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, the controller is configured to execute a set velocity control of open loop acceleration of the permanent magnet in the first control process, the controller, upon performing the lock detection process and detecting motor lock has occurred, restarts the electric motor, and performs an initial phase fixed control of maintaining fixed phase predetermined current and the set velocity control is performed after the initial phase fixed control in the first control process after the restarting, and the controller, upon detecting motor lock has occurred in the lock detection process after performing the set velocity control, restarts the electric motor, and in the first control process after the restarting, reduces a drive rotation speed acceleration of the set velocity control to be lower than the drive rotation speed acceleration of the set velocity control before the restarting, after performing the initial phase fixed control for a predetermined period of time.

[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

CLAIMS

1. 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,

the controller is configured to execute a set velocity control of open loop acceleration of the permanent magnet in the first control process,

the controller, upon performing the lock detection process and detecting motor lock has occurred, restarts the electric motor, and performs an initial phase fixed control of maintaining fixed phase predetermined current and the set velocity control is performed after the initial phase fixed control in the first control process after the restarting, and

the controller, upon detecting motor lock has occurred in the lock detection process after performing the set velocity control, restarts the electric motor, and in the first control process after the restarting, reduces a drive rotation speed acceleration of the set velocity control to be lower than the drive rotation speed acceleration of the set velocity control before the restarting, after performing the initial phase fixed control for a predetermined period of time.

2. The washing machine according to Claim 1, wherein the controller increases current or voltage controlled by the set velocity control in the first control process after the restarting, upon detecting that motor lock has occurred in the lock detection process and

restarting the electric motor.