(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 899 309 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.07.2015 Bulletin 2015/31

(51) Int Cl.:
D06F 39/08 *(2006.01)* ***A47L 15/42*** *(2006.01)*

(21) Application number: **15151838.8**

(22) Date of filing: **05.11.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR

(30) Priority: **23.11.2007 IT TO20070843**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
08168352.6 / 2 065 508

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Remarks:
This application was filed on 20-01-2015 as a divisional application to the application mentioned under INID code 62.

(54) Method for detecting the level of a wash liquid in a washing machine, and related washing machine

(57) The present invention relates to a method for detecting a level (L, L1, L2) of a wash liquid in a washing machine (10), in particular a household laundry washing machine or dishwasher, comprising:
- a tub (11) housing a drum (12) adapted to contain a certain quantity of laundry;
- an analogue pressure switch (15) associated with the tub (11) for detecting the pressure and consequently said level (L, L1, L2) of the wash liquid in said tub (11);
- means for managing and controlling the washing machine (10),

said method providing that said analogue pressure switch (15) is subjected to a calibration process, said calibration process being implemented during an operational step of the washing machine (10).

The invention is characterized in that said method for detecting the level (L, L1, L2) of a wash liquid in the washing machine (10) provides for activating a recirculation circuit of the washing machine (10), in particular said activation taking place when said analogue pressure switch (15) detects a predetermined level (L) of the wash liquid in said tub (11).

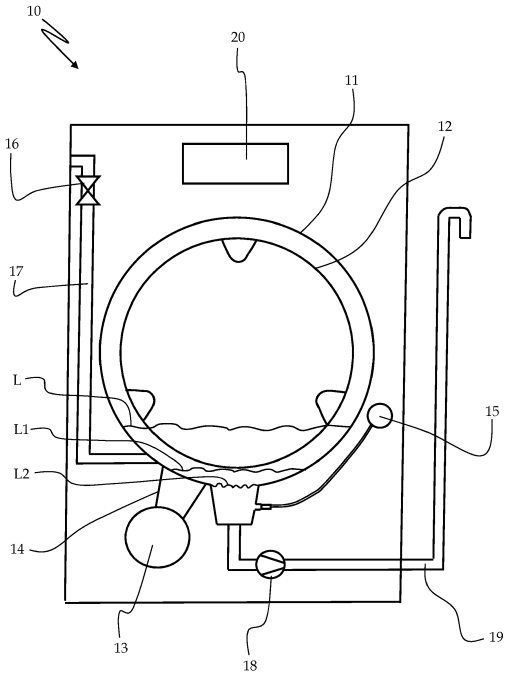

Fig. 1

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Description

[0001] The present invention relates to a method for detecting the level of a wash liquid in a washing machine, in particular a household laundry washing machine or dishwasher, according to the preamble of claim 1.

[0002] In the washing machines known in the art, the level of a wash liquid is usually detected by measuring the pressure of said washing liquid through a pressure switch.

[0003] A type of pressure switch known in the art is the so-called "state" pressure switch, which essentially operates like an on-off switch, since it allows the wash liquid to be supplied into the machine tub when the wash liquid pressure is lower than a limit value, and stops the wash liquid supply as soon as the wash liquid pressure reaches said limit value.

[0004] However, it has been observed that using a state pressure switch involves a number of drawbacks, the most important of which is that that such a pressure switch does not allow to detect different levels of the wash liquid contained in the tub of the washing machine. This drawback has become increasingly important in recent years, mainly because the control boards of washing machines can implement a plurality of functions associated with different levels of the wash liquid in the wash tub.

[0005] A known solution conceived in order to overcome this drawback and detect the level of a wash liquid in a washing machine utilizes a so-called "analogue" pressure switch. An example of such an analogue pressure switch is described in French patent No. FR 2 377 614.

[0006] An analogue pressure switch essentially consists of a casing containing a coil within which a ferromagnetic core is moved by a rubber diaphragm that expands through the effect of the pressure exerted by the wash liquid.

[0007] The coil is a part of an oscillating electric circuit that outputs a signal having a frequency that varies as a function of the different positions taken by the core within the coil itself, i.e. according to the deformation of the diaphragm caused by the pressure of the wash liquid.

[0008] The resonance frequency of the oscillating electric circuit changes in a substantially linear manner as a function of the displacement of the ferromagnetic core relative to the coil.

[0009] As a consequence, a control circuit of the washing machine is calibrated during the washing machine production or testing stages and is programmed in a manner such that it associates a certain value of the frequency of the oscillating electric circuit with a certain value of the pressure of the wash liquid in the washing machine.

[0010] It follows that the washing machine control circuit can detect the corresponding level of the wash liquid. This allows the control circuit to send appropriate commands to the various components of the washing machine, in particular pertaining to the washing machine wash liquid supply, according to the wash liquid level detected in the washing machine.

[0011] Although the analogue pressure switch allows for the detection of a plurality of different wash liquid levels in the tub of the washing machine, its use causes some problems which are related, in particular, to the fact that the analogue pressure switch is less accurate than the state pressure switch in detecting the wash liquid level.

[0012] A further drawback of the above-described analogue pressure switch is that the margin of error in measuring the fluid pressure increases over time and with the wear of the parts making up said analogue pressure switch.

[0013] In this frame, it is the main object of the present invention to overcome the above-mentioned drawbacks.

[0014] In particular, it is an object of the present invention to provide a method for detecting the level of a wash liquid in a washing machine, in particular a household laundry washing machine or dishwasher, which allows to detect a plurality of different wash liquid levels in the washing machine.

[0015] It is another object of the present invention to provide a method for detecting the level of a wash liquid in a washing machine, in particular a household laundry washing machine or dishwasher, which allows to carry out precise and accurate measurements of the different wash liquid levels in the washing machine.

[0016] It is a further object of the present invention to provide a method for detecting the level of a wash liquid in a washing machine, in particular a household laundry washing machine or dishwasher, which is not affected by the passing of time or by the wear of the parts that make up the pressure switch used for the measurement.

[0017] Said objects are achieved by the present invention through a method for detecting the level of a wash liquid in a washing machine, in particular a household laundry washing machine or dishwasher, and through a related washing machine incorporating the features set out in the appended claims, which are intended as an integral part of the present description.

[0018] Further objects, features and advantages of the present invention will become apparent from the following detailed description and from the annexed drawing, which is supplied by way of non-limiting explanatory example.

[0019] Fig. 1 is a diagrammatic view of a washing machine according to the present invention, designated as a whole by reference numeral 10.

[0020] Said washing machine 10 comprises a tub 11 which houses a drum 12 adapted to contain a certain quantity of laundry (not shown in the drawing).

[0021] Preferably, said drum 12 is rotatable about a substantially horizontal axis, being in particular driven by a motor 13 and transmission means 14.

[0022] However, for the purposes of the present invention, drum 12 may also be produced in a way to alternatively rotate about a substantially vertical axis.

[0023] Said washing machine 10 also comprises an

analogue pressure switch 15 associated with tub 11 in a manner such that it detects the pressure of the wash liquid in said tub 11 and, consequently, a level L of the wash liquid in said tub 11.

[0024] Said washing machine 10 further comprises:

- supply means for delivering the wash liquid from the water main to tub 11, said supply means comprising at least one valve 16 and one inlet duct 17;
- drain means for draining the wash liquid from tub 11, said drain means comprising at least one pump 18 and one outlet duct 19;
- means for managing and controlling washing machine 10.

[0025] In particular, said means for managing and controlling washing machine 10 comprise an electronic board 20 adapted to store and execute a plurality of wash programs, which typically comprise wash cycles that may vary depending on load, cloth type, dirtiness degree or required rinsing performance for the laundry to be washed.

[0026] According to the present invention, the method for detecting a level L of a wash liquid in washing machine 10 is characterized in that said analogue pressure switch 15 is subjected to a calibration process, said calibration process being implemented during an operational step of washing machine 10.

[0027] For the purposes of the present invention, an operational step is essentially a step of use of the washing machine by a user.

[0028] In particular, said calibration process comprises the following self-calibration steps:

a) detecting an initial frequency F_0 of the analogue pressure switch 15;
b) supplying wash liquid into tub 11 of the washing machine 10;
c) determining a level L of the wash liquid in tub 11 by detecting the variation of frequency ΔF of the analogue pressure switch 15 with respect to said initial frequency F_0.

[0029] Preferably, said initial frequency F_0 of the analogue pressure switch 15 is detected when tub 11 of washing machine 10 contains substantially no wash liquid.

[0030] In fact, since the frequency difference ΔF with respect to the initial frequency F_0 is a function of level L of the wash liquid in tub 11 of the washing machine, said level L can be calculated by detecting the variation of frequency ΔF with respect to an initial frequency F_0 of analogue pressure switch 15, said initial frequency F_0 being detected when tub 11 of washing machine 10 contains substantially no wash liquid.

[0031] More in detail, analogue pressure switch 15 follows a linear law which can be expressed as a $y = \alpha x + \beta$ function, wherein:

- the abscissa value is the wash liquid level L;
- the ordinate value is the frequency of analogue pressure switch 15;
- angular coefficient α is known and depends on the characteristics of analogue pressure switch 15.

[0032] As a consequence, according to the method of the present invention, the level L is calculated as a ratio between the variation of frequency ΔF and angular coefficient α.

[0033] Said self-calibration steps are preferably repeated on a periodical basis during the operational step of washing machine 10 according to the present invention.

[0034] In particular, said self-calibration steps may be repeated at every beginning and/or end of the wash cycles of each wash program. In fact, at the beginning and at the end of a wash cycle tub 11 contains substantially no wash liquid, since any wash liquid residue remaining in the laundry is substantially insignificant for determining level L of a wash liquid according to the present invention, and anyway it cannot affect the application of the method according to the present invention.

[0035] Said self-calibration steps may also be repeated every time a wash program of washing machine 10 according to the present invention is started; alternatively, said self-calibration steps may be carried out after a predefined number of wash programs.

[0036] The advantages of a method for detecting the level of a wash liquid in a washing machine, in particular a household laundry washing machine or dishwasher, as well as of a related washing machine according to the present invention are apparent from the above description.

[0037] In particular, such advantages consist in the fact that the method according to the present invention allows to detect a plurality of different levels of the wash liquid in the washing machine while at the same time providing precise and accurate measurements of the different levels of the wash liquid in the washing machine.

[0038] Another advantage of the present invention is that the method for detecting the level of a wash liquid in a washing machine, in particular a household laundry washing machine or dishwasher, is not affected by the passing of time or by the wear of the parts that make up the pressure switch used for the measurement.

[0039] The method and washing machine described herein by way of example may be subject to many possible variations without departing from the novelty spirit of the inventive idea; it is also clear that in the practical implementation of the invention the illustrated details may have different shapes or be replaced with other technically equivalent elements.

[0040] In particular, among the many possible variants, the method may comprise a steam treatment for the laundry contained in drum 12, said steam treatment being in particular carried out in a manner such that a first wash liquid level L1 is kept below drum 12, so that the laundry

will not absorb the wash liquid but will only be moistened by steam.

[0041] A further variant provides for activating a recirculation circuit (not shown in the drawing) for recirculating the wash liquid in washing machine 10, said activation taking place, in particular, when analogue pressure switch 15 detects a predetermined level L of the wash liquid in said tub 11. The recirculation circuit, which in a laundry washing machine terminates at an aperture obtained in the upper portion of tub 11 and serves to improve the soaking of the textile items during the wash treatment, may operate intermittently: in such a case, the recirculation circuit may also be deactivated when analogue pressure switch 15 detects a predetermined lower level L2 of the wash liquid in said tub 11 (wherein L2<L, L2 being preferably a level at which wash liquid heating means are completely immersed in the wash liquid). When a variable-speed motor is applied to the recirculation circuit, it is particularly advantageous to change the flow rate of the wash liquid flowing in the recirculation circuit as a function of the level detected by analogue pressure switch 15.

[0042] Reference has been made in the present description and in the annexed drawing to a household laundry washing machine; it is however clear that washing machine 10 may be a dishwasher and that the present invention is also applicable to said dishwasher. In such a case, the recirculation circuit will be the hydraulic circuit adapted to supply wash liquid to an upper sprayer and/or a lower sprayer.

[0043] It can therefore be easily understood that the present invention is not limited to the above-described method and washing machine, but may be subject to many modifications, improvements or replacements of equivalent parts and elements without departing from the inventive idea, as clearly specified in the following claims.

Claims

1. Method for detecting a level (L, L1, L2) of a wash liquid in a washing machine (10), in particular a household laundry washing machine or dishwasher, comprising:

   - a tub (11) housing a drum (12) adapted to contain a certain quantity of laundry;
   - an analogue pressure switch (15) associated with the tub (11) for detecting the pressure and consequently said level (L, L1, L2) of the wash liquid in said tub (11);
   - means for managing and controlling the washing machine (10),

   said method providing that said analogue pressure switch (15) is subjected to a calibration process, said calibration process being implemented during an operational step of the washing machine (10),

   said method being **characterized in that** it provides for activating a recirculation circuit of the washing machine (10), in particular said activation taking place when said analogue pressure switch (15) detects a predetermined level (L) of the wash liquid in said tub (11).

2. Method according to claim 1, **characterized in that** said recirculation circuit operates intermittently, in particular said recirculation circuit being deactivated when said analogue pressure switch (15) detects a predetermined lower level (L2) of the wash liquid in said tub (11), said lower level (L2) being lower than said predetermined level (L), and said lower level (L2) being preferably such that wash liquid heating means are completely immersed in the wash liquid.

3. Method according to one or more of the preceding claims, **characterized in that** said calibration process comprises the following self-calibration steps:

   a) detecting an initial frequency (F_0) of the analogue pressure switch (15);
   b) supplying wash liquid into the tub (11) of the washing machine (10);
   c) determining a level (L, L1, L2) of the wash liquid in the tub (11) by detecting the variation of frequency (ΔF) of the analogue pressure switch (15) with respect to said initial frequency (F_0).

4. Method according to claim 3, **characterized in that** said initial frequency (F_0) of the analogue pressure switch (15) is detected when the tub (11) of the washing machine (10) contains substantially no wash liquid.

5. Method according to one or more of claims 3 and 4, **characterized in that** said self-calibration steps are repeated on a periodical basis during the operational step of the washing machine (10).

6. Method according to claim 5, **characterized in that** said self-calibration steps are repeated at every beginning and/or end of the wash cycles of each wash program.

7. Method according to claim 5, **characterized in that** said self-calibration steps are repeated every time a wash program implemented by the washing machine (10) is started.

8. Method for detecting a level (L, L1, L2) of a wash liquid in a washing machine (10), in particular a household laundry washing machine or dishwasher, comprising:

   - a tub (11) housing a drum (12) adapted to con-

tain a certain quantity of laundry;
- an analogue pressure switch (15) associated with the tub (11) for detecting the pressure and consequently said level (L, L1, L2) of the wash liquid in said tub (11);
- means for managing and controlling the washing machine (10),

said method providing that said analogue pressure switch (15) is subjected to a calibration process, said calibration process being implemented during an operational step of the washing machine (10),
said method being **characterized in that** it provides for implementing a steam treatment on the laundry contained in the drum (12), in particular said steam treatment being carried out in a manner such that said wash liquid level (L1) is kept below the drum (12).

9. Method according to claim 8, **characterized in that** said calibration process comprises the following self-calibration steps:

a) detecting an initial frequency (F_0) of the analogue pressure switch (15);
b) supplying wash liquid into the tub (11) of the washing machine (10);
c) determining a level (L, L1, L2) of the wash liquid in the tub (11) by detecting the variation of frequency (ΔF) of the analogue pressure switch (15) with respect to said initial frequency (F_0).

10. Method according to claim 9, **characterized in that** said initial frequency (F_0) of the analogue pressure switch (15) is detected when the tub (11) of the washing machine (10) contains substantially no wash liquid.

11. Method according to one or more of claims 9 and 10, **characterized in that** said self-calibration steps are repeated on a periodical basis during the operational step of the washing machine (10).

12. Method according to claim 11, **characterized in that** said self-calibration steps are repeated at every beginning and/or end of the wash cycles of each wash program.

13. Method according to claim 11, **characterized in that** said self-calibration steps are repeated every time a wash program implemented by the washing machine (10) is started.

14. Method according to one or more of the preceding claims, **characterized in that** it provides for activating a recirculation circuit of the washing machine (10),said activation taking place when said analogue pressure switch (15) detects a predetermined level (L) of the wash liquid in said tub (11), in particular said recirculation circuit operating intermittently and said recirculation circuit being deactivated when said analogue pressure switch (15) detects a predetermined lower level (L2) of the wash liquid in said tub (11), said lower level (L2) being lower than said predetermined level (L), and said lower level (L2) being preferably such that wash liquid heating means are completely immersed in the wash liquid.

15. Washing machine (10), in particular a household laundry washing machine, comprising means for managing and controlling the machine (10), in particular an electronic board (20), adapted to implement the method according to one or more of the preceding claims.

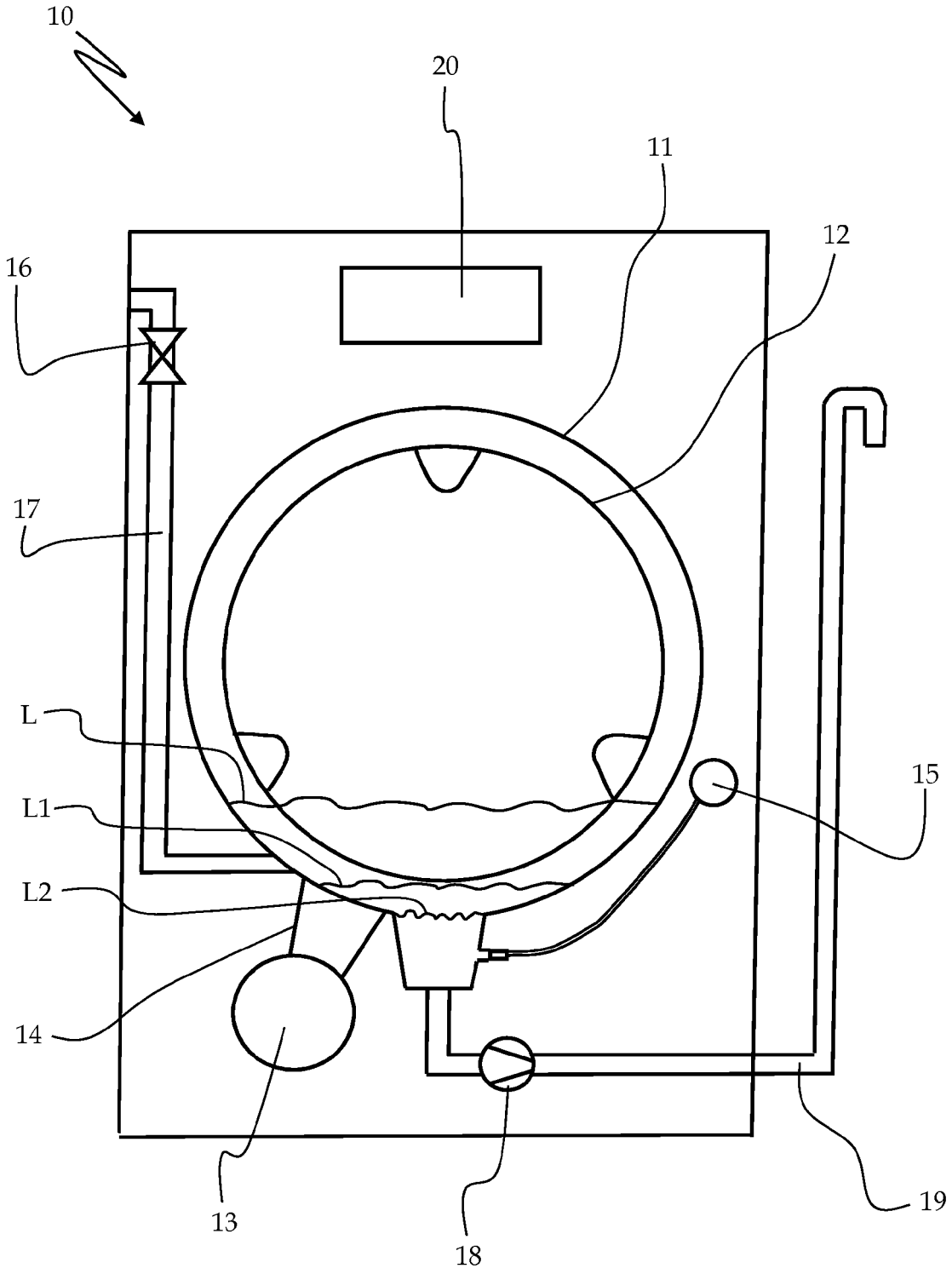

Fig. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 15 15 1838

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	FR 2 641 609 A1 (LICENTIA GMBH [DE]) 13 July 1990 (1990-07-13) * the whole document *	1-15	INV. D06F39/08 A47L15/42
A,D	FR 2 377 614 A (CROUZET SA [FR] CROUZET SA) 11 August 1978 (1978-08-11) * the whole document *	1-15	
A	EP 1 245 714 A (DIEHL AKO STIFTUNG GMBH & CO [DE]) 2 October 2002 (2002-10-02) * the whole document *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)
D06F
A47L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 May 2015	Stroppa, Giovanni

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
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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
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EPO FORM 1503 03.82 (P04C01)

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Application Number
EP 15 15 1838

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☒ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 15 15 1838

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-15

Method for detecting a level (L, Ll, L2) of a wash liquid in a washing machine (10), in particular a household laundry washing machine or dishwasher, comprising:
- a tub (11) housing a drum (12) adapted to contain a certain quantity of laundry;
- an analogue pressure switch (15) associated with the tub (11) for detecting the pressure and consequently said level (L, Ll, L2) of the wash liquid in said tub (11);
- means for managing and controlling the washing machine (10),said method providing that said analogue pressure switch (15) is subjected to a calibration process, said calibration process being implemented during an operational step of the washing machine (10),said method being characterized in that it provides for activating a recirculation circuit of the washing machine (10), in particular said activation taking place when said analogue pressure switch (15) detects a predetermined level (L) of the wash liquid in said tub (11).

1.1. claims: 8-15

Method for detecting a level (L, Ll, L2) of a wash liquid in a washing machine (10), in particular a household laundry washing machine or dishwasher, comprising:
- a tub (11) housing a drum (12) adapted to contain a certain quantity of laundry;
- an analogue pressure switch (15) associated with the tub (11) for detecting the pressure and consequently said level (L, Ll, L2) of the wash liquid in said tub (11);
- means for managing and controlling the washing machine (10),said method providing that said analogue pressure switch (15) is subjected to a calibration process, said calibration process being implemented during an operational step of the washing machine (10),said method being characterized in that it provides for implementing a steam treatment on the laundry contained in the drum (12), in particular said steam treatment being carried out in a manner such that said wash liquid level (Ll) is kept below the drum (12).

Please note that all inventions mentioned under item 1, although not necessarily linked by a common inventive concept, could be searched without effort justifying an additional fee.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 15 1838

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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20-05-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2641609 A1	13-07-1990	DE 3900705 A1	19-07-1990
		FR 2641609 A1	13-07-1990
		IT 1238141 B	09-07-1993
FR 2377614 A	11-08-1978		
EP 1245714 A	02-10-2002	AT 284461 T	15-12-2004
		DE 10115101 C1	30-01-2003
		EP 1245714 A2	02-10-2002
		ES 2231602 T3	16-05-2005

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- FR 2377614 **[0005]**