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

(11) EP 0 711 860 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
15.05.1996 Bulletin 1996/20

(51) Int. Cl.[6]: **D06F 35/00**

(21) Application number: **95116722.0**

(22) Date of filing: **24.10.1995**

(84) Designated Contracting States:
DE ES FR GB IT SE

(30) Priority: **08.11.1994 IT PN940066**

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(54) Improvement in the spin-extraction phase of a clothes washing machine

(57) Clothes washing machine, particularly for residential use, comprising a washing tub, an outlet conduit arranged under said tub, an analogue pressure sensor adapted to measure the pressure existing in a lower level of said conduit, a drain pump adapted to discharge the liquor contained in said conduit outside, wherein during the spin-extraction phase the drain pump is stopped at regular intervals, a waiting period being started each time that the operation of said pump is restored and said pressure being detected at the end of such waiting period. This operating sequence is repeated several times, the pressure difference being calculated on the basis of the pressure values detected in two subsequent measurement moments for each one of said sequences and then compared with a pre-determined value.

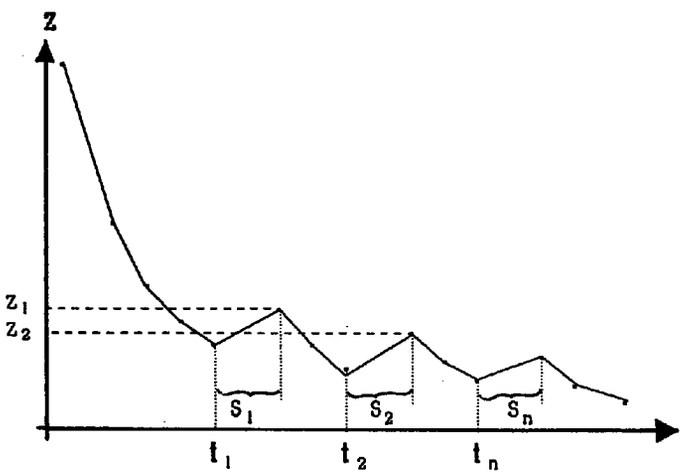

Fig. 2

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Description

The present invention refers to a clothes washing machine, in particular a household-type clothes washing machine, provided with improved means for performing the spin-extraction phase of its washing cycle.

Washing machines are known in the art, which operate under control of means adapted to control the sequence of their operating cycle that usually comprises, at the end of the washing and rinsing phases, a spin-extraction phase performed at a high revolution speed of the rotating drum so as to remove as much moisture as possible from the washload in view of reducing as much as possible the time required for subsequently drying the clothes, regardless of the manner in which such drying is actually performed, ie. whether it is done in a power-operated clothes drying machine or in a more traditional way by spreading and hanging the clothes on the line in a dry environment.

Said spin-extraction phase is controlled by said programme sequence controlling means which determine the spin-extraction time that, since it is pre-set in said programme sequence controlling means, has a fixed length and does therefore not take into any account the actual degree of moisture removal reached by the washload during the spin-extraction phase.

It has been observed that, under certain particular conditions, such as for instance when handling either fabrics that normally retain only small amounts of liquor or small washloads, or even when operating at the much higher spin-extraction speeds that can be attained by the latest washing machine models, the desired final moisture removal degree is reached much in advance of the pre-set end of the spin-extraction phase, so that the final portion of said spin-extraction phase is actually of no practical use. This brings of course about a significant waste of both time and energy. Furthermore, the machine is caused to unnecessarily undergo mechanical stresses under an avoidable addition of wear and tear.

It would therefore be desirable, and is actually a main purpose of the present invention, to provide a clothes washing machine which is so arranged as to be capable of automatically determining the degree of moisture removal from the washload and stopping the spin-extraction phase as soon as the desired moisture removal degree is reached, by to this aim making use of most simple and reliable methods, inexpensive component parts and readily available techniques.

The invention will be more clearly understood from the description which is given below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a schematic representation of the various component parts involved by the invention in a clothes washing machine;
- Figure 2 shows a diagram illustrating an example of operation of the spin-extraction phase according to the present invention.

In the course of the following description, the general term "water" will be used to indifferently mean both the washing and the rinsing liquor. However, such a simplification should not impair the lucidity of the exposition, considering the context in which the term is used, as anyone skilled in the art will readily appreciate.

With particular reference to Figure 1, which illustrates a preferred embodiment of the present invention, a solution according to the present invention is explained along with the related operating principle.

The described clothes washing machine comprises a washing tub 1, a rotating drum 2 arranged within said washing tub and adapted to hold the washload 3, an electric motor (not shown) connected with said rotating drum and adapted to drive it at variable, pre-selectable revolution speeds.

To these component parts, all other state-of-art elements of the washing machine which, although not specifically shown in the drawing, contribute to the establishment of the conditions required for a correct operation of the system, need also to be duly considered in this connection.

Underneath said washing tub there is provided an outlet conduit 5 which is arranged in a substantially vertical manner and is adapted to communicate, at its upper end, with the inside of said tub, a drain pump 6 being further connected therewith at its lower end.

During the phase in which the washload is caused to undergo spin-extraction following the washing and rinsing phases, said drain pump is kept constantly operating so as to enable it to continuously exhaust the water as it is extracted from the washload owing to the centrifugal force imparted by the high-speed rotation of the drum, said water falling down onto the bottom of the tub and entering the thereto connected outlet conduit which in turn delivers it to said pump.

In order to eliminate the afore mentioned drawback of a spin-extraction cycle going on well beyond the actual moisture removal needs, the present invention starts from the practical observation that, when a spin-extraction phase is started, there is a continuous downflow of water occurring in said outlet conduit 5, while the flow rate of said water tends to progressively diminish as the amount of residual moisture in the washload undergoing spin-extraction becomes smaller.

However, the flow rate of the drain pump is usually greater than the actual flow of water brought about by a spin-extraction and this, once that the initial transient state when the washing tub is being emptied, is instrumental in preventing a head of spin-extracted water from forming inside said conduit above the drain pump.

The invention consists in causing the operation of the drain pump to be stopped in a sequence of successive moments t1, t2, ...tn for correspondingly pre-set periods of time S1, S2, ...Sn, while the actual spin-extrac-

tion action is on the contrary allowed to go on uninterruptedly in the usual way.

As a consequence, during said periods of time S1, S2, ...Sn in which the drain pump is switched off, the spin-extracted water continues to flow into said outlet conduit, but is no longer discharged by the pump, so that it starts to accumulate and form the head Z, the level of which increases progressively as said water keeps flowing into said conduit.

When the drain pump is then switched on again to restore its operation, the water accumulated in the conduit is quickly discharged and the outlet conduit is therefore emptied.

If this on-off cycle is performed so as to discontinue and restore the operation of the drain pump in a sequence of successive moments t1, t2, ...tn, and for correspondingly pre-set periods of time S1, S2, ...Sn, an alternating pattern will be observed in the behaviour of the level of the water head Z in said outlet conduit, as this is best shown in Figure 2.

It has been in fact observed experimentally that, under the above described conditions of operation, the curve of the level of the water head Z versus time shows a kind of saw-toothed profile, as it on the other hand was to be expected.

However, owing to the amount of residual water in the washload decreasing gradually, also the flow rate of spin-extracted water tends to decrease in the same way, so that the highest water heads that are to be observed at the end of the respective periods of time during which the operation of the drain pump is discontinued, will rise to levels H1, H2, ...Hn the height of which decreases in an increasingly gradual manner, until it changes only slightly, as it is best illustrated in Figure 2, in the case of similarly long periods of time S1, S2, ...Sn.

If it can therefore be experimentally determined in advance that, with a given washload and a given clothes washing machine, the spin-extraction phase may be considered as being concluded when the rate of flow of the spin-extracted water from the washload decreases below a pre-determined value, it will in such a case be possible to correlate said rate of flow of the spin-extracted water with the amount of water let into the outlet conduit and not ejected therefrom by the drain pump at the end of given intervals and, as a result, with the highest level attained each time by the water head during said intervals.

It is therefore possible, by means of an analogue level sensor, such as an analalogue pressure switch widely available on the market, connected through a bell-type trap 9 to a point situated in the lower portion of said conduit, as well as processing, storage and control means (not shown) suitably connected to the driving motor, the drain pump and said analogue level sensor 8, to define a whole set of such operating conditions that, when checked and processed, they can be considered as actually representing the desired "wring-out" condition of the washload and can therefore be used to cause the motor driving the rotating drum at its high spin-extraction speed to automatically stop its operation.

As a result, a clothes washing machine which is equipped in the above indicated manner is actually enabled to continuously monitor the progressive evolution of the spin-extraction action on the washload, and the resulting gradual reduction of the flow of water extracted from the washload, through a sequence of successive measurements of the amount of water being let into the outlet conduit, as well as to automatically stop the spin-extraction phase as soon as the desired water removal from the washload is attained, thereby preventing said spin-extraction phase from being protracted unnecessarily.

It will be appreciated that this basic solution of the problem is such as to allow for a number of variants and improvements as it may appear to be adequate. For instance, a first variant may consist in detecting and processing not the highest absolute height reached by the water head at the end of the various intervals, ie. the periods of time during which the operation of the drain pump is discontinued, but the differences between the highest absolute heights Z1, Z2 detected at the end of two successive intervals, for a plurality of pairs of such successive intervals.

It is possible to determine experimentally, and for different washload conditions, a value of said difference between the highest levels reached by successive water heads in the outlet conduit, which value corresponds to the condition of "spin-extraction completed", in such a way that, when said difference is detected, said means can intervene automatically to bring the spin-extraction phase to an end.

Such a variant has the advantage that the difference between successive highest levels attained by the water head in the outlet conduit eliminates by compensation all factors that may undesirably affect the highest level attainable by said water head and, therefore, cause a wrong information to be detected by the system.

A second variant consists in arranging things so that said periods of time S1, S2, ...Sn are not equal to each other, as this would certainly be much simpler to implement, but have a differing length instead, said length preferably increasing in a progressive manner for the periods of time following the first one. This enables adequately high levels to be reached by the water head even during the last portions of the spin-extraction phase, since longer-lasting switch-off intervals of the drain pump make up for a decreasing rate of flow of spin-extracted water into the outlet conduit, and therefore a more slowly increasing level of the water head in the same outlet conduit, thereby eliminating the risk that the highest level reached by the water head at the end of a switch-off interval may remain below the value detected by the level sensor, so that the actual difference between the successive heads involved would not be detected and duly processed by the control means.

It will be appreciated that further technical solutions and improvements may be derived by those skilled in the

art from the teaching of the present description by using techniques and knowledges that are readily available in the art. Therefore, although the present invention has been described here using a generally known terminology, it shall by no means be considered as being limited by the described examples.

Claims

1. Clothes washing machine comprising a washing tub (1), a drum (2) rotatably arranged within said tub and adapted to hold the washload (3), an electric motor capable of rotatably driving said drum at different revolution speeds including the spin-extraction speed, an outlet conduit (5) provided underneath said washing tub, analogue level measurement means (8) adapted to measure the level of water existing in said outlet conduit (5), a drain pump (6) adapted to discharge outside the liquor contained in said conduit, **characterized in that** during the spin-extraction phase the operation of said drain pump (5) is interrupted in correspondence of a plurality of successive moments (t1, t2 ...tn) for correspondingly pre-set periods of time (S1, S2, ...Sn), said spin-extraction phase being further brought to an end when the level of the water head (Z) detected at the end of said periods of time decreases below a predetermined value.

2. Clothes washing machine, in particular of the household type, comprising a washing tub (1), a drum (2) rotatably arranged within said washing tub and adapted to hold the washload (3), an electric motor capable of rotatably driving said drum at different revolution speeds including the spin-extraction speed, an outlet conduit (5) provided underneath said washing tub, analogue level measurement means (8) adapted to measure the level of water existing in said outlet conduit (5), a drain pump (6) adapted to discharge outside the liquor contained in said conduit, **characterized in that** during the spin-extraction phase the operation of said drain pump (5) is interrupted in correspondence of a plurality of successive moments (t1, t2 ...tn) for correspondingly pre-set periods of time (S1, S2, ...Sn), the value of the level reached by the water head (Z2) being detected and stored at the end of each switch-off interval of the drain pump, said value of the level of the water head being then compared with the value of the level reached by the water head (Z1) in the preceding switch-off interval, and said spin-extraction phase being brought to an end when the difference between the values of the level of said water heads (Z1, Z2) is smaller than a pre-established value.

3. Clothes washing machine according to claim 1 or 2, **characterized in that** said periods of time (S1, S2, ...Sn) are of a length that increases progressively for the periods following the first one.

4. Clothes washing machine according to any of the preceding claims, **characterized in that** said analogue level measurement means (8) are analogue pressure switches coupled to a bell-type air trap (9) connected to a lower point of said outlet conduit.

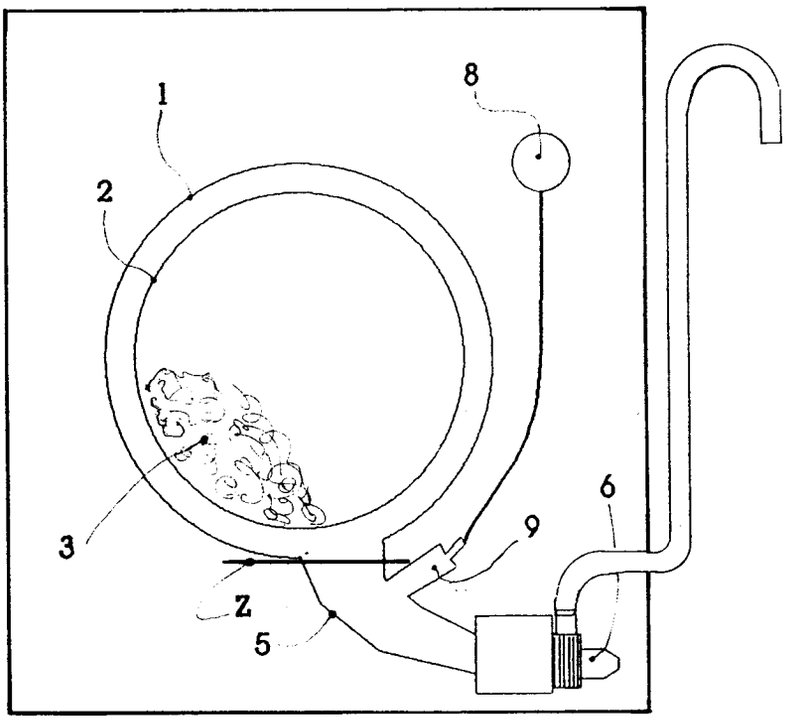

Fig. 1

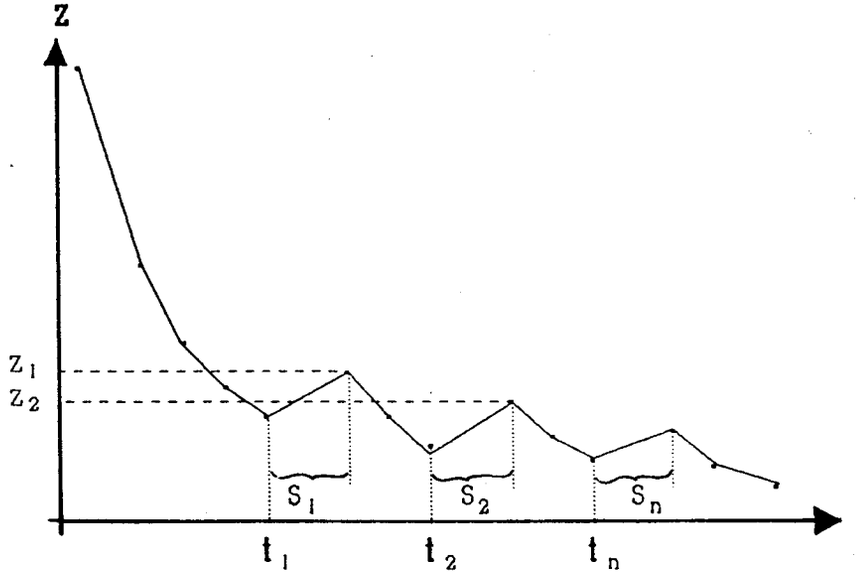

Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 11 6722

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP-A-0 553 645 (ZANUSSI ELETTRODOMESTICI S.P.A.) * the whole document * ---	1-4	D06F35/00
A	DE-A-40 12 115 (LICENTIA PATENT-VERWALTUNGS-GMBH) * the whole document * -----	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 February 1996	Courrier, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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