fins 31A.

[0057] As can be easily understood, assembling the pressure switch 2 is thus extremely simple and does not require the use of threaded connections or the like; in fact, it is sufficient to insert the fins 31A into the corresponding slots 31B and bring the pressure switch near the tub 2: at the end of its travel, the teeth 30B will engage with the edge of the eyelet 30A, thereby securing it in position.

[0058] Of course, other embodiments of the fastening means 3A and 3B are also conceivable, which may be chosen and adopted by the man skilled in the art without departing from the scope and teachings of the present invention.

[0059] According to one of such embodiments, the means 3A and 3B respectively associated with the pressure switch 2 and the tub 1 are reciprocated.

[0060] In another embodiment, the pressure switch 2 is coupled to the oscillating assembly, but not directly to the tub; to this end, the pressure switch 2 or its bracket

10 may be associated with the motor of the machine (if the motor is fastened to the oscillating assembly) or to other parts of the oscillating assembly itself, such as pipes, ducts, support bracket or the like.

Claims

1. A laundry treating machine of the type comprising a frame from which an oscillating assembly is suspended which comprises a tub (1) containing a drum, and wherein said machine also comprises a pressure sensor of the type fitted with at least one pressure switch (2) for measuring a level of a wash liquid in said tub (1),
characterised in that
said pressure switch (2) is associated with said oscillating assembly.

2. A machine according to claim 1, wherein said pressure switch (2) is associated with said tub (1).

3. A machine according to claim 1 or 2, wherein said pressure switch (2) comprises at least one diaphragm (6) adapted to move as a result of variations in the pressure of an air mass over said wash liquid in said tub (1).

4. A machine according to claim 1 or 2, wherein said pressure switch (3) comprises an intake duct (5), and wherein said tub (1) comprises a hole for inserting said intake duct (5) at a measuring point (4).

5. A machine according to claim 4, wherein said measuring point (4) is located in the lowest region of the tub (1), in a portion of the latter which is substantially bell-shaped.

6. A machine according to claim 4 or 5, wherein said pressure switch (3) comprises a shell (20) arranged around said diaphragm (5), and said intake duct (5) is a straight rigid pipe, preferably made of plastic material, manufactured in one piece with said shell, and wherein said intake duct (5) extends perpendicular to the diaphragm (6) for a total length shorter than 5 cm.

7. A machine according to one or more of the preceding claims, wherein said pressure switch (2) comprises fastening means (3A,3B) that comprise a first part (3A) associated with said pressure switch (2) and a second part (3B) associated with said tub (1), said first and second parts of said fastening means (3A, 3B) being adapted to cooperate together for positioning and snap-coupling said pressure switch (2) onto said tub (1).

8. A machine according to claim 7, wherein said first part of the fastening means (3A) comprises an eyelet (30A) and two positioning fins (31A), and wherein said second part of the fastening means (3B) comprises at least two teeth (30B) adapted to snap into said eyelet (30A) in the assembled condition, and at least two alignment slots (31B) adapted to allow said two positioning fins (31A) to slide when the pressure switch (2) is mounted to the tub (1).

9. A method for detecting operating vibrations of a laundry treating machine of the type comprising a frame from which an oscillating assembly is suspended which comprises a tub (1) containing a drum, and wherein said machine also comprises a pressure sensor of the type fitted with at least one pressure switch (2) for measuring a level of a wash liquid in said tub (1),
characterised in that
said pressure switch (2) is associated with said oscillating assembly, and said method comprises the step of detecting said vibrations through said pressure switch (2).

10. A method according to claim 9, **characterised by** comprising the steps of:

- translating a deformation of a diaphragm of said pressure switch into frequency values
- repeating the previous step for a predefined time interval
- detecting any fluctuations in said frequency values during said time interval
- calculating the average value among said frequency values
- calculating the value of the difference between the peak frequency value and the average frequency value
- if said difference exceeds a predefined threshold, taking corrective actions in order to balance the distribution of the laundry in the drum, preferably by stopping or slowing down the drum.

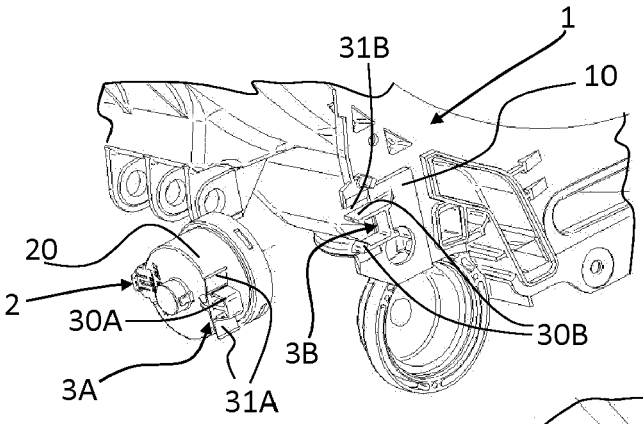

Fig. 1

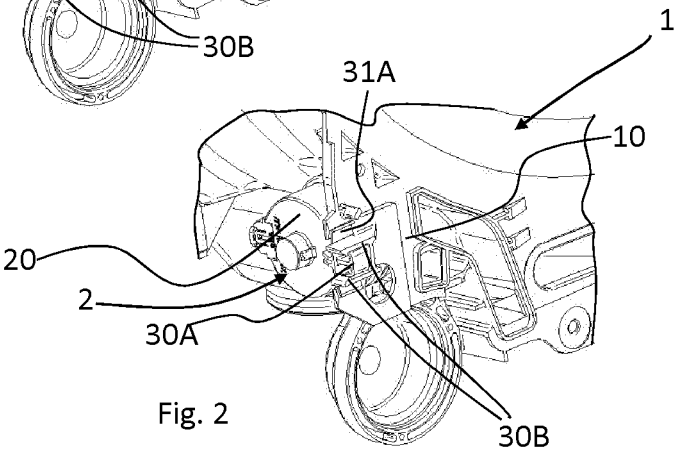

Fig. 2

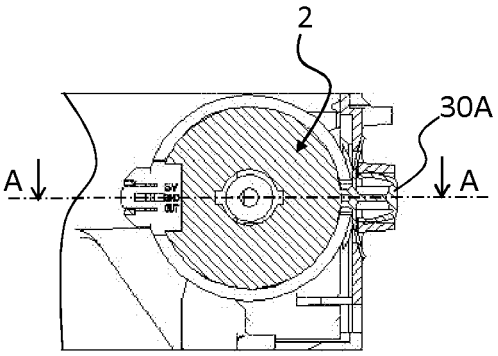

Fig. 3

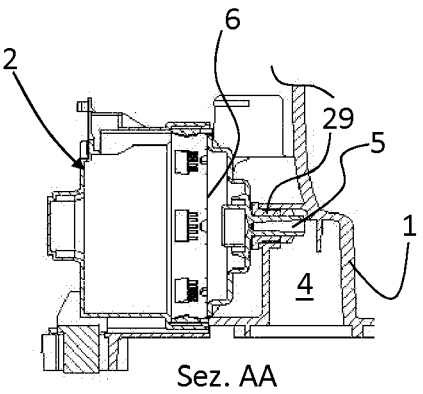

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Fig. 4

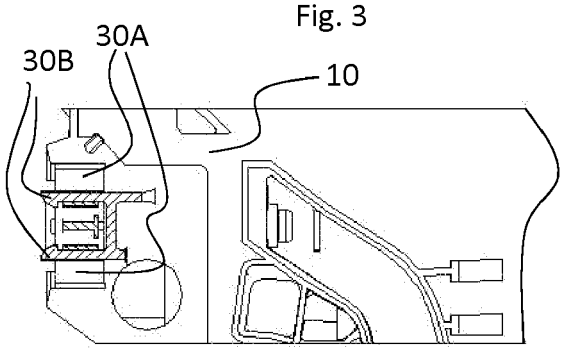

Fig.5