METHOD FOR REDUCING ENERGY CONSUMPTION IN A LAUNDRY MACHINE

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ABSTRACT

Method for reducing energy consumption in a laundry machine of the automatic type and comprising: a washing means to be rotatively driven by an electric motor during the agitation and spinning phases, and a control means which is operatively associated with the electric motor so as to instruct energization thereof. Said method comprises the steps of: providing energization of the electric motor upon start of each rotation of the washing means in a direction, with a certain percentage of the effective voltage of the electric power supply; maintaining the full energization of the electric motor during a predetermined period of time with an effective voltage at least equal to the certain percentage of the effective voltage of electric power supply to allow the electric motor and the washing means to reach a desired rotation regime; and adjusting the effective voltage applied to the electric motor to a value sufficient to maintain a desired rotation regime of the washing means.
START OPERATION PHASE (AGITATION/SPINNING)

FULL ENERGIZATION OF THE MOTOR WITH 100% OF THE EFFECTIVE VOLTAGE OF THE POWER SUPPLY

MAINTENANCE OF THE FULL EFFECTIVE VOLTAGE UNTIL MOTOR REACHES DESIRED ROTATION REGIME (TIMING)

GRADUAL REDUCTION OF THE EFFECTIVE VOLTAGE APPLIED TO THE MOTOR

ENERGIZATION OF THE MOTOR WITH REDUCED EFFECTIVE VOLTAGE IN RELATION TO THE EFFECTIVE VOLTAGE OF THE POWER SUPPLY

INCREASE THE REDUCED EFFECTIVE VOLTAGE TO VALUE OF MAINTENANCE OF DESIRED ROTATION REGIME (TIMING)

MAINTENANCE OF THE REDUCED EFFECTIVE VOLTAGE AT A CONSTANT VALUE

MAINTENANCE OF THE REDUCED EFFECTIVE VOLTAGE AT VARIABLE VALUES

MAINTENANCE OF THE REDUCED EFFECTIVE VOLTAGE AT A CONSTANT VALUE

MAINTENANCE OF THE REDUCED EFFECTIVE VOLTAGE AT VARIABLE VALUES

FIG. 1
METHOD FOR REDUCING ENERGY CONSUMPTION IN A LAUNDRY MACHINE

FIELD OF THE INVENTION

0001. The present invention refers to a method for reducing energy consumption during at least one of the operating phases of a laundry machine, which can be of the top or front load type, by adjusting the effective voltage applied to the electric motor on basis of the operating regime to be applied to said motor during one or more of its operating phases.

PRIOR ART

0002. As known in the prior art, the electric motors used in laundry machines are specified and designed to have the capacity of moving the whole mass composed by the mechanism of the laundry machine, including a washing means, which is formed in certain cases by a drum and an impeller which are rotatively driven by an electric motor, and by the load of clothes positioned to be washed inside the drum. During the agitation and spinning phases, the entire movable assembly of the machine, comprising the washing means containing the load of clothes, starts from a state of total immobility to a state of rotating movement with a determined speed established in the machine design and which is sufficient to produce the desired washing effect or a certain degree of discharge of the water still remaining in the already washed load of clothes. In the start of the spinning phase, for example, the electric motor has to make a huge effort to overcome the rest inertia of the whole mass formed by the movable parts of the machine and by the load of clothes contained in the drum, but after entering in a nominal operational regime, in which the rotating speed is already established, the electric motor makes little effort to maintain the rotating movement (or rotation) of the drum with the load of clothes. A substantial part of all the energy applied to the electric motor is transformed into heat, as it receives more energy than needed to maintain it working in the nominal operation regime already established for spinning, since the amount of energy supplied to the electric motor is dimensioned to overcome the rest inertia in the beginning of spinning. A similar situation occurs upon start of the drum rotation or start of each rotation cycle of the machine impeller, in one and/or other direction, in the agitation phase of the load of clothes immersed in the washing liquid.

0003. It should be further understood that upon start of the electric motor in the agitation phase of the laundry machine, the energization of the electric motor is effected so as to produce a quick start, with a substantial increase in the current of the motor windings, reducing the lifespan of said motor and unnecessarily increasing the consumption of energy.

0004. Current increase during start generally causes flickering of the lamps connected to the electric circuit that supplies energy to the laundry machine, mainly in case of the laundry machines that can rapidly reverse the rotation of the agitator during the agitation phase.

0005. Thus, in the conventional laundry machines, the agitation and spinning phases are effected with the electric motor being supplied with 100% the effective voltage of the electric power supply and therefore receiving an amount of energy higher than necessary to maintain its operation within the designed nominal patterns of the machine, leading to an unnecessary consumption of energy, part of which being transformed into heat that is lost to the atmosphere and which tends to reduce the lifespan of the motor.

0006. While prior art solutions are known to control the supply of energy to the electric motor, such system have a complex construction, modifying the characteristics of the energy received from the electric power supply and to be supplied to the electric motor during different operational phases of the laundry machine, requiring complex and high cost electronic arrangements, which are economically infeasible for some construction of laundry machines. In these prior art solutions, the alterations electronically effected in the parameters of the electric energy supplied to the electric motor of the machine are continuously controlled by an electronic control module, further varying the motor speed by controlling the frequency of the electric energy supplied to the machine.

0007. A known solution to control the operation of an electric motor in a laundry machine is described in patent U.S. Pat. No. 6,633,149. In this prior art method, the control of the electric motor is achieved by measuring the rotation speed of the motor; determining the difference between the measured speed and a set speed; and controlling the operation of the motor on the basis of said difference by controlling the triggering angle of a triac.

0008. While using the electronic switching of a triac by the control means of the machine to control the operation (rotation) of the electric motor, said prior art solution requires the provision of an electric motor rotation detecting means operatively associated with the electronic control means and the provision of a comparing means in the latter, to compare the measured rotation and the desired speed and to adjust the motor rotation in different operating phases of the machine, electronically controlling the triggering angle of a triac which works as an electronic switch to energize the electric motor. The object of the invention disclosed in the patent cited above is to control the operation of the electric motor in all operating phases of the machine, by providing a rotation detecting means, a comparing means and a control means which must be constructed to process the data received from the rotation detecting means and to instruct the triac to operate to supply the electric motor with an effective voltage, necessary to maintain the rotation desired for each operating phase of the laundry machine. Said prior art method requires a more sophisticated control means and at least one rotation detecting means of the electric motor, increasing the cost of the end product.

OBJECTS OF THE INVENTION

0009. As a function of the inconveniences mentioned above and related to the excessive energy consumption during one or more operating steps of the electric motor of a laundry machine, it is an object of the present invention to provide a method for reducing energy consumption during operation of a laundry machine, by providing an extremely simple and low cost electronic control which is disposed in such a way as to be driven by the control means already provided in said machine, in order to reduce the value of the effective voltage applied to said electric motor in certain conditions of its operating phases.

0010. It is a complementary and more specific object of the present invention to provide a method for reducing
energy consumption during operation of a laundry machine as mentioned above, by reducing the value of the effective voltage applied to said electric motor in certain conditions at least in one of the agitation and spinning phases and by controlling the triggering angle of a triac which operates as an electronic switch in the supply of electric energy of the motor. These and other objects of the present invention are attained by a method for reducing energy consumption during operation of an automatic laundry machine of the type comprising a washing means which is selectively and rotatively driven to wash a load of clothes placed in said machine; an electric motor which is selectively and operatively coupled to the washing means to make it rotate in at least one direction during the agitation and spinning phases, and a control means which is operatively associated with the electric motor so as to instruct energization thereof from a power supply during said agitation and spinning phases.

According to the invention, the method comprises the steps of: providing energization of the electric motor, upon start of each rotation of the washing means in a direction, in at least one of the agitation and spinning phases, with a certain percentage of the effective voltage of the electric power supply which is sufficient to start the electric motor; maintaining the energization of the electric motor with at least one effective voltage value at minimum equal to the certain percentage of the electric power supply during a predetermined time, defined by the control means and which is sufficient to allow the electric motor and the washing means to reach a rotation regime established for the respective operating phase being carried on in the laundry machine; and adjusting the effective voltage applied to the electric motor to at least one value that is sufficient to maintain a desired rotation regime in the respective operating phase being carried on, after the respective predetermined time has elapsed.

As it can be noted by the definitions presented above, the invention allows reducing the consumption of energy supplied to the electric motor of the machine during the agitation and spinning phases by means of an extremely simple solution of low cost, which can be easily incorporated to the machine design without provoking any relevant increase in its cost to the end user.

With the method proposed herein the heat of the electric motor is diminished during operation in the agitation and spinning phases, which allows said motor to operate in a more favorable temperature condition, increasing its lifespan, besides reducing energy consumption of the laundry machine as mentioned above.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described below, with reference to the enclosed drawings given by way of example to illustrate one way of carrying out the present invention and in which:

FIG. 1 is a block diagram illustrating the different operational steps effected according to the present invention and according to different sequences of process steps; and

FIG. 2 is a simplified block diagram of the control means provided in the laundry machine and which are necessary to carry out the invention.

DetaileD description of the invention

As mentioned above, the present method is applied to an automatic laundry machine of the type which comprises a tub 1, inside which is mounted a rotating cylindrical drum 2 for containing a load of clothes. It should be understood that the cylindrical drum 2 might be mounted with its axis disposed either horizontally or vertically.

The laundry machine further comprises an electric motor 3 operatively coupled to the cylindrical drum 2 to make the latter rotate around its axis inside the tub 1 during different operational phases of the laundry machine.

A control means 4 is provided to control the operations of the machine, driving the electric motor 3 and other components (not illustrated) of the system, such as water admission electro-valve, according to different operational conditions which include water level and time.

In the laundry machines presenting the cylindrical drum 2 (not shown) having a horizontal axis and frontally accessed, said cylindrical drum 2 defines a washing means L to be selectively and rotatively driven to wash a load of clothes fed into the machine. In these constructions, the agitation and spinning phases are achieved with the cylindrical drum 2 being rotatively driven in a single direction, and the spinning phase is effected in a higher speed.

On the other hand, in the laundry machines presenting the cylindrical drum 2 with a vertical axis and superiorly accessed (see appended FIG. 2), the washing means L further comprises, besides the cylindrical drum 2, an impeller 6 mounted inside the cylindrical drum 2 which is also selectively and operatively coupled to the electric motor 3.

In the machines with the cylindrical drum 2 provided with a vertical axis and housing an impeller 6, the agitation phase is usually carried on upon the impeller 6 being rotatively driven in one and in the other direction, while the cylindrical drum 2 remains usually stationary.

During the agitation and spinning phases, the electric motor 3 is energized by instruction from the control means 4, in order to start rotating from a stop condition, accelerating to a condition of desired operational rotation, usually permanent, in which the rotation of the electric motor 3 is stabilized at a design nominal value.

The control means 4 is operationally associated to a triac 5 through which the electric motor 3 is energized from an electric power supply. Thus, the control means 4 acts on the triac 5 varying its triggering angle in order to modify the value of the effective voltage applied in energizing the electric motor 3. The control means 4 presents its electronic structure programmed to operate the triac 5 according to a switching pattern designed to provide an effective voltage to the electric motor which is suitable to a respective operational condition of the laundry machine.

In a way of carrying on the invention, the spinning phase, in either of the two types of machines mentioned above, may have its start defined by fully energizing the electric motor 3 with 100% of the effective voltage of electric power supply, in order to start the electric motor 3 by increasing the rotation thereof from stop until a permanent rotation condition is achieved, with the cylindrical
drum 2 and eventually the impeller 6 rotating in one direction and also in a permanent rotation condition which is desired, designed and set for the spinning phase.

[0026] The full energization of the electric motor 3 with 100% of the electric power supply voltage is sustained for a predetermined amount of time, defined by the control means 4, sufficient for the electric motor 3 and the washing means L to which it is coupled to achieve the permanent rotation condition defined for the spinning phase. The predetermined amount of time is fixed and defined according to the most severe start condition to which the electric motor is to be subjected, in order to assure that during the acceleration of the electric motor 3 with maximum load there is no reduction of the effective voltage being applied thereto.

[0027] After the predetermined amount of time has elapsed, the control means 4 carries on a gradual variation of the triggering angle of the triac 5 in order to reduce the effective voltage applied to the electric motor 3 to a value necessary and sufficient to sustain the permanent rotation condition for the remaining of the spinning phase.

[0028] The value of the reduced effective voltage to sustain the permanent rotation condition is calculated in order to assure a level of energization sufficient to sustain said permanent rotation condition under maximum load being applied to the electric motor. It may be further understood that the value of the reduced effective voltage may be constant for the remaining of the spinning phase or may undergo periodic variations, when said value may be momentarily increased to assure the maintenance of the minimum desired rotation for the washing means L, which may comprise the cylindrical drum 2 and the impeller 6 or just the former in the case of front-load type laundry machines.

[0029] The operational phases described above for the spinning phase may also be applied for promoting the agitation operations, particularly in front-load type machines in which the agitation phase is effected with the cylindrical drum with horizontal axis rotating in a single direction.

[0030] It should be further understood that the initial energization of the electric motor 3 in the agitation and spinning phases mentioned above is not necessarily executed with 100% of the effective voltage of electric power supply, and the starting effective voltage may be substantially lower than the full effective voltage available in the electric power supply, it being sufficient that said voltage is adequate to rotate the rotating assembly of the machine with the load of clothes.

[0031] As may be observed in the right portion of the diagram of FIG. 2, the present method may comprise a sequence of phases which start with the energization of the electric motor 3 with a reduced value of effective voltage in relation to the full effective voltage available in the electric power supply, said reduced effective voltage then being increased, for a predetermined period of time, to achieve at least a sufficient value to maintain a desired rotation regime for the washing means L for the remaining of the operational phase being carried on, which may be a rotation in one direction of the washing means L in an agitation or spinning operation.

[0032] After the predetermined period of time of increased effective voltage applied to start the electric motor 3 has elapsed, there occurs the adjustment of the effective voltage applied to said motor to a constant value, or to periodically variable lower or higher values, sufficient to sustain a desired rotation regime of the washing means L in the respective operational phase being carried on, which may be an agitation or spinning operation.

1. A method for reducing energy consumption in a laundry machine of the automatic type and comprising: a washing means selectively and rotatively driven to provide the washing of a load of clothes fed to the machine; an electric motor selectively and operationally coupled to the washing means in order to make the latter rotate at least in one direction, during the agitation and spinning phases, and a control means which is operatively associated with the electric motor so as to instruct energization thereof from an electric power supply during said agitation and spinning phases, wherein said method comprises the steps of: providing energization of the electric motor, upon start of each rotation of the washing means in a direction, in at least one of the agitation and spinning phases, with a certain percentage of the effective voltage of the electric power supply, sufficient to start the electric motor; maintaining the energization of the electric motor with at least one effective voltage value at minimum equal to the certain percentage of the effective voltage of the electric power supply during a predetermined period of time, defined by the control means and which is sufficient to allow the electric motor and the washing means to reach a rotation regime established for the respective operating phase being carried on in the laundry machine; and adjusting the effective voltage applied to the electric motor to at least one value that is sufficient to maintain a desired rotation regime in the respective operating phase being carried on, after the respective predetermined period of time has elapsed.

2. Method, according to claim 1, wherein the energization of the electric motor is achieved through a triac operatively associated to the control means, the value of the effective voltage applied to the electric motor being achieved by the variation of the triggering angle of the triac by the control means.

3. Method, according to claim 2, wherein the energization of the electric motor, upon start of each rotation in a direction of the washing means, is carried on with a percentage of less than 100% of the effective voltage of the electric power supply.

4. Method, according to claim 2, wherein the energization of the electric motor, upon start of each rotation in a direction of the washing means, is carried on with 100% of the effective voltage of the electric power supply.

5. Method, according to claim 3, wherein the step of adjusting the effective voltage applied to the electric motor after the predetermined amount of time from the start of the energization thereof has elapsed comprises gradually reducing the effective voltage applied to the electric motor to values necessary and sufficient to sustain a desired rotation regime for the remaining of the operational phase being carried on.

6. Method, according to claim 5, wherein the reduced effective voltage applied to the electric motor after said predetermined period of time has elapsed is kept constant.

7. Method, according to claim 3, wherein the effective voltage applied to the electric motor during said predetermined period of time from the energization thereof is kept constant.
8. Method, according to claim 3, wherein the effective voltage applied to the electric motor during said predetermined period of time is increased to achieve at least a value which is sufficient to maintain a desired rotation regime of the washing means for the remaining of the operational phase being carried on.

9. Method, according to claim 8, wherein the value of the effective voltage applied to the electric motor, after the predetermined time from the energization thereof has elapsed, is less than 100% of the effective voltage of the electric power supply.

10. Method, according to claim 1, wherein the washing means comprises a cylindrical drum with a horizontal axis.

11. Method, according to claim 1, wherein the washing means comprises a cylindrical drum with a vertical axis and an agitator mounted inside the cylindrical drum.

12. Method, according to claim 4, wherein the step of adjusting the effective voltage applied to the electric motor after the predetermined amount of time from the start of the energization thereof has elapsed comprises gradually reducing the effective voltage applied to the electric motor to values necessary and sufficient to sustain a desired rotation regime for the remaining of the operational phase being carried on.

13. Method, according to claim 4, wherein the effective voltage applied to the electric motor during said predetermined period of time from the energization thereof is kept constant.