

APPARATUS FOR CONTROLLING AN AC POWER ELEVATOR

The present invention relates to an improved apparatus for controlling an AC power elevator.

5 A control circuit for a power elevator which employs induction motors for a winding motor and a door motor is shown in Fig. 1.

In Fig. 1, a three-phase AC power source is connected to terminals 1; a drive device 2 is connected to the AC power source at the terminals 1 and is composed of a
10 thyristor, a power transistor, and an electromagnetic contactor, etc.; a winding three-phase induction motor 3 is connected to the drive device 2; a brake wheel 4 is coupled to the motor 3; a brake shoe 5 is provided to face with the
15 outer periphery of the brake wheel 4 and applies a brake force to the brake wheel 4 by the force of a spring (not shown); a brake coil 6 separates the brake shoe 5 from the brake wheel 4 against the force of the spring when the coil 6 is energized; a drive sheave 7 is driven by the motor 3
20 for a winch; a main rope 8 engaged on the sheave 7; a cage 9 is coupled to one end of the main rope 8; a cage door 10 opens or closes the entrance of the cage 9; a three-phase induction motor 11 drives the cage door 10 to open or close the cage door 10; a balancing weight 12 is coupled to the
25 other end of the main rope 8; a door motor drive device 13

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is inserted between the power source 1 and the motor 11 and is composed of a thyristor, a power transistor, an electromagnetic contactor, etc.; an operation command generator 14 generates a command to start or stop the motor 3 so as to control the gate or the thyristor or the base of the transistor of the drive device 2; and a door command generator 15 generates a command to start or stop the motor 11 so as to control the drive device 13 similarly to the generator 14.

10 An example of the concrete structure of the drive device 2 is shown in Fig. 2.

In Fig. 2, terminals R, S and T are connected to a three-phase AC power source 1; a rectifier 101 converts a three-phase AC power source voltage into a DC voltage; a smoothing capacitor 102 smooths the DC output of the rectifier 101; an inverter 103 of widely known pulse width modulation type is connected to the DC side of the rectifier 101 and converts a predetermined DC voltage into an alternating current having a variable voltage and variable frequency under the pulse width control; the winding three-phase induction motor 3 is driven by the inverter 103; an inverter 113 for electric power regeneration is connected between the power source at the terminals R, S and T and the output side of the rectifier 101; normally open contacts 118a - 118c of the electromagnetic contactor

for operation are energized when the cage 9 is started and are deenergized when the cage 9 is stopped; and normally open contacts 119a - 119c of the electromagnetic contactor are energized after the contacts 118a - 118c of the electromagnetic contactor are energized, and are deenergized after the contacts 118a - 118c are deenergized.

Fig. 2 shows an internal circuit diagram of the rectifier 101, wherein the rectifier 101 consists of diodes $D_1 - D_6$. The rectifier output of the rectifier 101 is smoothed, and is supplied to the inverter 103 illustrated in Fig. 4. In Fig. 4, diodes are connected reversely to transistors $Q_1 - Q_6$; and the inverter is conducted sequentially in the operating direction by the voltage applied to the bases of the transistors. The drive device 2 is thus constructed. A variety of concrete arrangement of the drive device 13 for the door motor can be considered, and may be constructed similarly to the drive device 2.

The detailed circuit diagram of the operation command generator 14 is shown in Fig. 5. This circuit mainly consists of a calling button 218, a car direction command generator 219, and a frequency and phase order signal generator 220.

In Fig. 5, when the button 218 is conducted, a power source voltage V_{cc} is applied to a speed pattern circuit (SP) to charge a capacitor C_1 through a resistor R_1 . In

this manner, a charging voltage V_p shown in Fig. 6 can be obtained. The charging voltage V_p due to the conduction of the button 218 is applied to a voltage controlled oscillator 223, which in turns generates an output pulse 222a
5 responsive to the voltage V_p .

Fig. 7 shows the waveform diagram of the output pulses at the respective sections in Fig. 5. The output pulse 222a is supplied to 6 step Up/Down Counter 224, which in turn generates the output pulses 224a, 224b and 224c shown
10 in Fig. 7, thereby controlling the inverter 103.

The counter 224 receives a car direction command signal from the car direction command generator 219. The power source voltage V_{cc} is applied to the counter 224 when the contact (UP) is closed, thereby rotating the induction
15 motor 3 so as to lift the cage of the elevator. When the contact (DN) is closed, the case is reversely lowered.

More particularly, the output pulses 226a - 231a shown in Fig. 7 are outputted from OR gates 226 - 231, are used as the gate pulses of the transistors $Q_1 - Q_6$ of the
20 inverter 103, and the inverter 103 generates the AC power having variable voltage and variable frequency of the phase order corresponding to the car direction.

The operation command generator 14 is thus constructed, thereby controlling the inverter 103 of the drive
25 device 2 and driving the winding induction motor 3.

The door command generator 15 may be constructed in the same manner as the operation command generator 14, and when the generator 15 is constructed in the same manner as the generator 14, the car direction command generator 219 in Fig. 5 may be used as the door opening or closing command generator in such a manner that the UP switch is used as the door OPEN switch, and the DOWN switch is used as the door CLOSE switch. In this case, Vp in Fig. 6 becomes the door opening or closing speed command.

10 The control circuit for the elevator thus constructed controls the motor 3 by the operation command generator 14 and the drive device 2, thereby starting the cage 9, and the cage 9 is moved to the storey to be called and is then stopped. When the cage 9 is stopped, the motor 11 is 15 controlled by the door command generator 15 and the drive device 13, thereby opening the cage door 10. When a predetermined period of time (such as 4 seconds) is elapsed after the cage door 10 is opened, the motor 11 is controlled by the drive device 13, thereby closing the cage door 20 10. When another calling is generated from other storey, the motor 3 is again controlled by the drive device 2, and the cage 9 starts moving.

In this manner, unless a high class elevator is employed, the opening or closing period of the cage door 10 25 and the operation period of the cage 9 are controlled so as

not to be superposed. Therefore, when induction motors are used for the winding motor 3 and the door motor 11, it is not economic to accommodate the exclusive drive device 13 as the door motor 11.

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SUMMARY OF THE INVENTION

The present invention enables the avoidance of the above-mentioned drawbacks and its object is to provide a control apparatus for controlling an AC powered elevator, which commonly uses the drive device for a winding induction 10 motor and the drive device for a door induction motor, thereby inexpensively constructed.

Another object of the present invention is to provide a control apparatus for controlling an AC powered elevator, which can effectively prevent the cage door of the elevator 15 from opening during the moving, thereby improving the safety.

Still another object of the present invention is to provide a control apparatus for controlling an AC powered elevator, which can prevent passengers from being enclosed 20 in the cage of the elevator.

There is provided, according to the present invention apparatus for controlling an AC powered elevator comprising:

a three-phase AC power source;

5 a drive device connected to said three-phase AC power source for converting the AC source power into AC power having a variable frequency;

a winding induction motor connected to and controlled by said drive device for driving the cage of the elevator;

10 a door induction motor connected to and controlled by said drive device for opening or closing the cage door of the elevator;

a motor control command device having an operation command generator which generates a command for starting or stopping the cage of the elevator to control said drive device and a door command generator which generates a command for opening or closing the cage door to control said drive device for controlling the winding induction motor and the door induction motor independently as to timing; and

switching means connected between said AC power source and said door induction motor for applying a door-closing voltage to said door induction motor irrespective of said drive device during the running of said cage thereby to hold said cage door closed.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a circuit diagram showing a conventional apparatus for controlling an AC powered elevator;

Fig. 2 is a circuit diagram illustrating concretely a drive device;

5 Fig. 3 is a circuit diagram showing a rectifier;

Fig. 4 is a schematic circuit diagram of an inverter;

Fig. 5 is a detailed circuit diagram illustrating an operation command generator;

10 Fig. 6 is a diagram illustrating the waveform of the charging voltage V_p ;

Fig. 7 is a diagram illustrating the waveform of the output pulses of the sections of the circuit in Fig. 5;

Fig. 8 is a circuit diagram showing an apparatus for controlling an AC powered elevator;

15 Fig. 9 is a circuit diagram showing an embodiment of the present invention; and

Figs. 10 and 11 are timing charts for explaining the operations of the embodiment shown in Fig. 9.

20 The same reference numerals in the respective drawings denote the same or equivalent parts and components.

25 In Fig. 8 the same reference numerals as those in Fig. 1 denote the same or equivalent parts and components.

In Fig. 8, contacts 14a - 14c of an electromagnetic contactor are inserted between the drive device 2 and the motor 3 and are closed by the command of the operation command generator 14 during the movement of the cage 9 and are opened while the cage door 10 is controlled; contacts 15a - 15c of an electromagnetic contactor are inserted between the drive device 2 and the motor 11 and are closed by the command of the door command generator 15 during the control of the cage door 10 and are opened during the movements of the cage 9; and a motor control command device 17 consists of the operation command generator 14 and the door command generator 15.

The detailed circuits and the operation of the respective sections are similarly arranged to those of the apparatus in Fig. 1.

The operation of this apparatus will be described below.

The contacts 14a - 14c of the electromagnetic contactor are closed by the command of the command device 17 during the operation of the cage 9, and the contacts 15a - 15c are opened. Therefore, the motor 3 is controlled by the drive device 2, and the cage 9 is started or stopped. When the cage 9 is stopped, the contacts 14a - 14c are again opened by the command of

the command device 17, and the contacts 15a - 15c are closed. In this manner, the motor 11 is controlled by the drive device 2, and the cage door 10 is opened or closed. When the cage door 10 is closed, the contacts 15a - 15c are again opened by the command of the command device 17, and the contacts 14a - 14c are closed, thereby controlling the motor 3. More particularly, the command device 17 and the drive device 2 are operated to control the motors 3 and 11 independently at the timing. Therefore, an exclusive device for controlling the motor 11 can be eliminated.

Fig. 9 shows an embodiment of the present invention, wherein the parts and the components except those shown are similarly constructed to those in Fig. 8.

In Fig. 9, contacts 18a- 18c of an electromagnetic contactor for forcibly opening the cage door 10 are inserted between the power source 1 and the door induction motor 11; contacts 19a - 19c of an electromagnetic contactor for holding the cage door closed are provided corresponding to the contacts 18a - 18c and are connected to switch the phase of the power source and are closed during the running of the cage 9; and resistors 20a and 20b are respectively connected to the contacts 19a and 19c.

More particularly, when the cage 9 is running, the contacts 19a - 19c are closed. Therefore, a voltage is applied to the motor 11 irrespective of the operation of the drive device 2, and a pushing force is applied to the closed cage door 10. In this manner, the cage door 10 is prevented from opening due to any reason during the running of the cage 9. The resistors 20a and 20b are for limiting a current during this pushing of the cage door 10. Since the contacts 19a - 19c are not interposed via a complicated device such as the drive device 2, the operations are effective, and stable pushing force can be maintained.

When the cage 9 is stopped in the zone in which the door of the floor of the storey can be opened or closed, owing to a defect of the command device 17 or the drive device 2, and a predetermined period of time e.g. 2 secs has elapsed but the cage door 9 is not opened, the contacts 18a - 18c are closed. In this manner, the motor 11 rotates in the direction of opening the door, and the cage door 10 is opened. Therefore, passengers can not be trapped in the cage 9.

The operation of the embodiment in Fig. 9 will be described below with reference to the timing chart in Fig. 10. In normal operation i.e., when the drive device 2 is driven by the command of the command device 17, the contacts 18a - 18c are normally open, and the AC

output of the power source 1 is not supplied to the induction motor 11. When the elevator is operating, the contacts 19a - 19c are closed by the command of the operation command generator 14 of the command device 17,
 5 a voltage is applied to the motor 11, a pushing force is applied to the closed cage door 10 and the cage door 10 is effectively held closed.

When the cage is stopped in the zone in which the door can be opened but the door is not opened, a
 10 detector which detects the stopping of the cage in the said zone is operated as shown in Fig. 11, a timer is operated by a signal from the detector, the electromagnet is energized by the signal from the timer after a predetermined period of time has elapsed, and
 15 the contacts 18a - 18c are closed. In this manner, the motor 11 is operated, thereby opening the door, and passengers are not trapped in the cage of the elevator.

Therefore, according to the embodiment in Fig. 9, the contacts 18a - 18c and 19a - 19c are not
 20 simultaneously closed.

The drive devices 2 of the above-mentioned embodiments may be applied to both the motor primary voltage controller and the variable voltage and variable frequency power source via thyristors.

CLAIMS:

1. Apparatus for controlling an AC powered elevator comprising:

a three-phase AC power source;

5 a drive device connected to said three-phase AC power source for converting the AC source power into AC power having a variable frequency;

a winding induction motor connected to and controlled by said drive device for driving the cage of the elevator;

10 a door induction motor connected to and controlled by said drive device for opening or closing the cage door of the elevator;

a motor control command device having an operation command generator which generates a command for starting or stopping the cage of the elevator to control said drive device and a door command generator which generates a command for opening or closing the cage door to control said drive device for controlling the winding induction motor and the door induction motor independently as to timing; and

20 switching means connected between said AC power source and said door induction motor for applying a door-closing voltage to said door induction motor irrespective of said drive device during the running of said cage thereby to hold said cage door closed.



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2. Apparatus for controlling an AC powered elevator as set forth in claim 1 wherein:

said switching means is connected in series with a current limiting resistor.

5 3. Apparatus for controlling an AC powered elevator as set forth in claim 1 or 2 wherein:

said switching means comprise at least one contact of an electromagnetic contactor which is operated by the command of said operation command generator.

10 4. Apparatus as claimed in any of claims 1 to 3 further including door opening switching means connected between said AC power source and said door induction motor for driving said door induction motor in the cage door opening direction when said said cage is stopped in a
15 zone in which a landing door can be opened and after a predetermined period of time has elapsed said door has not been opened.

5. Apparatus for controlling an AC powered elevator as set forth in claim 4, wherein:

20 said door opening switching means comprise at least one contact of an electromagnetic contactor energized by a timer operated by a detector for detecting stopping of said cage in the said zone.



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6. An elevator control apparatus substantially as herein described with reference to Fig 9 of the accompanying drawings.



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