DESCRIPTION

WASHING MACHINE

TECHNICAL FIELD

[0001] The present disclosure relates to a washing machine.

BACKGROUND ART

[0002] Conventionally, in this type of washing machine, the rotational position of the motor is detected as follows. Rotational position detection is to detect the electric angle of the motor, and a Hall element, a rotary encoder, or the like is used as a rotation sensor. However, when it is not possible to provide a rotation sensor due to cost and structural restrictions, there are methods of detecting the rotational position without a rotation sensor, including a method using an induced voltage and a method using inductance.

[0003] When an induced voltage is used, the induced voltage proportional to the rotation speed of the motor is calculated from the input voltage and current to the motor, and the rotational position is detected from this induced voltage. This detection method enables accurate rotational position detection in the region where the rotation speed of the motor is high because the induced voltage is large, but cannot perform correct rotation detection in the region where the rotation speed of the motor is low when starting or stopping because the induced voltage is small.

[0004] When an inductance is used, the inductance of the motor is calculated from the input voltage and current to the motor, and the rotational position is detected by utilizing the fact that the inductance fluctuation cycle is twice the electric angle of the motor. This detection method is limited to a motor having a magnetic salient polarity, and a voltage is applied to the motor at a cycle different from the rotation cycle of the motor (see, for example, PTL 1).

Citation List

Patent Literature

[0005] PTL 1: Unexamined Japanese Patent Publication No. 2001-169590

SUMMARY

[0006] However, such a conventional washing machine uses a control method that does

not feed back phase information because it is difficult to perform phase estimation in a region where the rotation speed is low in a motor having a magnetic non-salient polarity. In this case, since the phase is uncertain, the torque is not correctly transmitted to the motor, and there is a problem that the motor fails to start and enters a lock state. Even if a restarting operation is performed for an unlocking operation in the same manner by the starting method, the lock state is not released, resulting in a failure to start.

[0006a] In an aspect, the present disclosure refers to a washing machine comprising: a rotating object that comes into contact with laundry; an electric motor having a permanent magnet and windings; a power supply circuit that supplies current to the electric motor; a transmission mechanism that transmits torque of the electric motor to the rotating object; and a controller that executes a washing control operation, wherein the controller is configured to execute: a first control process of energizing the windings regardless of a position of the permanent magnet, a second control process of energizing the windings in accordance with the position of the permanent magnet; and a lock detection process of detecting that motor lock has occurred when the permanent magnet is not rotated at a predetermined rotation speed after transition from the first control process to the second control process, and the controller performs phase fixed control in different phases a plurality of times at a start of driving by the first control process upon detecting motor lock in the lock detection process.

[0006b] In another aspect, the present disclosure refers to a washing machine comprising: a rotating object that comes into contact with laundry; an electric motor having a permanent magnet and windings; a power supply circuit that supplies current to the electric motor; a transmission mechanism that transmits torque of the electric motor to the rotating object; and a controller that executes a washing control operation, wherein the controller is configured to execute: a first control process of energizing the windings regardless of a position of the permanent magnet, a second control process for energizing the windings in accordance with the position of the permanent magnet; and a lock detection process of detecting that motor lock has occurred when the permanent magnet is not rotated at a predetermined rotation speed after transition from the first control process to the second control process, and the controller reduces a drive rotation speed acceleration by the first control process upon detecting that the motor lock has occurred in the lock detection process.

[0007] In an example, the present disclosure provides a washing machine that can easily release the lock state by changing the starting method when starting fails and the lock state is reached.

[0008] In an example, the washing machine according to the present disclosure includes a rotating object that comes into contact with laundry, an electric motor having a permanent magnet and windings, a power supply circuit that supplies current to the electric motor, a transmission mechanism that transmits the torque of the electric motor to the rotating object, and a controller that executes a washing control operation. Further, the controller can execute the first control process of energizing the windings regardless of the position of the permanent magnet and the second control process of energizing the windings in accordance with according to the position of the permanent magnet. Further, the controller can execute a lock detection process of detecting motor lock when the permanent magnet is not rotated at a predetermined rotation speed after transition from the first control process to the second control process. Upon detecting that the motor is locked in a lock detection process, the controller performs phase fixed control in different phases a plurality of times at the start of driving by the first control process.

[0009] The washing machine according to the present disclosure can easily release the lock state by changing the starting method when the machine fails to start and enters the lock state.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Fig. 1 is a sectional view of the main part of a washing machine according to a first exemplary embodiment.

Fig. 2 is a block diagram of a drive system of a motor of the washing machine according to the first exemplary embodiment.

Fig. 3 is an equivalent circuit diagram of the motor of the washing machine according to the first exemplary embodiment.

Fig. 4 is a control block diagram at the time of phase estimation of the motor of