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

Verfahren zum Erfassen des Füllstands einer Waschflüssigkeit in einer Waschmaschine und entsprechende Waschmaschine

Procédé de détection du niveau d'un liquide de nettoyage dans un lave-linge, et lave-linge associé

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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 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] A further method for determining the water quantity in the washing container of a washing machine is known from FR 2 641 609 A1.

[0007] 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.

[0008] 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.

[0009] 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.

[0010] 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.

[0011] 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 com-

mands 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.

[0012] 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.

[0013] 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.

[0014] In this frame, it is the main object of the present invention to overcome the above-mentioned drawbacks.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] Fig. 1 is a diagrammatic view of a washing machine according to the present invention, designated as a whole by reference numeral 10.

[0021] 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).

[0022] Preferably, said drum 12 is rotatable about a substantially horizontal axis, being in particular driven by a motor 13 and transmission means 14.

[0023] However, for the purposes of the present inven-

tion, drum 12 may also be produced in a way to alternatively rotate about a substantially vertical axis.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] For the purposes of the present invention, an operational step is essentially a step of use of the washing machine by a user.

[0029] 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 .

[0030] 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.

[0031] 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.

[0032] 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.

[0033] 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 .

[0034] Said self-calibration steps are preferably repeated on a periodical basis during the operational step of washing machine 10 according to the present invention.

[0035] 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.

[0036] 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.

[0037] 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.

[0038] 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.

[0039] 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.

[0040] 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.

[0041] 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.

[0042] 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.

[0043] 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.

[0044] 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 analogue pressure switch (15) being subjected to a calibration process, said calibration process being implemented during an operational step of the washing machine (10), **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) when the tub (11) of the washing machine (10) contains substantially no wash liquid;
- 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)

2. Method according to claim 1, **characterized in that** said self-calibration steps are repeated on a periodical basis during the operational step of the washing machine (10).
3. Method according to claim one or more of claims 1 and 2, **characterized in that** said self-calibration steps are repeated at every beginning and/or end of the wash cycles of each wash program.
4. Method according to claim one or more of claims 1 and 2, **characterized in that** said self-calibration steps are repeated every time a wash program implemented by the washing machine (10) is started.
5. Method according to one or more of the preceding claims, **characterized by** implementing a steam treatment on the laundry contained in the drum (12), said steam treatment being in particular carried out in a manner such that said wash liquid level (L1) is kept below the drum (12).
6. 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), 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).
7. Method according to claim 6, **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.
8. 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.

Patentansprüche

1. Verfahren zum Detektieren eines Pegels (L, L1, L2) einer Waschflüssigkeit in einer Waschmaschine (10), insbesondere einer Haushaltswäschewaschmaschine oder einer Geschirrspülmaschine, umfassend:

- einen Bottich (11), der eine Trommel (12) berbergt, die angepasst ist, eine bestimmte Menge von Wäsche zu enthalten;
- einen analogen Druckschalter (15), der mit dem Bottich (11) verbunden ist, zum Detektieren des Drucks und somit des Pegels (L, L1, L2) der Waschflüssigkeit in dem Bottich (11);
- Mittel zum Bedienen und Steuern der Waschmaschine (10), wobei der analoge Druckschalter (15) einem Kalibrierungsprozess unterworfen wird, wobei der Kalibrierungsprozess während eines Betriebschritts der Waschmaschine (10) implementiert ist,

dadurch gekennzeichnet, dass der Kalibrierungsprozess die folgenden Selbstkalibrierungsschritte umfasst:

- a) Detektieren einer initialen Frequenz (F_0) des analogen Druckschalters (15), wenn der Bottich (11) der Waschmaschine (10) im Wesentlichen keine Waschflüssigkeit enthält;
- b) Einspeisen von Waschflüssigkeit in den Bottich (11) der Waschmaschine (10);
- c) Bestimmen eines Pegels (L, L1, L2) der Waschflüssigkeit in dem Bottich (11) durch Detektieren der Veränderung der Frequenz ΔF des analogen Druckschalters (15) in Bezug auf die initiale Frequenz (F_0).

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Selbstkalibrierungsschritte während des Betriebsschritts der Waschmaschine (10) regelmäßig wiederholt werden.
3. Verfahren nach einem oder mehreren der Ansprüche 1 und 2, **dadurch gekennzeichnet, dass** die Selbstkalibrierungsschritte zu jedem Anfang und/oder Ende der Waschzyklen von jedem Waschprogramm wiederholt werden.
4. Verfahren nach einem oder mehreren der Ansprü-

che 1 und 2, **dadurch gekennzeichnet, dass** die Selbstkalibrierungsschritte jedes Mal wiederholt werden, wenn ein Waschprogramm, das durch die Waschmaschine (10) implementiert ist, gestartet wird.

5. Verfahren nach einem oder mehreren der vorangegangenen Ansprüche, **gekennzeichnet durch** ein Implementieren einer Dampfbehandlung der in der Trommel (12) enthaltenen Wäsche, wobei die Dampfbehandlung insbesondere in einer Weise durchgeführt wird, dass der Waschflüssigkeitspegel (L1) unterhalb der Trommel (12) gehalten wird.

6. Verfahren nach einem oder mehreren der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** es ein Aktivieren einer Dauerumlaufschaltung der Waschmaschine (10) vorsieht, wobei die Aktivierung insbesondere stattfindet, wenn der analoge Druckschalter (15) einen vorbestimmten Pegel (L) der Waschflüssigkeit in dem Bottich (11) detektiert.

7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** die Dauerumlaufschaltung intermittierend arbeitet, insbesondere, dass die Dauerumlaufschaltung deaktiviert wird, wenn der analoge Druckschalter (15) einen vorbestimmten unteren Pegel (L2) der Waschflüssigkeit in dem Bottich (11) detektiert, wobei der untere Pegel (L2) niedriger ist als der vorbestimmte Pegel (L), und wobei der untere Pegel (L2) bevorzugt so ist, dass Waschflüssigkeit vollständig in der Waschflüssigkeit eingetaucht sind.

8. Waschmaschine (10), insbesondere eine Haushaltswäschewaschmaschine, umfassend Mittel zum Bedienen und Steuern der Maschine (10), insbesondere eine elektronische Platine (20), die angepasst sind, das Verfahren nach einem oder mehreren der vorangegangenen Ansprüche zu implementieren.

Revendications

1. Procédé de détection d'un niveau (L, L1, L2) d'un liquide de lavage dans une machine à laver (10), en particulier dans un lave-linge ou un lave-vaisselle domestique, comportant :
- une cuve (11) logeant un tambour (12) conçu pour contenir une certaine quantité de linge ;
 - un pressostat analogique (15) associé à la cuve (11) pour détecter la pression et, en conséquence, ledit niveau (L, L1, L2) du liquide de lavage dans ladite cuve (11) ;
 - des moyens de gestion et de commande de la machine à laver (10), ledit pressostat analogique (15) étant soumis à

un processus de calibrage, ledit processus de calibrage étant mis en oeuvre pendant une étape fonctionnelle de la machine à laver (10), **caractérisé en ce que** ledit processus de calibrage comprend les étapes d'auto-calibrage suivantes :

- a) détection d'une fréquence initiale (F_0) du pressostat analogique (15) lorsque la cuve (11) de la machine à laver (10) ne contient essentiellement aucun liquide de lavage ;
- b) distribution de liquide de lavage dans la cuve (11) de la machine à laver (10) ;
- c) détermination d'un niveau (L, L1, L2) du liquide de lavage dans la cuve (11) en détectant la variation de fréquence ΔF du pressostat analogique (15) par rapport à ladite fréquence initiale (F_0).

2. Procédé selon la revendication 1, **caractérisé en ce que** lesdites étapes d'auto-calibrage sont répétées sur une base périodique pendant l'étape fonctionnelle de la machine à laver (10). 20
3. Procédé selon l'une ou plusieurs des revendications 1 et 2, **caractérisé en ce que** lesdites étapes d'auto-calibrage sont répétées à chaque début et/ou fin des cycles de lavage de chaque programme de lavage. 25
4. Procédé selon l'une ou plusieurs des revendications 1 et 2, **caractérisé en ce que** lesdites étapes d'auto-calibrage sont répétées à chaque fois qu'un programme de lavage mis en oeuvre par la machine à laver (10) est démarré. 30
5. Procédé selon l'une ou plusieurs des revendications précédentes, **caractérisé par** la mise en oeuvre d'un traitement à la vapeur du linge contenu dans le tambour (12), ledit traitement à la vapeur étant, en particulier, réalisé d'une manière telle que ledit niveau de liquide de lavage (L1) est maintenu au-dessous du tambour (12). 35
6. Procédé selon l'une ou plusieurs des revendications précédentes, **caractérisé en ce qu'il** prévoit l'activation d'un circuit de recirculation de la machine à laver (10), ladite activation se produisant en particulier lorsque ledit pressostat analogique (15) détecte un niveau prédéterminé (L) du liquide de lavage dans ladite cuve (11). 40
7. Procédé selon la revendication 6, **caractérisé en ce que** ledit circuit de recirculation fonctionne de façon intermittente, en particulier ledit circuit de recirculation étant désactivé lorsque ledit pressostat analogique (15) détecte un niveau inférieur prédéterminé (L2) du liquide de lavage dans ladite cuve (11), ledit niveau inférieur (L2) étant plus bas que ledit niveau 45

prédéterminé (L), et ledit niveau inférieur (L2) étant, de préférence, tel que des moyens de chauffage du liquide de lavage sont entièrement immergés dans le liquide de lavage.

8. Machine à laver (10), en particulier un lave-linge domestique, comportant des moyens de gestion et de commande de la machine (10), en particulier une carte électronique (20), conçue pour mettre en oeuvre le procédé selon l'une ou plusieurs des revendications précédentes. 50

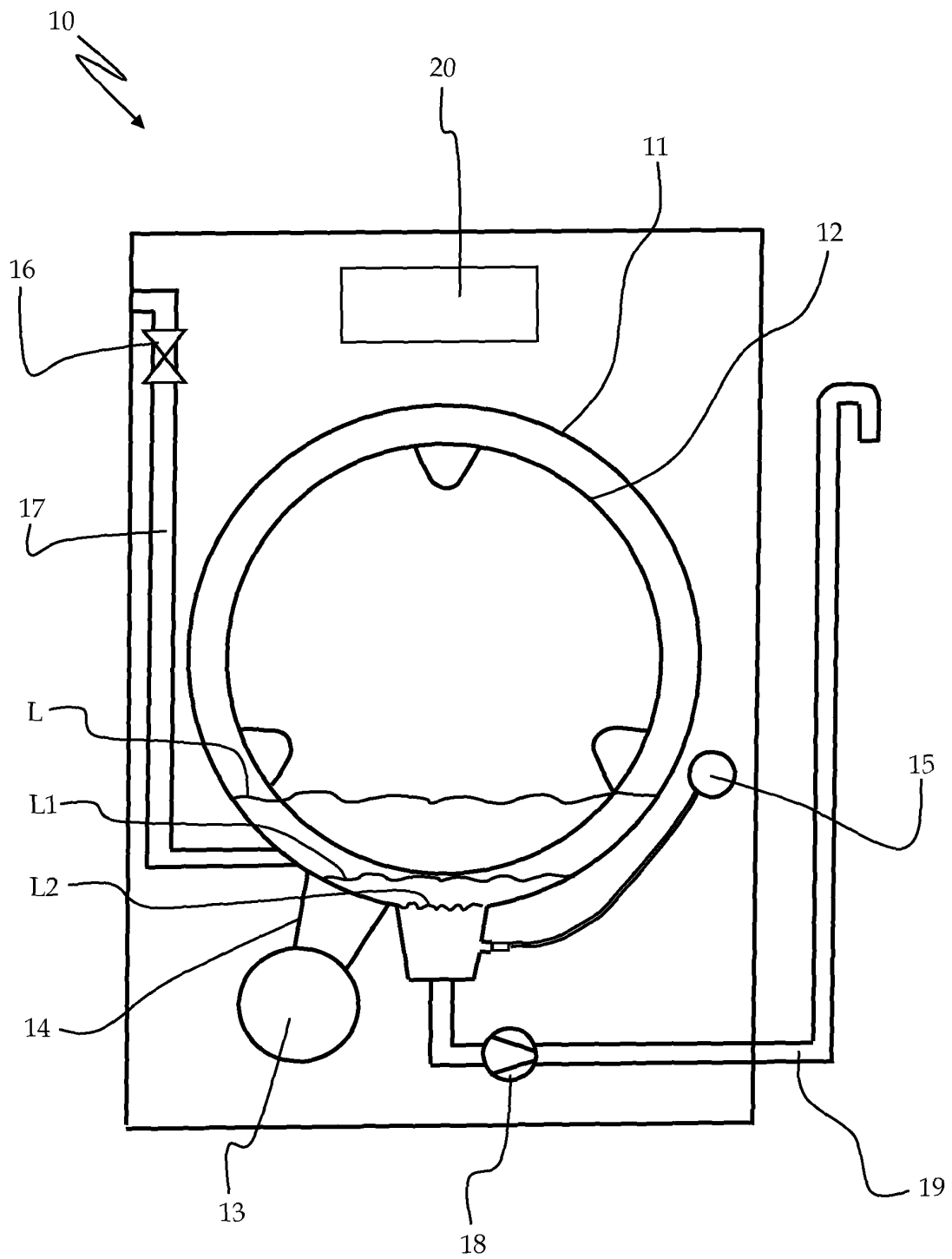


Fig. 1

REFERENCES CITED IN THE DESCRIPTION

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