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(54) **Device for locking a door, particularly of a washing machine.**

(57) The device for locking a door, particularly usable in a washing machine, comprises means (12) for actuating a pawl (11) in a door locking and unlocking position, during the operation of the washing machine, which are activated and deactivated by the variation in the pressure inside the washing machine's discharge duct (10) for a preset time which is not shorter than the time for which the drum (3) of the washing machine rotates faster than the safety speed.

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DEVICE FOR LOCKING A DOOR, PARTICULARLY A WASHING MACHINE

The present invention relates to a device for locking a door, particularly of a washing machine.

As is known, various devices are currently used in washing machines to prevent the opening of their door both when there is water in the tank and during the rotation of the drum at a speed which exceeds the limit speed and is deemed dangerous by currently applicable rules.

In the first case, in order to ensure the locking of the door of the washing machine when there is water inside the washing machine's tank above the limit level of the lower edge of the door, the pressure created by the water head present in the duct of a pressure switch is used so that said pressure switch activates a door locking pawl.

In the second case, in order to ensure the locking of the door also during the rotation of the washing machine's drum when said drum rotates at a speed in excess of the limit speed, various systems are currently used, based for example on the use of speed sensors, speedometer dynamos, small air compressors driven by the main motor of the washing machine, and others.

However, all these systems have a high installation cost and poor reliability in operation.

Therefore, current washing machines presently have electromagnetic, electrothermal or similar safety systems for the locking of their door, all of which act on a door locking pawl.

Said devices, however, are active only if they are powered by an electric voltage, so that if said voltage is lacking they are deactivated, consequently unlocking the door.

In order to obviate this disadvantage, thermal, pneumatic, inertial or electronic devices for delaying the deactivation of the locking of the door for the time required by the drum of the washing machine to reduce its speed below the safety limit value are resorted to.

Although these last delay devices partially solve the above described disadvantages related to safety devices, since various types of washing machine with different spin-dry speeds and different dynamic characteristics are currently commercially available, said devices must be set by the manufacturer with wide safety margins in excess of the maximum time presumed necessary for any washing machine drum to reduce its speed below the safety limit speed.

Furthermore, depending on the washing cycles and on the technical-functional characteristics of each washing machine, it is necessary to take into account the variability of the delay times due to the different temperatures reached during the operation of the machine.

The consequence of the above is that sometimes the user of the washing machine must wait for an even rather long period of time before the door of the machine is unlocked, or worse, for example in the case of particularly unfavorable operating conditions of the washing machine, the door often locks permanently.

The aim of the present invention is to eliminate the above described disadvantages of devices for locking the door of a washing machine which belong to the known art.

Within the scope of this technical aim, an important object of the present invention is to provide a device for locking a door particularly of a washing machine which is activated or deactivated directly by a physical value, for example by the pressure which occurs in the discharge duct of the washing machine itself.

Another object of the invention is to provide a device for locking a door particularly of a washing machine which can be activated in advance with respect to the beginning of the rotation of the drum of the machine and remains in this condition until the drum reaches the safety speed prescribed by the currently applicable rules on the subject.

Not least object of the invention is to provide a device for locking a door particularly of a washing machine which furthermore allows to give an electric signal enabling the start of the spin-dry operation only if the door has been locked first.

This aim, these objects and others are achieved by a device for locking a door particularly of a washing machine, comprising means for the actuation of a pawl in a position for locking and unlocking the door of the washing machine during its operation, characterized in that said actuation means are activated and deactivated by the pressure variation in the discharge duct of said washing machine for a preset time which is not shorter than the time during which the drum of said washing machine rotates faster than the safety speed.

Further characteristics and advantages of the invention will become apparent from the description of a preferred but not exclusive embodiment of the device for locking a door particularly of a washing machine according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figures 1 and 2 are schematic transverse sectional views of the essential elements of a washing machine, respectively during discharge and when idle.

With reference to Figure 1, which illustrates the operation of the washing machine during discharge, the locking device according to the invention is

generally indicated by the reference numeral 1 and is applied to a washing machine of which the main elements are schematically shown; more precisely, a tank, indicated by the numeral 2, inside which a drum 3 rotates in a per se known manner and is driven by a motor 4 by means of a transmission belt 5.

A discharge pipe 6 is furthermore provided on the bottom of the tank 2 and is directly connected to a filter 7 for preventing the passage of foreign matter into the discharge pump 9.

As is known, the discharge pump 9 draws the water from the tank 2 and introduces it into the discharge duct 10, the discharge outlet whereof is normally at a level which is necessarily higher than the maximum level reached by the water inside the tank 2.

In particular, the locking device according to the invention comprises, in a per se known manner, actuation means, and more precisely a pressure switch 12 which acts on a pawl 11 to move it to a position for locking and unlocking the door of the washing machine, which is not illustrated, in the presence of water in the tank 2 above the limit level, using the pressure created by the water head in the pipe 19 of the pressure switch even when the discharge pump 9 is not working.

Advantageously, since the pipe 19 of the pressure switch senses the pressure downstream with respect to the discharge pump 9, during the discharge of the water from the tank 2 the discharge pump 9 furthermore maintains the necessary pressure for the activation of the pressure switch independently of the amount of water present in the tank.

In other words, the pressure switch causes the movement of the pawl 11 and therefore the locking of the door of the washing machine both when water is present inside the tank and also when the tank is half-empty, by virtue of the pressure generated by the actuation of the discharge pump of the washing machine.

Furthermore, so that the pressure switch keeps the door locked even when the discharge pump of the washing machine is deactivated at the end of the cycle, the device according to the invention has auxiliary means, generally indicated by 14, which are suitable for maintaining the necessary pressure in the pipe 19 of the pressure switch so that it keeps the door of the washing machine locked during the rotation of the drum 3 inside the tank 2.

More precisely, the auxiliary means 14 may be of any type: electromagnetic, electrothermal, pneumatic, etc.

In a preferred solution, said auxiliary means comprise an impeller 15 which is keyed on the shaft of the motor 4 which is suitable for rotating the drum 3 of the washing machine by means of the transmission belt 5.

The impeller 15 is connected, through a channel 18, to the discharge duct 10 of the washing machine, from which it draws water so as to pressurize it in the pipe 19 filled with air with which the pressure switch 12 is associated.

Substantially, therefore, even when the discharge pump of the washing machine is deactivated at the end of the spin-dry cycle, the impeller 15, which is still rotating while the drum slows down, maintains the drawing of the residual water in the discharge duct 10, pressurizing it inside the pipe 19 and therefore maintaining a sufficient pressure value in the pipe 19 for the activation of the pressure switch 12, which therefore keeps the door of the washing machine locked.

Advantageously, it is furthermore possible to associate with the pressure switch 12 a switch 20 which is suitable for enabling the rotation of the drum 3 of the washing machine to perform the spin-drying operation only if the discharge pump is operating and therefore if the door is locked.

From the above description it can be seen that the activation of the pressure switch 12, and therefore the locking of the door, are produced initially by the pressure created by the water 8 in the tank 2, then by the discharge pump during the tank emptying step which always precedes spin-drying, and finally by the rotation of the impeller 15 which is rotated by the motor 4 during the spin-dry operation, which maintains said pressure until the drum has reduced its speed below the limit value.

The sequentiality of the operation of the door lock furthermore allows, as mentioned, to associate with the pressure switch 12 a switch 20 which, by closing after the door has been locked, produces the electric signal which enables the start of the spin-dryer, so as to define an intrinsic safety of all the device, since the spin-dryer can never be operated if the discharge pump is not operating and if the door of the washing machine is not locked.

The operation of the device according to the invention is evident from what has been described and illustrated.

In particular, when the washing machine is idle, there is always an amount of residual water in the filter and in the discharge pump, and said amount is more or less at the level indicated by the numeral 30 in Figure 2, which illustrates the washing machine when idle.

This amount of water is sufficient to activate the discharge pump, allowing the locking process of the pressure switch, with the protrusion of the locking pawl 11 and the closure of the enabling switch 20 if the washing machine starts with a program comprising only spin-drying, which is obviously always associated with the operation of the discharge pump.

At the end of the operation of the discharge pump, during the spin-drying step, the special pump defined by the impeller 15 continues to operate and maintains the locking pressure in the pipe 19 of the pressure switch until the drum slows to less than the safety speed limit.

This cycle is repeated every time a spin-drying step is performed, either on its own or within, and at the end of, a complete washing cycle.

In practice it has been observed that the device according to the invention is particularly advantageous in that it defines a safety system with direct locking of the door which uses the pressure created by the impeller 15 in the discharge duct both in association with the discharge pump 9 and on its own.

This pressure is obviously closely linked to the rotation rate of the drum and therefore gives the device high precision, reliability and intrinsic operating safety by means of the advance of the operation of the impeller 15 in relation to the discharge pump 9 on the spin-dry motor 4 and therefore on the impeller 15, and by virtue of the fact that both the discharge pump 9 and the impeller 15 are mutually interconnected and are connected to the pipe 19 for activating the pressure switch 12 for locking the door of the machine.

The invention thus conceived is susceptible to numerous modifications and variations, all of which are within the scope of the inventive concept; for example, in replacement of the impeller 15 it is possible to apply a known delay system, such as for example an electromagnetic, electrothermal or pneumatic device, in cooperation with the pressure which the washing machine's discharge pump creates on the pressure switch.

All the details may furthermore be replaced with technically equivalent elements.

In practice, the materials employed, as well as the dimensions, may be any according to the requirements and to the state of the art.

WHERE TECHNICAL FEATURES MENTIONED IN ANY CLAIM ARE FOLLOWED BY REFERENCE SIGNS, THOSE REFERENCE SIGNS HAVE BEEN INCLUDED FOR THE SOLE PURPOSE OF INCREASING THE INTELLIGIBILITY OF THE CLAIMS AND ACCORDINGLY, SUCH REFERENCE SIGNS DO NOT HAVE ANY LIMITING EFFECT ON THE SCOPE OF EACH ELEMENT IDENTIFIED BY WAY OF EXAMPLE BY SUCH REFERENCE SIGNS.

Claims

1. Device for locking a door, particularly of a washing machine, which comprises means (12) for actuating a pawl (11) in a position for locking and unlocking the door of the washing machine during its operation, characterized in that said actuation means (12) are activated and deactivated by the variation in the pressure in the discharge duct (10) of said washing machine for a preset time which is not shorter than the time during which the drum (3) of said washing machine rotates faster than the safety speed.

2. Locking device according to claim 1, characterized in that said actuation means comprise a pressure switch (12) for actuating said pawl (11), said pressure switch being activated both by the pressure generated by the level of the water which is present in the tank (2) of said washing machine and by the discharge pump (9) of said washing machine in order to maintain said pressure suitable for activating said pressure switch independently of the level of said water in said tank.

3. Locking device according to claims 1 and 2, characterized in that it comprises auxiliary means (14) for maintaining said pressure suitable for activating said pressure switch (12) during the rotation of said drum (3) faster than the safety speed when said discharge pump (9) is deactivated.

4. Locking device according to claim 3, characterized in that said auxiliary means comprise at least one electromagnetic, electrothermal or pneumatic device.

5. Locking device according to claim 3, characterized in that said auxiliary means comprise an impeller (15) which is rigidly associated with the motor (4) of said drum (3) and is connected on one side to the discharge duct (10) of said washing machine, which extends from said discharge pump (9), and on another side to said pressure switch (12).

6. Locking device according to claim 5, characterized in that said impeller (15) draws the water to be sent to said pressure switch below the residual water level (30) of said discharge pump even when said discharge pump is deactivated.

7. Locking device according to claims 1 and 2, characterized in that it comprises a switch (20) which is associated with said pressure switch and is suitable for activating the rotation of said drum in the spin-drying operation only if said door is locked.

8. Locking device according to claim 2, char-

acterized in that said discharge pump acts on said pressure switch to lock said door during the discharge of said water prior to said spin-drying operation.

9. Process for locking a door of a washing machine by means of a pressure switch for the actuation of a pawl which locks said door, characterized in that it consists in activating said pressure switch by applying thereto a preset pressure independently of the presence of water inside the drum supporting tank of said washing machine for a time which is substantially not shorter than the rotation of said drum faster than the safety speed during the spin-drying operation of said washing machine.

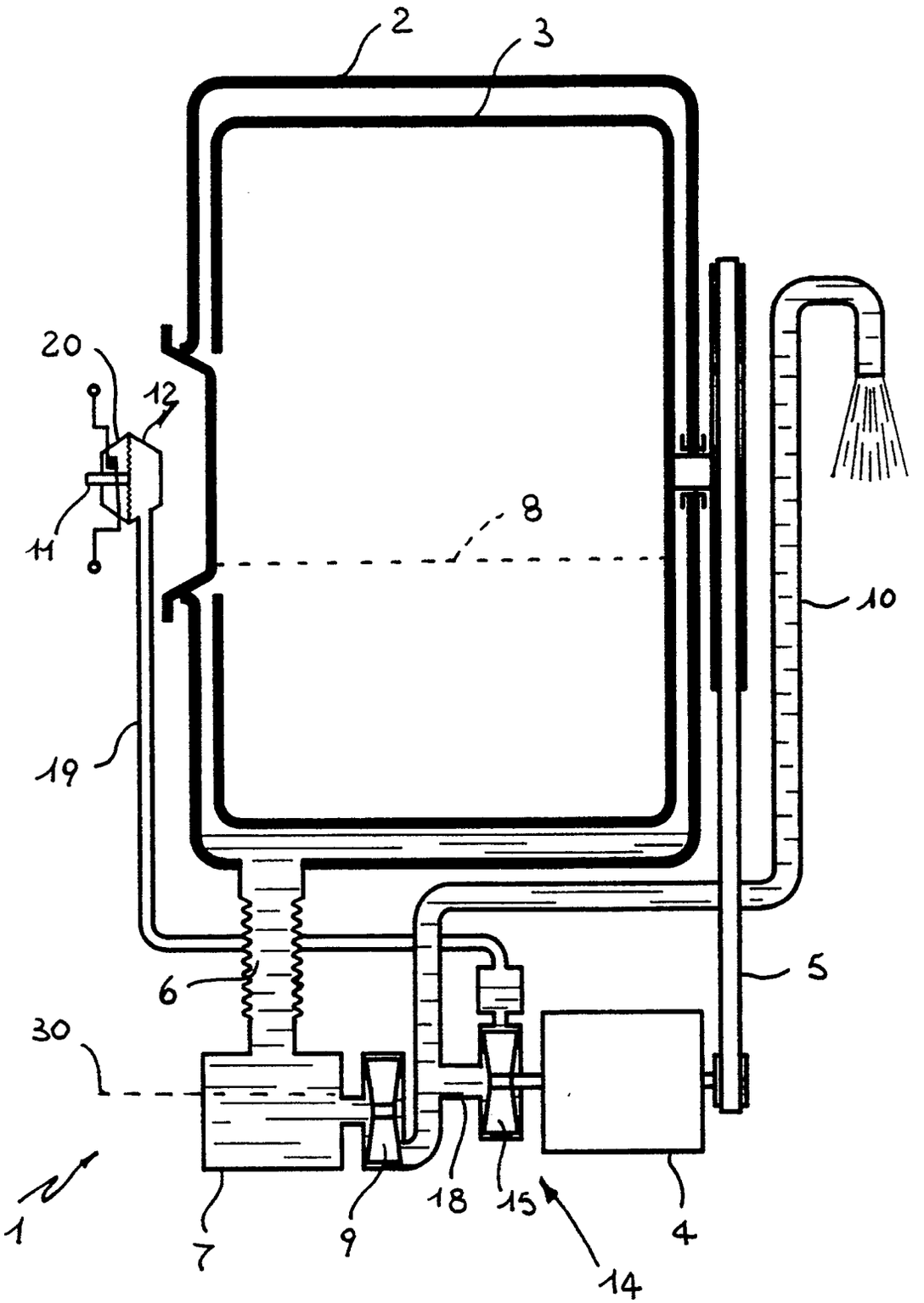

FIG. 1

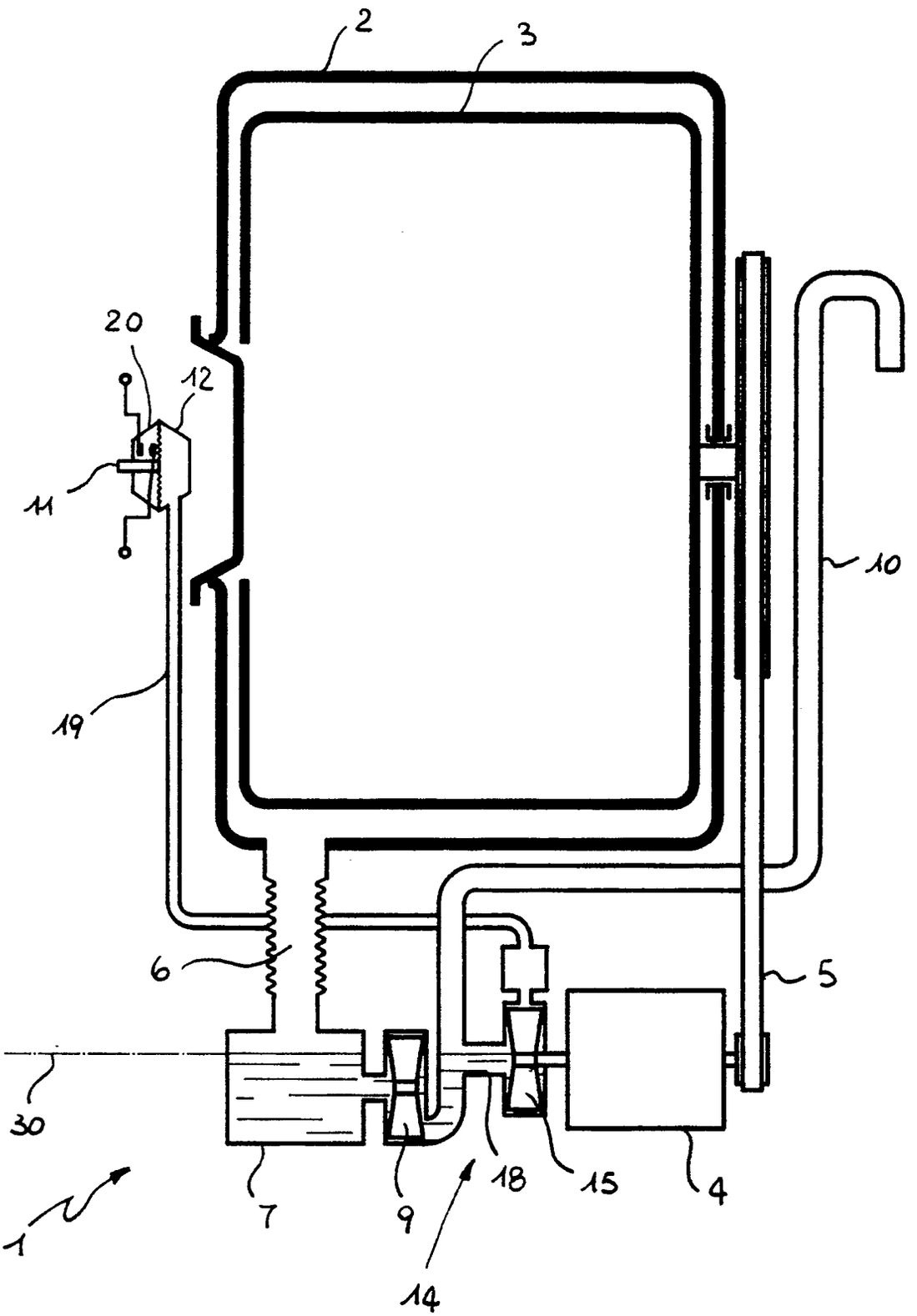

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number

EP 90 12 5224

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.5)
X,A	FR-A-2 261 430 (EUROPE MANUFACTURING TRUST REG.) * page 2, line 32 - page 3, line 40 * * page 4, lines 12 - 24 *	9,1-4	D 06 F 37/42
A	DE-B-1 218 394 (HERMANN ZANKER K.G.) * column 2, line 29 - column 3, line 32 *	1,2,8,9	
A	FR-A-2 268 896 (INDUSTRIE A. ZANUSSI S.P.A.) * page 6, line 15 - page 8, line 8 *	1,2,8	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D 06 F

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	10 April 91	GOODALL C.J.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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A: technological background
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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
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