

A WINDING DRUM TYPE ELEVATOR CONTROL

This invention relates to a winding drum type elevator control.

5 A winding drum type elevator has been proposed as an elevator small in size, low in speed and short in lifting distance. Such an elevator is as shown diagrammatically in Figure 1.

10 In Figure 1, reference numeral 1 designates a three-phase induction motor; 2, a worm driven by the motor 1; 3, a worm gear engaged with the worm; 4, a winding drum coupled to the worm gear; 5, a main cable which is wound on the winding drum 4 or unwound from the same; 6, a block which is rotatably mounted on the ceiling 7 of a shaft and around which the main cable 5
15 extends; and 8, a cage to which one end of the main cable 5 is fastened.

In moving the cage upwardly, a brake (not shown) is released to start the motor 1, so that the winding drum 4 is turned through the worm 2 and the worm gear 3,
20 i.e., the main cable 5 is wound on to the winding drum 4, whereby the cage 8 is moved upwardly. In order to move the cage 8 downwardly, the motor 1 is turned in the opposite direction to turn the winding drum 4 in the opposite direction, so that the main cable 5 is
25 unwound from the winding drum 4 and the cage 8 is moved downwardly by its own weight. When the speed of the motor 1 reaches the synchronous speed, a dynamic braking force acts on the motor 1, and when the speed is decreased to the extent that the dynamic braking
30 torque is in balance with the load torque, the cage 8 is run at a constant speed.

Since the elevator is designed as described above, if starting torque is produced so as to provide suitable acceleration for the upward movement operation, in the downward movement operation the starting shock is large and persons are not comfortable in the cage 8. This difficulty may be overcome by increasing the inertial moment; however, in this case, a large amount of heat is generated by the motor 1, and accordingly it is necessary to increase the size of the motor 1. The torque generated by the motor 1 may be suppressed by inserting start resistance; however, in this case, the starting circuit is unavoidably intricate.

An object of this invention is to eliminate the above described difficulties accompanying a conventional winding drum type elevator.

According to the present invention there is provided a winding drum type elevator control in which a winding drum driven by an induction motor is provided, and in the upward movement operation a cage thereof is run by winding a main cable thereof on said winding drum, while in the downward movement operation said cage is run by unwinding said main cable from said winding drum and comprising first switching means which, for the upward movement operation, are closed to apply electric power to said motor to allow the latter to operate in a normal full torque mode, second switching means which, for the downward movement operation, are closed to apply electric power to said motor to allow the latter to start in a low torque mode and third switching means for applying electric power to said motor to allow the latter to operate in said normal full torque mode, said third switching means operating automatically when the downward speed of said cage reaches a predetermined

value or when the cage has been in motion for a predetermined time.

In the accompanying drawings;

5 Figure 1 is an explanatory diagram outlining a winding drum type elevator;

Figure 2 is a circuit diagram showing a first example of a winding drum type elevator starting device according to this invention;

10 Figure 3 is a characteristic diagram indicating torque with slip for a description of the operation of the device in Figure 2;

Figure 4 is a circuit diagram showing a second example of the device according to the invention;

15 Figure 5 is a characteristic diagram indicating torque with slip for a description of the operation of the device in Figure 4;

Referring firstly to Figure 2, reference characters R, S and T designates the phases of a three-phase AC power source; U, V and W, the terminals of an electric motor 1; 11a, 11b and 11c, upward movement electromagnetic contactor contact means which are connected between the phases R, S and T and the terminals U, V and W and are closed in the upward movement operation; 12a, a downward movement electromagnetic contactor contact means which is connected between the phase R and the terminal V and is closed in the downward movement operation; and 12b, a downward movement electromagnetic contactor contact means which is connected between the phase S and the terminal U.

In Figure 3, reference numeral 13 designates the torque of the motor 1 when the latter is energized by three-phase alternating current; 14, the torque of the motor 1 when the latter is energized by single-phase alternating current; 15, load torque in upward movement operation; and 16, load torque downward movement operation.

A downward movement electromagnetic contactor contact means 17 is provided which is connected in parallel with the contact means 11c and which is closed a predetermined period of time after the downward movement operation is started (or immediately after the speed of the cage 8 reaches a predetermined value substantially).

In upward movement operation, when the contact means 11a through 11c are closed, three-phase alternating current is supplied to the motor 1, as a result of which the cage 8 is run at the speed which is determined by the point A where the motor torque 13 is in balanced with the load torque 15.

In downward movement operation, when the contact means 12a and 12b are closed, single-phase alternating current is supplied to the motor 1. The motor 1 is started moderately by being pulled by the load torque 16 attributed to the weight of the cage 8, so that the cage 8 is accelerated smoothly. Thus, the speed of the motor 1 exceeds the synchronous speed, and but for contact means 17, the cage would run at the speed which is determined by the point B where the dynamic braking torque 14 is in balance with the load torque 16.

However, when the speed of the cage 8 has substantially reached the predetermined value, the contact means 17 is

closed, so that three-phase alternating current is applied to the motor. As a result, the cage 8 is run at the speed which is determined by the point C where the dynamic braking torque 13 is in balance with the load torque 16. Thus, the heat generation of the motor 1 due to the single-phase operation is suppressed, while the increase of the speed of the cage 8 is limited.

A second example of the device according to the invention is shown in Figures 4 and 5.

In Figure 4, reference characters R and S designate a single-phase AC source; 21A, the starting winding of an electric motor 21; 21B, the main winding of the same 21; 21C, a starting capacitor connected in series to the starting winding 21A; 211, a transformer having terminals 211a and 211b of a rated voltage (100V or 200V for instance) and a terminal 211c of a voltage lower than the rated voltage on the secondary side; 212a, an upward movement electromagnetic contactor contact means which is connected between the terminal 211a and one end of the main winding 21B and which is closed in the upward movement operation; 212b, an upward movement electromagnetic contactor contact means which is connected between the terminal 211b and the other end of the main winding 21B and which is closed in the upward movement operation; 212c, an upward movement electromagnetic contactor contact means which is connected between the starting winding 21A and the main winding 21B; 212d, an upward movement electromagnetic contactor contact means which is connected between the main winding 21B and the starting capacitor 21C; 213a, a downward movement electromagnetic contactor contact means which is connected between the terminal 211a and the one end of

the main winding 21B and which is closed in the downward movement operation; 213b, a downward movement electromagnetic contactor contact means which is connected between the terminal 211c and the other end of the main cable 21B; 213c, a downward movement electromagnetic contactor contact means which is connected between the main winding 21b and the starting capacitor 21C; and 213d, a downward movement electromagnetic contactor contact means which is connected between the main cable 21B and the starting winding 21A.

A downward movement electromagnetic contactor contact means 218a is provided which is connected in parallel with the contact means 212b and which is closed a predetermined period of time after downward movement operation starts (or immediately after the speed of the cage reaches a predetermined value) and a downward movement electro-magnetic contactor contact means 218b is provided which is connected between the terminal 211c and the contact means 213b, the contact means 218b being operated as opposed to the contact means 218a.

In Figure 5, reference numeral 214 designates the torque of the motor 21 which is provided when a rated voltage is applied thereto; 215, the torque of the motor 21 which is provided when a voltage lower than the rated voltage is applied; 216, the load torque in upward movement operation, and 217, the load torque in downward movement operation.

In upward movement operation, when the contact means 212a through 212d are closed, the rated voltage of single phase is supplied to the starting winding 21A and the main winding 21B, to start the motor. As a result, the cage is run at the speed which is

determined by the point A' where the motor torque 214 is in balanced with the load torque 216.

5 In downward movement operation, when the contact means 213a through 213d are closed, a voltage lower than the rated voltage is applied to the starting winding 21A and the main winding 21B. In this case, the motor torque 215 is decreased in proportion to the square of voltage; however, the motor is sufficiently started by the low torque, being pulled by the load. Thus, the
10 motor 21 is started moderately, and the cage is accelerated smoothly. Thus, the speed of the motor 21 exceeds the synchronous speed, and but for the contact means 218a the cage would run at the speed which is determined by the point B' where the dynamic braking
15 torque is in balance with the load torque 217.

However, when the speed of the cage substantially reaches the predetermined value, the contact means 218a is closed, while the contact means 218b is opened, so that the rated voltage is applied to the motor 21. As
20 a result, the cage is run at the speed which is determined by the point C' where the dynamic braking torque 214 is in balance with the load torque 217. Thus, the increase of speed of the motor 21 due to the low voltage operation is suppressed, and the rated
25 speed is maintained.

In the above-described embodiments, the motors are of the capacitor start system; however, it goes without saying that the technical concept of the invention is applicable to other type motors.

30 As is apparent from the above description, in the devices for starting a winding drum type elevator described, the motor is operated with a torque lower

than its rated one in starting downward movement of the cage of the elevator. Therefore, in starting downward movement of the cage, persons therein are comfortable, and yet the device can be manufactured at relatively low cost. After a predetermined time in downward operation or on reaching a predetermined speed full torque operation is resumed to reduce heat dissipation and limit running speed.

CLAIMS

1. A winding drum type elevator control in which a winding drum driven by an induction motor is provided, and in the upward movement operation a cage thereof is run by winding a main cable thereof on said winding drum, while in the downward movement operation said cage is run by unwinding said main cable from said winding drum and comprising first switching means which, for the upward movement operation, are closed to apply electric power to said motor to allow the latter to operate in a normal full torque mode, second switching means which, for the downward movement operation, are closed to apply electric power to said motor to allow the latter to start in a low torque mode and third switching means for applying electric power to said motor to allow the latter to operate in said normal full torque mode, said third switching means operating automatically when the downward speed of said cage reaches a predetermined value or when the cage has been in motion for a predetermined time.

2. A control as claimed in claim 1 wherein three-phase alternating current is supplied to said motor, and said first switching means operates to supply, for the upward movement operation, three-phase alternating current to said motor to allow the latter to operate in said normal full torque mode, and said second switching means operates to supply single-phase alternating current to said motor in starting the downward movement operation.

3. A control as claimed in claim 2 wherein said first switching means are connected between said motor and the phases of a three-phase AC source, said first switching means being closed to supply three-phase



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alternating current to said motor for the upward movement operation, said second switching means are connected between said motor and two predetermined phases of said three-phase AC source, said second switching means being closed to supply single-phase alternating current to said motor in the downward movement operation, and said third switching means are connected between said motor and the remaining phase of said three-phase AC source, said third switching means being closed when said cage has a predetermined speed after the downward movement operation has been started, to apply three-phase alternating current to said motor to allow the latter to operate in said normal full torque mode.

4. A device as claimed in claim 1 wherein single-phase alternating current is applied to said motor, and said first switching means operates to apply, for the upward movement operation, a predetermined voltage to said motor to allow the latter to operate in said normal full torque mode and said second switching means operates to apply, for the downward movement operation, a voltage lower than said predetermined voltage to said motor to allow the latter to start with low torque.

5. A device as claimed in claim 4 wherein single-phase alternating current is applied to said motor through a transformer having an output terminal for providing a predetermined voltage and an output terminal for providing a voltage lower than said predetermined voltage, said first switching means being connected between said output terminal providing said predetermined voltage and said motor and being closed for the upward movement operation to allow said motor to operate in said normal full torque mode, said second switching means being connected between said motor and



- 5 said output terminal for providing said voltage lower than said predetermined voltage and being closed for starting the downward movement operation to allow said motor to start with low torque and said third switching means being connected between said motor and said output terminal for providing said predetermined voltage and said output terminal for providing said voltage lower than said predetermined voltage and operating to supply said predetermined voltage to said
- 10 motor when said cage has a predetermined speed after the downward movement operation has been started, to allow said motor to operate in said normal full torque mode.
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