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(54) A MACHINE FOR WASHING AND SPIN-DRYING LAUNDRY

(71) We, THOMSON-BRANDT, a French Body Corporate, of 173, Boulevard Haussmann, 75008 Paris, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a drum washing machine for washing and spin-drying laundry.

A drum washing machine generally has one or more electric motors which for washing drive the laundry drum in rotation at a speed of substantially 50 rpm and for spin-drying cause a predetermined increase in the speed of the drum from 50 rpm to a value equal to or greater than 800 rpm. When the drum is rotating at high speed for spin-drying, if the laundry is incorrectly distributed in the drum this usually gives rise to an imbalance which causes vibration and oscillations which are sometimes severe and often damaging to the machine. When the machine is operating normally, the programme device governs the passage from a low speed of rotation of the drum to a high speed to follow a predetermined pattern.

In this pattern there is frequently a phase provided in which conditions are brought about, which assist in distributing the laundry properly in the drum, such as a certain speed of rotation of the laundry drum, a certain water level in the tank, and so on. It may however happen that the machine is accidentally switched directly to the high spin-drying speed without passing through the phase which assists in distributing the laundry in the drum, or else there may be an interruption in the spin drying operation, as a result of a breakdown in the current supply to the machine for example, and the machine may be automatically returned to spin drying operation when the current supply is restored. When this is the case the laundry, which is either improperly distributed or has become improperly distributed in the drum, produces the disadvantageous consequences already mentioned above.

The present invention, has as an object to overcome these disadvantages.

Accordingly the present invention consists in a drum washing machine operative to wash at a drum speed of substantially 50 rpm and to spin-dry with the drum rotating at speeds ranging from substantially 50 rpm to a value equal to or greater than 800 rpm, said machine including a DC motor for driving said drum and a control system, said control system comprising a programme device having at lest for electrical contacts, an assembly for controlling the speed of operation of said DC motor, and a pressure switch sensitive to high and low levels of water in the tank of the machine and having two electrical contacts connected to said programme device and to a bistable electronic flip-flop, the flip-flop having an output connected to said speed controlling assembly so as to control operation of said assembly such that spin drying cannot be carried out or initiated with either too little or too much water in said tank.

In order that the invention may be better understood, an embodiment thereof will now be described, by way of example, with reference to the accompanying drawings in which:

Fig. 1 is a schematic perspective view of a machine according to the invention for washing and spin-drying laundry,

Fig. 2 is a schematic view of part of the electrical circuit of a system for controlling the operation of the motor driving the washing and/or spin-drying machine of Fig. 1,

Fig. 3 is a curve, plotted as a function of time, for the spin-drying speeds of the laundry drum of the machine of Fig. 1 for

washing and spin-drying laundry, the curve being divided into phases I, II, III and IV, and

Fig. 4 is a diagram of the periods during which the contacts of the control system of Fig. 2 are closed, which diagram is divided into phases I, II, III and IV corresponding to the four phases shown in Fig. 3 of the curve for spin-drying speed.

Referring to Fig. 1, a washing and spin-drying machine 1 has a cabinet 2, a tank 3, a laundry drum 4, a DC drive motor 5, and a system 6 for controlling this motor 5, which system automatically causes the machine 1 to wash at an ordinary speed of 50 rpm and to spin-dry following the pattern indicated by the curve of Fig. 3. This Figure shows, in phase I, a rapid increase in the speed of the laundry drum from 50 rpm to 80 rpm, followed by a slow rise from 80 rpm to 160 rpm, and a rapid rise from 160 rpm to 450 rpm, during which phase a pump (not shown) drains the tank 3 and has virtually empited it of its water by the end of phase I; in phase II, the speed of the drum is maintained relatively constant at 450 rpm; in phase III, the speed of the drum increases rapidly from 450 rpm to 800 rpm and then remains relatively constant at 800 rpm; and in a phase IV, the speed of the drum falls rapidly from 800 rpm to a value of zero.

As shown in Fig. 2, the system 6 for controlling the DC motor 5 comprises in combination, firstly, a programme device 7 which has at least four electrical contacts 8, 9, 10 and 11, secondly a pressure switch 14 which has two electrical contacts 15, 16, thirdly, an electronic flip-flop 12, and fourthly, a usual type of assembly 13 for controlling the speed of operation of the motor 5. The contacts of the pressure switch 14 are sensitive to the level of water in the tank of the machine. The "low level" contact 15 and the "high level" contact 16 respectively close when the level of water in the tank 3 is below a predetermined level N1 and above a predetermined level N2. In the control system 6, the first and second contacts 9 and 10 of the programme device 7 are respectively connected in series with the low and high level contacts 15 and 16 of the pressure switch 14 whilst the third contact 8 of the programme device 7 is connected in parallel with the pair of series contacts 9 and 15. The electronic flip-flop 12 is a logic circuit having a known bistable sysem and which has a first input T, a second input S, a first output Q and a second, complementary output $\overline{Q}$. The first input T of the flip-flop 12 is connected to the common point 17 of parallel contacts 8, 9 and 15, and input S is connected to point 18 of the series contacts 10 and 16 of programme device 17 and pressure switch 14. The assembly 13 for controlling the speed of the motor 5 is of a known type which consists chiefly of a system 19 termed a speed-increase ramp-generator and a plurality of inputs for 50 rpm, 80 rpm, 450 rpm and 800 rpm.

The system 19 is a "resistance-capacitance" system which causes the speed of the motor 5 to change from 80 rpm to 450 rpm with a pre-established pattern of rise as indicated in Fig. 3. The 50 rpm and 800 rpm inputs of assembly 13 are connected to points 17 and 20 respectively of contacts 8 and 11 of programme device 7, and the 80 rpm and 450 rpm inputs are connected to the first output Q of flip-flop 12, the second output $\overline{Q}$ of the latter not being used.

During the four phases of spin-drying (Fig. 3) the pump (not shown) for draining water from the machine operates continuously. The control system 6 has a special programme for the closing of the four contacts of the programme device 7 and the two contacts of the pressure switch 14, as indicated in the diagram of Fig. 4 in which the numerals indicate the contacts and and heavy lines indicate the periods for which they are closed. The diagram is divided into four phases I, II, III, IV corresponding to those of the spin-drying curve of Fig. 3. Contacts 8 and 10 are thus closed during phase I of the spin-drying operation, whilst contact 9 is closed during phases I, II, and III and contact 11 is closed during phase III. The tank of the machine is almost completely empty of water by the end of phase I of the spin-drying operation. Contact 16 of the pressure switch 14, i.e. the high-level contact, closes when the water in the tank is above a predetermined level N2 and opens when the water falls below this level N2. In practice, contact 16 opens before the end of phase I of the spin-drying operation. On the other hand, contacts 15 of the pressure switch 14, i.e. the low-level contact, is open when the water in the tank of the machine is above the said predetermined level N1 and closes when the water is below the level N1. In practice contact 15 closes slightly before the end of phase I of the spin-drying operation.

The combination of a programme device 7, a pressure switch 14, an electronic flip-flop 12 and a speed-control assembly 13, plus a special programme which is observed by the opening and closing of the contacts of the programme device 7 and the pressure switch 14, not only enables spin-drying to take place following a given curve for drum-speed but also ensures that the machine is very safe in operation.

In the example illustrated, this combination (Fig. 2) coupled with the programme observed by the opening and closing of the contacts shown in the diagram

in Fig. 4, enables spin drying to take place following the curve for drum-speed shown in Fig. 3, and also enables the machine to be very safe in operation, as will be explained in detail below.

The flip-flop 12 of the control system 6 is a logic circuit having a known bistable system which, to change from one predetermined state (called the rest state) to the other state (termed the working state), requires a pulse to be applied to a predetermined input. Once this first changeover has taken place, to cause the flip-flop to change back from the working state to the rest state a pulse has to be applied to another input. When the first input S of the flip-flop is at the "O" level, that is to say it is unsupplied or switched off, its first output Q is always at the "O" level, i.e. in the rest state, whatever the state of supply at its second input T, i.e. no matter whether T is supplied or not, or in other words is at the "1" level or the "O" level. When the second input T is at the "1" level for example and the first input S changes from the "O" level to the "1" level, the first output Q of the flip-flop changes over from the "O" level to the "1" level, that is to say from the rest state to the working state. If input T remains at the "1" level and input S returns to the "O", the first output Q remains at the "1" level. In the event that input T now changes to the "O" level, the first output Q reverts to the "O" level, i.e. the rest state, input S having remained at its "O" level.

During normal operation of the machine 1, spin-drying begins at the moment indicated by the curve and diagram shown respectively in Figs. 3 and 4 when contacts 8, 9, 10 and 16 are closed (Fig. 2) and contacts 15 and 11 are open. Since contacts 10, 16 and 8 are closed, inputs S and T of flip-flop 12 are both at the "1" level and the first ouput Q of the flip-flop is at the "1" level. Contact 8 and output Q act simultaneously on the assembly 13 for controlling the speed of motor 5. The laundry drum 4 turns at 50 rpm and changes quickly to 80 rpm. Its speed then observes a pre-established rise which is governed by the system 19 termed the speed-increase ramp-generator system and reaches a speed of 450 rpm. During this time, the drain pipe is removing water from the tank. When the water falls below the above-mentioned level N1, contact 16 of pressure switch 14 opens and its contact 15 closes. Input S of flip-flop 12 then goes to the "O" level, whilst input T, being supplied through the three contacts 8, 9, and 15, remains at the "1" level. Output Q of the flip-flop also remains at the "1" level, i.e. in the working state. The spaced controlling assembly 13, being actuated by output Q of flip-flop 12 continues to operate and the speed of the drum, having reached 450 rpm, is held relatively constant at this value. The end of phase I is marked by contacts 8 and 10 opening. The closure of contacts 9 and 15 continues into phase II, which causes the speed of the drum to remain unchanged at 450 rpm. Phase III begins with contact 11 closing. Since the 800 rpm input of assembly 13 is now supplied, the speed of the drum changes rapidly from 450 rpm to 800 rpm and remains relatively steady at this level during phase III of spin-drying. Phase III of spin-drying concludes with the opening of contacts 9 and 11. Input T of flip-flop 12 returns to the "O" level and output Q of the flip-flop then goes to the "O" level or to the rest state. In phase IV, since none of its input are supplied, assembly 13 allows the speed of the motor 5 to drop to zero and the spin-drying operation comes to an end.

Since the tank 3 of machine 1 is empty, contact 16 of the pressure switch 14 is open and input S of flip-flop 12, because of this, is at the "O" level. Whatever the logic state at input T of flip-flop 12, or in other words whatever the open or closed state of the contacts 8, 9 and 11 of programme device 7, the first output Q of flip-flop 12 will always be at the "O" level, i.e. will remain in the rest state. The laundry drum is able to turn at 50 rpm when contact 8 closes but spin-drying cannot be initiated. The improved control system 6 of the machine will thus not permit spin-drying to begin when the tank 3 of the machine 1 is empty of water. There is thus not risk of imbalance in the laundry due to the laundry being improperly distributed, which would cuase mechanical damage to the machine during spin-drying.

In phase I of the spin-drying operation, when the water in the tank of the machine is above the level N2 mentioned in a previous paragraph, if there is a current breakdown as the speed of the drum is rising towards 450 rpm the spin-drying operation is interrupted. At the moment when the current is restored, since contacts 8, 10 and 16 are closed, inputs S and T of flip-flop 12 are at the "1" level and the first output Q of the flip-flop is also at the "1" level. The laundry drum turns at 50 rpm and then quickly reaches a speed of 80 rpm at its speed then follows the upward course indicated in the normal way (Fig. 3). Because of this the spin-drying operation starts again from the beginning with the laundry properly distributed in the drum, given that the water remaining in the tank of the machine, whose level is above the predetermined level N2, is sufficient to allow the laundry to slide easily when the drum rotates and thus to prevent any imbalance from being created.

In the event of a current breakdown

occuring when the water still in the tank is below the above level N2, when current is restored the laundry drum is able to turn at 50 rpm but spin-drying cannot begin. This case is similar to that of beginning spin-drying with the tank of the machine empty of water, as described in a previous paragraph. Output Q of flip-flop remains in the rest state given that its input S has no supply because contact 16 of the pressure switch is open. The improved machine-control system 6 thus makes it possible to avoid spin-drying taking place with the laundry improperly distributed as a result of an insufficient quantity of water in the tank.

If on the other hand the pump for draining the machine is blocked, and the water cannot be removed from the tank, phase I of the spin-drying operation can take place but as soon as contacts 8 and 10 of the programme device 7 open at the beginning of phase II of the spin-drying operation, since contact 15 of pressure switch 14 is open, input T of flip-flop 12 goes from the "1" level to the "O" level and its first output Q returns to the "O" level, i.e. the rest state whatever supply there is to the first input S of flip-flop 12. The spin-drying operation comes to a halt. Because of this safe operation by the machine is ensured.

Should the programme device 7 be accidentally set directly to the position which corresponds to that which it occupies in phase II or phase III of the spin-drying operation, whatever the amount of water present in the tank of the machine, spin-drying cannot begin since the contacts 8 and 10 of the programme device 7 are open in the said phases. In effect, when input S of flip-flop 12 is at the "O" level, i.e. is not supplied, its first ouput Q is also in the rest state whatever the state of supply at input T of flip-flop 12. Any danger of the laundry drum turning at high speed (450 rpm or 800 rpm) without the laundry within it having first been properly distributed is thus avoided.

Thus the washing machine described herein is a machine in which, as a safety measure, a direct switch to spin drying, or its direct resumption after operations have been interrupted, can only take place when it is possible for the laundry to be properly distributed in the laundry drum, that it to say when the water in the tank of the machine is above a predetermined level N, and, after such an interruption, the rotation of the drum resumes at a speed of substantially 50 rpm and the speed of the drum rises following a predetermined pattern.

WHAT WE CLAIM IS:—

1. A drum washing machine operative to wash at a drum speed of substantially 50 rpm and to spin-dry with the drum rotating at speeds ranging from substantially 50 rpm to a value equal to or greater than 800 rpm, said machine including a DC motor for driving said drum and a control system, said control system comprising a programme device having at least four electrical contacts, an assembly for controlling the speed of operation of said DC motor, and a pressure switch sensitive to high and low levels of water in the tank of the machine and having two electrical contacts connected to said programme device and to a bistable electronic flip-flop, the flip-flop having an output connected to said speed controlling assembly so as to control operation of said assembly such that spin drying cannot be carried out or initiated with either too little or too much water in said tank.

2. A machine according to claim 1, wherein first and second contacts of the programme device are respectively connected in series with the two contacts of the pressure switch and connected to the two inputs of the electronic flip-flop, the output of the latter being connected to the speed control assembly via a speed-rise ramp generator, and wherein a third contact of the programme device is connected to the speed-control assembly and is connected in parallel with the series connected pair of contacts formed by the first contact of the programme device and the low level contact and the pressure switch, and a fourth contact of the programme device is connected directly to the said speed control assembly.

3. A machine according to claim 2, in which the spin-drying regime of the machine has four phases, during which the pump for draining the drum is in continuous operation, namely phase I in which the spin-drying of the laundry takes place with a rise in the speed of the drum from substantially 50 rpm to substantially 450 rpm, a phase II in which the speed of the drum is substantially constant at 450 rpm, a phase III in which the speed of the drum rises from 450 rpm to 800 rpm or a higher value, and a phase IV in which the speed of the drum drops to a value of zero, and wherein the programme observed by the closing of the contacts of the programme device and the pressure switch of the systems for controlling the drive motor provides for the first contact of the programme device to be closed during phases I, II, III of the spin-drying operation, for the second and third contacts of the of the programme device to be closed during phase I of the spin-drying operation, for the fourth contact of the programme device to be closed during phase III of the spin-drying operation, and for the high and

low level contacts of the pressure-switch to be closed when the water in the tank of the machine is above a predetermined level N2 and below a predetermined level N1 respectively.

4. A machine for washing and spin-drying laundry substantially as hereinbefore described with reference to the accompanying drawings.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG.1

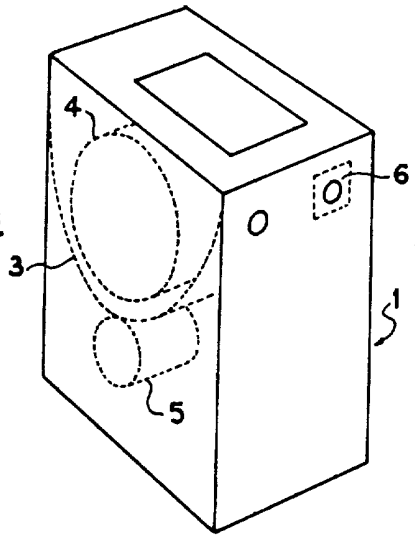


FIG. 3

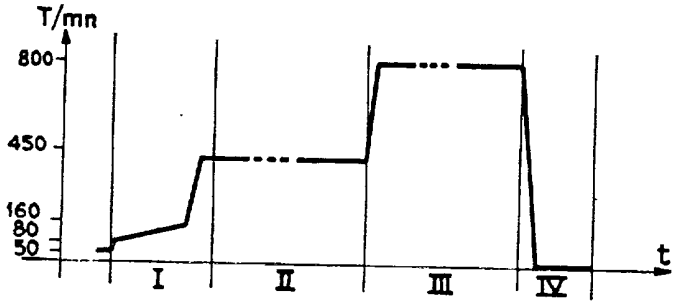


FIG.4

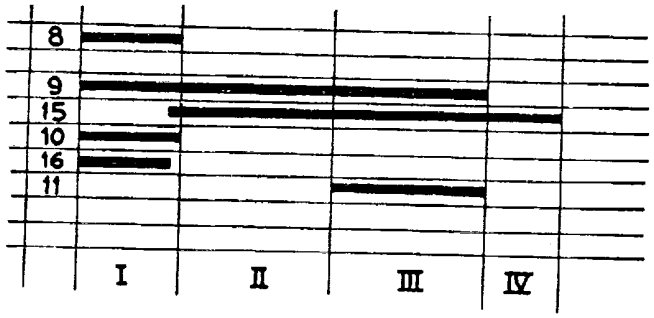
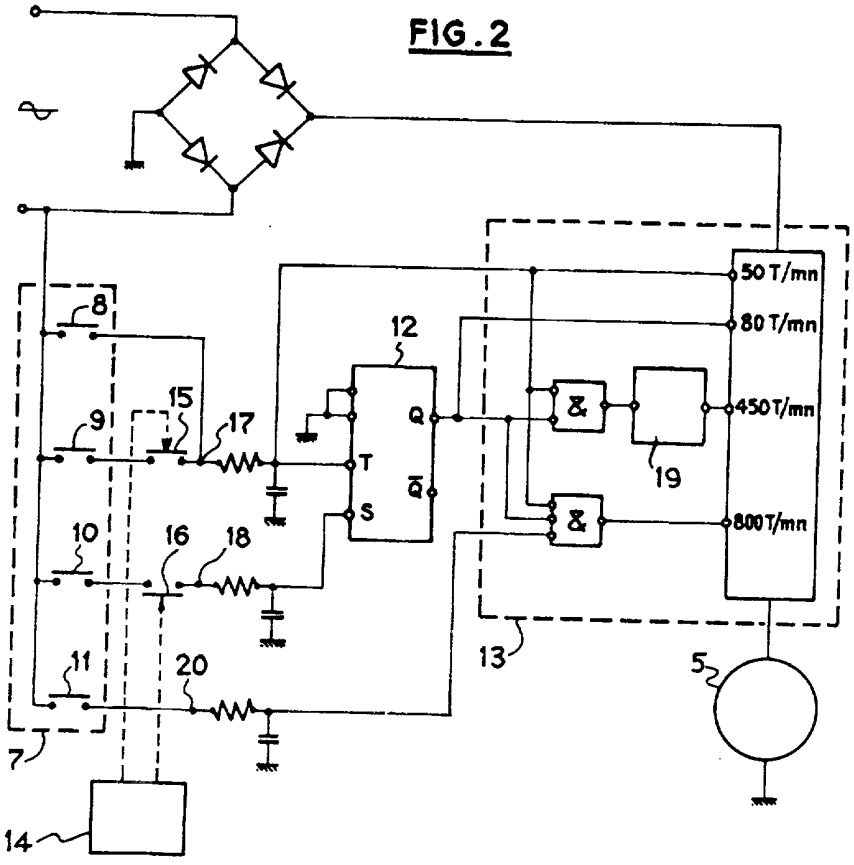


FIG.2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