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Control Device for an a.c. elevator

This invention relates to an improved control device for an elevator driven by an a.c. motor.

According to a known device of this kind, an elevator car is driven by an induction motor to which a current is
5 supplied from an a.c. source of variable voltage and frequency to effect speed control of the motor. This known device is shown in Fig. 1.

In Fig. 1, the numeral 1 designates a three-phase full wave rectifier device consisting of thyristors 1a to
10 1f connected in turn to an alternating current source R, S, T. The numeral 2 designates a capacitor for smoothing the output voltage of the rectifier device 1. The numeral 3 designates an inverter connected to the direct current side of the rectifier device and made up of diodes 3a to 3f and
15 transistors 3A to 3F. The inverter is designed to convert the direct current into the alternating current by controlling the base electrodes of the transistors 3A to 3F and to render the voltage and frequency of the resulting alternating current variable. The numeral 4 designates a three-phase
20 induction motor driven by the inverter 3. The numeral 5

designates a brake wheel coupled to the motor 4. The numeral 6 designates a brake shoe mounted opposite to the outer periphery of the brake wheel 5 for braking the brake wheel 5 under the force of a spring, not shown. The numeral 7 denotes a brake coil adapted when energized to disengage the brake shoe 6 from the brake wheel 5 against the force of the spring. The numeral 8 designates a driving sheave of a winch driven by the induction motor. The numeral 9 designates a main guy or cable wound about the sheave 8.

10 The numeral 10 designates a car connected to the main cable 9. The numeral 11 designates a counterweight. The numerals 12a to 12c designate contacts of a magnetic contactor connected between the source R, S, T and the rectifier device 1 and designed to be closed and opened when the car 10 travels and comes to a stop, respectively. The numerals 13a to 13c designate contacts of a magnetic contactor connected between the contacts 12a to 12c and adapted to be opened and closed following opening and closure of the contacts 12a to 12c, respectively.

20 In operation, the brake wheel 5 is pressured by the brake shoe 6 under the force of the abovementioned spring. When the start commands are issued to the car 10, the contacts 12a to 12c are closed, so that the rectifier 1 delivers a d.c. output. When the capacitor has been charged to a
25 predetermined potential, control elements of respective

-3-

inverter arms, not shown, are sequentially rendered operative in accordance with the desired car direction so that a.c. output signals of variable voltage and frequency are produced in accordance with the phase order corresponding to the prevailing car direction. Thereafter, the contacts 13a to 13c are closed, and the aforesaid output signal is supplied to the motor 4. The brake coil 7 is energized at the same time so that the brake shoe 6 is disengaged from the brake wheel 5. In this manner, the motor 4 is started in the direction determined by the phase order of the input signals. Thus the car 10 starts its travel. The rpm of the motor 4 and hence the speed of the car 10 are controlled by frequency control function of the inverter 3. As the car 10 approaches the floor of destination, the car starts to be slowed down. The contacts 12a to 12c are opened shortly before the car gets to the floor of destination, so that the motor 4 is disconnected from the source. The brake coil 7 is deenergized at the same time and the brake shoe 6 is pressured to the brake wheel 5 under the force of the aforementioned spring for braking the brake wheel 5. At this time, only the control elements of certain predetermined arms of the inverter 3 are rendered operative by the opening of the contacts 12a to 12c so that the charge of the capacitor 2 flows to the motor 4 for applying a d.c. braking torque to the motor 4. In this manner, the car 10 is stopped

positively at the floor of destination.

However, when the thyristors are turned on with closure of the contacts 12a to 12c, a large charging current with quick build-up characteristics flows through the capacitor 2, thus occasionally damaging the thyristors 1a to 1f. Moreover, the service life of the capacitor 2 may be shortened where the start and stop operations are repeated frequently, as in the case of an elevator. Reactors or other current limiting devices may be connected to the direct current side of the rectifier device 1 for protecting the thyristors 1a to 1f and the capacitor 2 from such adverse effects. However, such control device tends to be costly.

It is a main object of the present invention to provide a control device for an a.c. elevator which is free from the above inconvenience and in which the large charging current may not flow to the capacitor at the time of starting of elevator operation.

It is another object of the present invention to prevent damage of rectifying elements of the rectifier device.

Fig. 1 is a diagrammatic view showing a prior-art control device of the a.c. elevator.

Fig. 2 is a diagrammatic view showing an embodiment

-5-

of the control device of the a.c. elevator according to the present invention.

Fig. 3 is a diagrammatic view showing a modified embodiment of the present invention.

An embodiment of the present invention is described by referring to Fig. 2.

In the Figure, the numeral 15 designates a second rectifier device connected between the source R, S, T and
10 the output side of the first rectifier device 1 and consisting of a group of diodes 15a to 15f connected for forming a three-phase full wave rectifier circuit. The numeral 16 designates an impedance consisting of a resistor connected to the output side of the rectifier 15. Other elements are
15 the same as those shown in Fig. 1.

The capacitor 2 is charged by the rectifier device 15 and the impedance 16 even while the car 10 is at a standstill. Thus, when the contacts 12a to 12c have been closed at the start of elevator travel, the capacitor 2 is not
20 charged suddenly by the direct current flowing through the lower impedance of the rectifier device 1. In this manner the thyristors and capacitors 2 may not be affected by the excessive charging current to the capacitor 2 when the elevator is started.

25 Fig. 3 illustrates a modified embodiment of the

In the Figure, the numeral 1 denotes a rectifier device wherein a group of diodes 11a to 11f are used in place of the thyristors 1a to 1f to the rectifier device shown in Fig. 1. The numerals 16a to 16c designate an impedance
5 consisting of resistors connected across the contacts 12a to 12c. Other elements are the same as those shown in Fig. 1.

This embodiment refers to a form of a variable voltage and frequency generator with the rectifier device 1 being formed by a group of diodes 11a to 11f.

10 As is clear from the drawing, while the car is stopped, that is, when the contacts 12a to 12c are opened, the capacitor 2 is charged at all times through the impedance in the form of resistors which is connected in the alternating current side of the rectifier device. Accordingly, when the
15 contacts 12a to 12f are closed at the start of elevator travel, discharge rush current does not flow to the capacitor 2, and hence the diodes 11a to 11f may not be damaged by the overcurrent flowing through the diodes.

As mentioned above, the present invention is directed
20 to a control device for the a.c. elevator wherein the alternating current from the commercial a.c. source is rectified by the rectifier circuit, smoothed by the capacitor and converted by the inverter into the a.c. power of the variable frequency used for driving the elevator car.

25 According to the present invention, the capacitor may be

charged through the impedance connected to the commercial a.c. source while the elevator is stopped. In this manner, the large charging current may be prevented from flowing to the capacitor during startup of the car so that the rectifier elements of the rectifier device and the capacitor may not be damaged by overcurrent conditions.



CLAIMS:

1. A control device for an a.c. elevator comprising:
a commercial a.c. source;
first rectifier means for rectifying the commercial
a.c. source;

5 a capacitor for smoothing the output voltage of the
first rectifier means;

switching contacts that are provided between the
commercial a.c. source and the first rectifier means,
that are closed when the elevator car runs, and that are
10 opened when the elevator car stops;.

an inverter for converting the smoothed output
voltage of the capacitor into a.c. power of a variable
frequency;

an a.c. motor for driving the elevator car by the
15 a.c. power supplied from said inverter; and

second rectifier means for rectifying the voltage of
the commercial a.c. source and charging said capacitor
by the thus rectified voltage at least when the car is
stopped, said second rectifier means being provided
20 between the commercial a.c. source and the capacitor and
bypassing said contacts.

2. A control device for an a.c. elevator according to
claim 1, wherein said second rectifier means has an



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impedance, and the rectified output of the second rectifier means is supplied to the capacitor via the impedance.

3. A control device for an a.c. elevator comprising:

5 a commercial a.c. source;

rectifier means for rectifying the commercial a.c. source;

a capacitor for smoothing the output voltage of the rectifier means;

10 contacts that are provided between the commercial source and rectifier means, that are closed when the elevator car runs, and that are opened when the elevator car stops;

an inverter for converting the smoothed output
15 voltage of the capacitor into an a.c. power of a variable frequency;

an a.c. motor for driving the elevator car by the a.c. power supplied from said inverter; and

an impedance that is provided between said rectifier
20 means and the commercial a.c. source bypassing said contacts in order to electrically charge said capacitor.

4.A control device for an a.c. elevator according to claim 3, wherein when said contacts are opened, said capacitor is electrically charged by the commercial a.c.
25 source through said impedance and said rectifier means.