

ELEVATOR CONTROL SYSTEM, MOTOR CONTROL APPARATUS, AND ELEVATOR CONTROL METHOD

TECHNICAL FIELD

[0001]

The present invention relates to an elevator control system, a motor control apparatus, and an elevator control method.

RELATED ART

[0002]

There is known an elevator including a synchronization motor that elevates and lowers an elevator car, an inverter that supplies drive power to the synchronization motor, and a brake that brakes the synchronization motor. In the elevator, a position variation of the elevator car (i.e., roll back) occurs when the brake is released in order to elevate or lower the elevator car. For suppressing the roll back, there is a method of performing control of generating torque corresponding to load of the elevator car, using a detection value of a load sensor that detects the load of the elevator car (e.g., refer to patent literature 1).

[0003]

Patent literature 1: JP 06-321441 A

SUMMARY

[0004]

Nevertheless, in the case of an elevator not using a load sensor (so-called load-sensor-less elevator), torque required in the brake release cannot be identified in advance by a load sensor. Thus, it is difficult to suppress the roll back.

[0005]

Thus, the object of the present invention is to provide an elevator control system, a motor control apparatus, and an elevator control method that can suppress roll back that occurs in the brake release, even if a load sensor is not used.

[0006]

An elevator control system according to a first aspect is a system for controlling, by vector control, a synchronization motor configured to elevate and lower an elevator car of an elevator. The elevator control system includes: a brake controller configured to output a brake release command for releasing a

brake for braking a rotation of the synchronization motor; a control starter configured to start, before the brake is released, zero speed control of controlling a rotational speed of the synchronization motor to zero, or zero servo control of retaining a magnetic pole position of the synchronization motor; and a d-axis current controller configured to start to flow d-axis current in the synchronization motor before the brake is released.

[0007]

A motor control apparatus according to a second aspect is an apparatus for controlling, by vector control, a synchronization motor configured to elevate and lower an elevator car of an elevator. The motor control apparatus includes: a control starter configured to start, before a brake for braking a rotation of the synchronization motor is released, zero speed control of controlling a rotational speed of the synchronization motor to zero, or zero servo control of retaining a magnetic pole position of the synchronization motor; and a d-axis current controller configured to start to flow d-axis current in the synchronization motor before the brake is released.

[0008]

An elevator control method according to a third aspect is a method for controlling, by vector control, a synchronization motor configured to elevate and lower an elevator car of an elevator. The elevator control method includes: outputting a brake release command for releasing a brake for braking a rotation of the synchronization motor; starting, before the brake is released, zero speed control of controlling a rotational speed of the synchronization motor to zero, or zero servo control of retaining a magnetic pole position of the synchronization motor; and starting to flow d-axis current in the synchronization motor before the brake is released.

[0009]

According to an aspect, it is possible to provide an elevator control system, a motor control apparatus, and an elevator control method that can suppress roll back that occurs in the brake release, even if a load sensor is not used.

BRIEF DESCRIPTION OF DRAWINGS

[0010]

FIG. 1 is a block diagram illustrating a system structure of an elevator according to an embodiment;

FIG. 2 is a flowchart illustrating an elevator control method according to the embodiment;

FIG. 3 is a time chart illustrating an operation example of the elevator control system according to the embodiment;

FIG. 4 is a diagram illustrating a control method of d-axis current according to Modified Example 1 of the embodiment;

FIG. 5 is a diagram illustrating a control method of d-axis current according to Modified Example 1 of the embodiment;

FIG. 6 is a block diagram illustrating a system structure of an elevator according to Modified Example 2 of the embodiment; and

FIG. 7 is a block diagram illustrating a system structure of an elevator according to another embodiment.

DETAILED DESCRIPTION

[0011]

An embodiment will be described with reference to the drawings. In the following description of the drawings, the same or similar parts are assigned the same or similar signs.

[0012]

(System Structure of Elevator)

FIG. 1 is a block diagram illustrating a system structure of an elevator 1 according to an embodiment. As illustrated in FIG. 1, the elevator 1 includes a synchronization motor 10, a current sensor 11, a brake 12, an encoder 13, an elevator car 14, a counter weight 15, a wire rope 16, a hoisting device 17, an upper controller 100, and an inverter 200.

[0013]

The synchronization motor 10 elevates and lowers the elevator car 14 by driving the hoisting device 17. The synchronization motor 10 may be an Interior Permanent Magnet (IPM) motor. In the embodiment, the synchronization motor 10 is a gearless synchronization motor that drives the hoisting device 17 not via a gear. The synchronization motor 10 is a pencil-shaped synchronization motor having a shape elongated in an axis direction (rotation axis direction). In an installed state, the pencil-shaped synchronization motor can reduce an installation space in a height direction. The synchronization motor 10 of the present embodiment has properties of low inertia and low torque (i.e., highly-responsive) as compared with a thin large-diameter motor (flat motor with a large diameter) generally supplied for hoisting of an elevator for tall buildings. In addition, the pencil-shaped motor has a shape elongated in the axis direction (rotation axis direction), as compared with a thin large-diameter motor (flat motor with a large diameter)

generally supplied for hoisting of an elevator for tall buildings.

[0014]

The current sensor 11 detects phase current of the synchronization motor 10, and outputs a detection value to the inverter 200.

[0015]

The brake 12 brakes the synchronization motor 10. The brake 12 releases the braking of the synchronization motor 10 by being released based on a brake release command when the elevator car 14 is elevated or lowered. In the embodiment, the brake release command is output from the upper controller 100. The brake 12 is released after a predetermined delay time from the reception of the brake release command.

[0016]

The encoder 13 is attached to a rotation shaft of the synchronization motor 10. The encoder 13 detects at least any of a rotational speed and a magnetic pole position of the synchronization motor 10, and outputs a detection value to the inverter 200.

[0017]

The elevator car 14 and the counter weight 15 are connected to the wire rope 16 stretched over the hoisting device 17. The elevator 1 according to the embodiment is a load-sensor-less elevator not including a load sensor that detects load of the elevator car 14.

[0018]

The upper controller 100 controls the brake 12 and the inverter 200. The upper controller 100 may be a Programmable Logic Controller (PLC).

[0019]

The inverter 200 supplies the synchronization motor 10 with drive power. The inverter 200 corresponds to a motor control apparatus. Here, the motor control apparatus is not limited to the inverter, and may be a power conversion apparatus such as a matrix converter. The motor control apparatus can be read as a power conversion apparatus. The motor control apparatus (power conversion apparatus) is an apparatus that converts power such as frequency, current, and voltage, by switching of semiconductor switches.

[0020]

In the embodiment, the inverter 200 controls the synchronization motor 10 using vector control. In the vector control, as components of current (temporal current) flowing from the inverter 200 to the synchronization motor 10, d-axis current corresponding to a magnetic flux component, and q-axis current corresponding to a torque (rotative force) component are independently

controlled. Based on the magnetic pole position detected by the encoder 13, and the phase current detected by the current sensor 11, the inverter 200 independently controls the d-axis current and the q-axis current. In addition, a d-axis is an axis parallel to a magnetic flux axis made by a rotator permanent magnet of the synchronization motor 10, and a q-axis is an axis perpendicular to the magnetic flux axis made by the rotator permanent magnet of the synchronization motor 10.

[0021]

In the embodiment, the upper controller 100 and the inverter 200 form an elevator control system 2. Nevertheless, at least part of functions of the upper controller 100 may be incorporated in the inverter 200.

[0022]

In such an elevator 1, roll back being a position variation of the elevator car 14 can occur when the brake is released in order to elevate or lower the elevator car 14. In addition, in the load-sensor-less elevator 1, if the brake 12 is released, the q-axis current rapidly flows in the synchronization motor 10 due to the vector control, for generating large torque. This accordingly causes such a problem that a sudden current flow in the synchronization motor 10 at the release of the brake 12 causes roll back to occur, and produces sound (electromagnetic noise) from the synchronization motor 10. The sound produced by the synchronization motor 10 can propagate into the elevator car 14 via the hoisting device 17 and the wire rope 16.

[0023]

Next, a structure of the upper controller 100 will be described. The upper controller 100 includes an inverter activator 101 and a brake controller 102.

[0024]

When the elevator car 14 is elevated or lowered, the inverter activator 101 outputs an inverter activation command to the inverter 200 for activating the inverter 200. The inverter 200 performs activation in response to the reception of the inverter activation command.

[0025]

The brake controller 102 outputs the brake release command to the brake 12 and the inverter 200 after the inverter activator 101 has output the inverter activation command. Nevertheless, the brake controller 102 may be provided in the inverter 200. If the brake controller 102 is provided in the inverter 200, the brake release command may be output from the inverter 200 to the brake 12.

[0026]

Next, a structure of the inverter 200 will be described. The inverter 200 includes a control starter 201, a speed controller 202, a subtractor 203, a q-axis current controller 204, a d-axis current controller 205, a coordinate transformer 206, a current regulator 207, a coordinate transformer 208, and a power converter 209.

[0027]

Before the brake 12 is released, the control starter 201 starts zero speed control of controlling a rotational speed of the synchronization motor 10 to zero. More specifically, the control starter 201 controls the speed controller 202 so as to set zero as a value of a speed command. The control starter 201 may start the zero speed control after the activation of the inverter 200 and before the reception of the brake release command. In addition, the control starter 201 controls the d-axis current controller 205 so as to start to flow the d-axis current.

[0028]

The speed controller 202 outputs a speed command for designating a rotational speed of the synchronization motor 10. Under the control of the control starter 201, the speed controller 202 starts the zero speed control of controlling a rotational speed of the synchronization motor 10 to zero. After the brake 12 is released, the speed controller 202 ends the zero speed control, and starts speed-up control of increasing the rotational speed of the synchronization motor 10.

[0029]

The subtractor 203 calculates a deviation of the speed command output by the speed controller 202, and a rotational speed detection value output by the encoder 13, and outputs the calculated deviation to the q-axis current controller 204.

[0030]

The q-axis current controller 204 controls the q-axis current to be flowed in the synchronization motor 10. The q-axis current controller 204 calculates a q-axis current command (I_q command) corresponding to a torque component on a rotational biaxial coordinate (d-q-axes), so as to set the deviation of the speed command output by the speed controller 202, and the rotational speed detection value output by the encoder 13, to zero, and outputs the I_q command to the current regulator 207.

[0031]

The d-axis current controller 205 controls the d-axis current to be

flowed in the synchronization motor 10. Under the control of the control starter 201, before the brake 12 is released, the d-axis current controller 205 starts to flow the d-axis current in the synchronization motor 10. More specifically, the d-axis current controller 205 outputs a d-axis current command (I_d command) corresponding to a magnetic flux component on the rotational biaxial coordinate (d-q-axes), to the current regulator 207. The d-axis current controller 205 consecutively increases the d-axis current to be flowed in the synchronization motor 10, over a predetermined period from the flow start of the d-axis current to the release of the brake 12. Here, the "predetermined period" is not limited to the entire period from the flow start of the d-axis current to the brake release, and may be a partial period from the flow start of the d-axis current to the brake release. In addition, "consecutively increasing" may mean gradually increasing, or digitally (in a phased manner) increasing from the micro viewpoint.

[0032]

Based on the phase current (e.g., U phase current and V phase current) detected by the current sensor 11, and the magnetic pole position detected by the encoder 13, the coordinate transformer 206 transforms the detection values of the phase current into values of the d-axis current (I_d) and the q-axis current (I_q). Such a method of coordinate conversion (vector calculation) is widely known to those skilled in the art. Thus, the detailed description of the coordinate conversion will be omitted.

[0033]

The current regulator 207 calculates a deviation of the value of the d-axis current command (I_d command) output by the d-axis current controller 205, and a d-axis current value (I_d) output by the coordinate transformer 206, calculates a d-axis voltage command (V_d command) so as to set the deviation to zero, and outputs the d-axis voltage command (V_d command) to the coordinate transformer 208. In addition, the current regulator 207 calculates a deviation of the value of the q-axis current command (I_q command) output by the q-axis current controller 204, and a q-axis current value (I_q) output by the coordinate transformer 206, calculates a q-axis voltage command (V_q command) so as to set the deviation to zero, and outputs the q-axis voltage command (V_q command) to the coordinate transformer 208.

[0034]

Based on the d-axis voltage command (V_d command) and the q-axis voltage command (V_q command) that are output by the current regulator 207, and the magnetic pole position detected by the encoder 13, the coordinate

transformer 208 transforms the d-axis voltage command (Vd command) and the q-axis voltage command (Vq command) into voltage commands (Vu command, Vv command, and Vw command) of a coordinate system at rest, and outputs the voltage commands (Vu command, Vv command, and Vw command) to the power converter 209.

[0035]

Based on the voltage commands (Vu command, Vv command, and Vw command) output by the coordinate transformer 208, the power converter 209 converts power from a power source (not illustrated) into three-phase alternating current (motor drive power), and supplies the drive power to the synchronization motor 10.

[0036]

(Elevator Control Method)

FIG. 2 is a flowchart illustrating an elevator control method according to the embodiment.

[0037]

As illustrated in FIG. 2, in step S1, the inverter activator 101 activates the inverter 200.

[0038]

In step S2, the speed controller 202 (the control starter 201) starts the zero speed control of controlling a rotational speed of the synchronization motor 10 to zero. As compared with zero servo control of controlling so as to maintain the magnetic pole position of the synchronization motor 10 to a default position (zero position), the zero speed control needs not switch from position control to speed control when executing subsequent speed control (speed-up control).

[0039]

In step S3, the d-axis current controller 205 starts to flow the d-axis current in the synchronization motor 10. The d-axis current controller 205 consecutively increases the d-axis current to a target value. By starting to flow the d-axis current in the synchronization motor 10, retaining force of retaining the rotation shaft of the synchronization motor 10 can be exhibited. Furthermore, even if the q-axis current flows in the synchronization motor 10 when the brake 12 is released, a variation of current at the release of the brake 12 can be made small.

[0040]

In step S4, the brake controller 102 outputs a brake release command.

[0041]

In step S5, the d-axis current controller 205 causes the d-axis current to reach the target value (i.e., completes a rise of the d-axis current). More specifically, the d-axis current controller 205 increases the d-axis current to the target value so that the d-axis current becomes larger than the q-axis current at a time point at which the brake 12 is released. By increasing the d-axis current to the target value before the brake 12 is released, even if the q-axis current flows in the synchronization motor 10 at the brake release, a variation of current at the brake release can be made small.

[0042]

In step S6, the brake 12 is released after a predetermined delay time from the reception of the brake release command.

[0043]

In step S7, the speed controller 202 switches from the zero speed control to the speed-up control of increasing the rotational speed of the synchronization motor 10. As a result, elevation or lowering of the elevator car 14 is performed.

[0044]

In step S8, the d-axis current controller 205 consecutively decreases the d-axis current to be flowed in the synchronization motor 10. "Consecutively decreasing" may mean gradually decreasing, or digitally (in a phased manner) decreasing from the micro viewpoint.

[0045]

(Operation Example)

FIG. 3 is a time chart illustrating an operation example of the elevator control system according to the embodiment.

[0046]

Time t1: as illustrated in FIG. 3(a), the inverter activator 101 outputs an inverter activation command to the inverter 200. In addition, as illustrated in FIG. 3(d), the speed controller 202 (the control starter 201) starts the zero speed control. Furthermore, as illustrated in FIG. 3(e), the d-axis current controller 205 starts to flow the d-axis current in the synchronization motor 10. The d-axis current controller 205 consecutively increases the d-axis current to a target value. As an example, the target value of the d-axis current can be set to a value corresponding to about 50% of rated current of the synchronization motor 10.

[0047]

Time t2: as illustrated in FIG. 3(b), the brake controller 102 outputs a brake release command to the brake 12 and the inverter 200.

[0048]

Time t3: as illustrated in FIG. 3(e), the d-axis current controller 205 causes the d-axis current to reach the target value (i.e., completes a rise of the d-axis current). In this manner, the d-axis current controller 205 consecutively increases the d-axis current to be flowed in the synchronization motor 10, over a predetermined period (period from the time t1 to time t3) from the flow start of the d-axis current to the release of the brake 12. Here, while consecutively increasing the d-axis current, the d-axis current controller 205 changes a rate of increase. In the example in FIG. 3(e), while consecutively increasing the d-axis current, the d-axis current controller 205 decreases the rate of increase of the d-axis current after increasing the rate of increase of the d-axis current. In other words, the d-axis current controller 205 changes the d-axis current in an S-shaped manner. This can smoothly increase the d-axis current at the start of the predetermined period. Thus, sound production caused by the d-axis current can be prevented.

[0049]

Time t4: as illustrated in FIG. 3(c), the brake 12 is actually released. If the brake 12 is actually released, the encoder 13 detects a rotational speed change of the synchronization motor 10. Here, the value of the speed command to be output by the speed controller 202 is set to zero by the zero speed control. Thus, as illustrated in FIG. 3(g), the q-axis current controller 204 calculates and outputs the q-axis current command (I_q command) so as to stop the change in the rotational speed of the synchronization motor 10. As a result, the q-axis current flows in the synchronization motor 10. Nevertheless, because the d-axis current has been already increased to the target value, even if the q-axis current flows in the synchronization motor 10 at the brake release, a variation of motor current at the brake release can be made small. Thus, a sudden current flow in the synchronization motor 10 at the release of the brake 12 can be prevented.

[0050]

Time t5: as illustrated in FIG. 3(d) and 3(f), the speed controller 202 (the control starter 201) ends the zero speed control, and starts speed-up control of increasing the rotational speed of the synchronization motor 10.

[0051]

Time t6: as illustrated in FIG. 3(e), the d-axis current controller 205 consecutively (gradually) decreases the d-axis current to be flowed in the synchronization motor 10, within a period up to a time t7. By gradually decreasing the d-axis current to be flowed in the synchronization motor 10, a

rapid increase in the q-axis current can be suppressed. This can further reduce a possibility of the occurrence of shock or the like that is caused by an excess current flow in the synchronization motor 10.

[0052]

(Conclusion of Embodiment)

The elevator control system 2 according to the embodiment includes the brake controller 102 that outputs a brake release command for releasing the brake 12 of the synchronization motor 10, the control starter 201 that starts zero speed control of controlling a rotational speed of the synchronization motor 10 to zero, before the brake 12 is released, and the d-axis current controller 205 that starts to flow the d-axis current in the synchronization motor 10 before the brake 12 is released. As compared with zero servo control of controlling so as to maintain the magnetic pole position of the synchronization motor 10 to a default position (zero position), the zero speed control needs not switch from position control to speed control when executing subsequent speed control. This can further reduce a possibility of the occurrence of shock or the like (roll back) in the switching. In addition, by starting to flow the d-axis current in the synchronization motor 10 before the brake 12 is released, retaining force of retaining the rotation shaft of the synchronization motor 10 can be exhibited. Furthermore, even if the q-axis current flows in the synchronization motor 10 when the brake 12 is released, a variation of current at the release of the brake 12 can be made small. Thus, a sudden current flow in the synchronization motor 10 at the release of the brake 12 can be prevented. This can reduce the possibility of occurrence of shock or the like at the release of the brake 12. In addition, sound (electromagnetic noise) can be prevented from being produced by a sudden (rapid) current flow in the synchronization motor 10.

[0053]

The d-axis current controller 205 may consecutively increase the d-axis current to be flowed in the synchronization motor 10, over a predetermined period from the flow start of the d-axis current to the release of the brake 12. There is concern that, if sudden d-axis current flows in the synchronization motor 10, sound is produced from the synchronization motor 10 due to the d-axis current. Thus, by consecutively increasing the d-axis current to be flowed in the synchronization motor 10, over the predetermined period from the flow start of the d-axis current to the release of the brake 12, a sudden (rapid) d-axis current flow in the synchronization motor 10 can be prevented.

[0054]

In the embodiment, while consecutively increasing the d-axis current,

the d-axis current controller 205 changes a rate of increase. While consecutively increasing the d-axis current, the d-axis current controller 205 may decrease the rate of increase of the d-axis current after increasing the rate of increase of the d-axis current. By gradually decreasing the rate of increase of the d-axis current after gradually increasing the rate of increase of the d-axis current, the d-axis current can be smoothly increased at the start of the predetermined period. This can prevent sound production caused by the d-axis current, more surely.

[0055]

The d-axis current controller 205 may increase the d-axis current to the target value so that the d-axis current becomes larger than the q-axis current at a time point at which the brake 12 is released. By increasing the d-axis current to the target value so that the d-axis current becomes larger than the q-axis current at the time point at which the brake 12 is released, even if the q-axis current flows in the synchronization motor 10 at the release of the brake 12, a variation of current at the release of the brake 12 can be made small. Thus, sound can be prevented from being produced from the synchronization motor 10 at the release of the brake 12, more surely.

[0056]

After the brake 12 is released, the control starter 201 may end the zero speed control, and start speed-up control of increasing the rotational speed of the synchronization motor 10. After the speed-up control is started, the d-axis current controller 205 may consecutively decrease the d-axis current to be flowed in the synchronization motor 10. By gradually decreasing the d-axis current to be flowed in the synchronization motor 10, after the speed-up control is started, a rapid increase in the q-axis current can be suppressed. This can further reduce a possibility of the occurrence of shock or the like that is caused by an excess current flow in the synchronization motor 10.

[0057]

The synchronization motor 10 may be a pencil-shaped synchronization motor having a shape elongated in the axis direction (rotation axis direction). In an installed state, the pencil-shaped synchronization motor can reduce an installation space in a height direction. Thus, the pencil-shaped synchronization motor is preferable for low-rise buildings with limited installation spaced.

[0058]

(Modified Example 1)

In the aforementioned embodiment, the description has been given of

an example in which, while consecutively increasing the d-axis current within the predetermined period, the d-axis current controller 205 decreases the rate of increase of the d-axis current after increasing the rate of increase of the d-axis current (refer to FIG. 3(e)).

[0059]

Nevertheless, as illustrated in FIG. 4, while consecutively increasing the d-axis current within the predetermined period, the d-axis current controller 205 may keep the rate of increase of the d-axis current constant. In other words, the d-axis current controller 205 linearly increases the d-axis current.

[0060]

Alternatively, as illustrated in FIG. 5, while consecutively increasing the d-axis current within the predetermined period, the d-axis current controller 205 may increase the rate of increase of the d-axis current. More specifically, the d-axis current controller 205 increases the d-axis current at a first rate of increase up to the middle of the predetermined period, and increases the d-axis current at a second rate of increase higher than the first rate of increase, from the middle of the predetermined period. This can suppress the rate of increase of the d-axis current at the flow start of the d-axis current, and prevent sound production caused by the d-axis current, more surely.

[0061]

(Modified Example 2)

In the aforementioned embodiment, the description has been given of an example in which the control starter 201 starts the zero speed control before the brake 12 is released. Nevertheless, as illustrated in FIG. 6, the control starter 201 may start the zero servo control before the brake 12 is released. In the modified example illustrated in FIG. 6, a subtractor 203a is configured to be able to switch input between the speed controller 202 and a zero servo controller 210. Before the brake 12 is released, the control starter 201 inputs output of the zero servo controller 210 into the subtractor 203a. After the brake 12 is released, the control starter 201 inputs output of the speed controller 202 into the subtractor 203a.

[0062]

(Other Embodiments)

FIG. 7 is a block diagram illustrating a system structure according to another embodiment. As illustrated in FIG. 7, a sensor 18 that detects vibration and/or sound produced by the synchronization motor 10 is attached to the synchronization motor 10. The sensor 18 may be installed around the synchronization motor 10 without being directly attached to the synchronization

motor 10. The inverter 200 includes a parameter adjuster 211 that adjusts a parameter related to the d-axis current to be flowed in the synchronization motor 10, based on a detection value of the sensor 18. Alternatively, the parameter adjuster 211 may be provided in the upper controller 100.

[0063]

Here, as illustrated in FIGS. 3(e), 4, and 5, the parameter related to the d-axis current is any of a length of the predetermined period (i.e., time required for increase in the d-axis current), a slope/shift of a rate of increase of the d-axis current (i.e., increase pattern of the d-axis current), and the target value (i.e., ratio of the d-axis current with respect to rated current).

[0064]

As an example, the parameter adjuster 211 stores each parameter and a detection value of the sensor 18 that is obtainable when the brake 12 is released, in association with each other, and decides a value of each parameter so that vibration and/or sound produced by the synchronization motor 10 becomes small, based on a change in sensor detection value that is obtainable when a corresponding parameter is changed.

[0065]

In this manner, by adjusting a parameter related to the d-axis current to be flowed in the synchronization motor 10, based on a detection value of a sensor that detects vibration and/or sound produced by the synchronization motor 10, the parameter can be automatically adjusted to an optimum parameter so as to suppress vibration and/or sound produced by the synchronization motor 10.

CLAIMS

1. An elevator control system for controlling, by vector control, a synchronization motor configured to elevate and lower an elevator car of an elevator, the elevator control system comprising:
 - a brake controller configured to output a brake release command for releasing a brake for braking a rotation of the synchronization motor;
 - a control starter configured to start, before the brake is released, zero speed control of controlling a rotational speed of the synchronization motor to zero, or zero servo control of retaining a magnetic pole position of the synchronization motor; and
 - a d-axis current controller configured to start to flow d-axis current in the synchronization motor before the brake is released.
2. The elevator control system according to claim 1, wherein
 - before the brake is released, the control starter is configured to start the zero speed control of controlling a rotational speed of the synchronization motor to zero.
3. The elevator control system according to claim 1 or 2, wherein
 - the d-axis current controller is configured to consecutively increase the d-axis current to be flowed in the synchronization motor, over a predetermined period from a flow start of the d-axis current to a release of the brake.
4. The elevator control system according to claim 3, wherein
 - while consecutively increasing the d-axis current, the d-axis current controller is configured to change a rate of increase.
5. The elevator control system according to claim 4, wherein
 - while consecutively increasing the d-axis current, the d-axis current controller increases a rate of increase of the d-axis current.
6. The elevator control system according to claim 4, wherein
 - while consecutively increasing the d-axis current, the d-axis current controller is configured to decrease a rate of increase of the d-axis current after increasing a rate of increase of the d-axis current.
7. The elevator control system according to any one of claims 1 to 6, further

comprising

a q-axis current controller configured to control q-axis current to be flowed in the synchronization motor,

wherein the d-axis current controller is configured to increase the d-axis current to a target value so that the d-axis current becomes larger than the q-axis current at a time point at which the brake is released.

8. The elevator control system according to claim 2, wherein

after the brake is released, the control starter is configured to end the zero speed control, and to start speed-up control of increasing a rotational speed of the synchronization motor, and

after the speed-up control is started, the d-axis current controller is configured to consecutively decrease the d-axis current to be flowed in the synchronization motor.

9. The elevator control system according to any one of claims 1 to 8, further comprising:

a sensor configured to detect vibration and/or sound produced by the synchronization motor; and

a parameter adjuster configured to adjust a parameter related to the d-axis current to be flowed in the synchronization motor, based on a detection value of the sensor.

10. The elevator control system according to any one of claims 1 to 9, wherein

the synchronization motor is a pencil-shaped synchronization motor having shape elongated in an axis direction.

11. A motor control apparatus for controlling, by vector control, a synchronization motor configured to elevate and lower an elevator car of an elevator, the motor control apparatus comprising:

a control starter configured to start, before a brake for braking a rotation of the synchronization motor is released, zero speed control of controlling a rotational speed of the synchronization motor to zero, or zero servo control of retaining a magnetic pole position of the synchronization motor; and

a d-axis current controller configured to start to flow d-axis current in the synchronization motor before the brake is released.

12. An elevator control method for controlling, by vector control, a

synchronization motor configured to elevate and lower an elevator car of an elevator, the elevator control method comprising:

- outputting a brake release command for releasing a brake for braking a rotation of the synchronization motor;

- starting, before the brake is released, zero speed control of controlling a rotational speed of the synchronization motor to zero, or zero servo control of retaining a magnetic pole position of the synchronization motor; and

- starting to flow d-axis current in the synchronization motor before the brake is released.