

"A SYSTEM FOR CONTROLLING AN ELEVATOR"

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The present invention relates to a system for controlling an elevator and, more particularly, to a system for controlling an elevator having an AC two-speed motor capable of operating at a normal rated speed for maintenance purpose of the elevator.

Figure 1 shows a conventional system using an AC motor having two-windings, one for high speed and the other for low speed, to control an elevator car or cage through a cable, a drum and a counterweight. In Figure 1, numeral 1 indicates a winch; 2 is a main cable wound around the drum of the winch; 3 is the car or cage connected to one end of the cable 2; 4 is the counterweight connected to the other end of the cable 2; and 5 is the motor coupled to the winch 1 through a shaft 6 and which has a high speed winding 5a and a low speed winding 5b. An electromagnetic brake 7 having an electromagnetic coil 7a is coupled to the shaft 6; when this coil 7a is de-energised, the brake 7 produces braking force and, if the coil is excited by a DC supply 8, the braking force is released. The elevator control circuit has terminals 9R, 9S and 9T which are connected to a three-phase AC power supply. These terminals are connected to the high speed winding 5a on motor 5 via separate lines which include respective high speed contactors 10a, 10b and 10c. The terminals are also connected to the low speed winding 5b on motor 5 through another set of lines which include respective low speed contactors 11a, 11b, 11c. The R-phase and S-phase lines connected to power terminals 9R and 9S are connected through respective ascent contactors 12a and 12b which, when closed, cause the motor 5 to be driven in the forward direction so as to raise the car

12

3. An ascent brake contact 12c is connected in series with the electromagnetic coil 7a and DC source 8; this contact is opened or closed in synchronism with the ascent contactors 12a and 12b. Power terminals 9R and 9S are respectively connected to one end of descent contactors 13a and 13b; the other end of the contactor 13a is connected to the ascent contactor 12b at its junction with the motor, whereas the other end of the contactor 13b is connected to the ascent contactor 12a at its junction with the motor. When they are in a closed position, contactors 13a and 13b cause the motor 5 to be driven in the reverse direction so as to lower the car 3. Descent brake contactor 13c is connected in parallel to the ascent brake contactor 12c and is opened or closed in synchronism with the descent contactors 13a and 13b.

The elevator shown above is operated as follows. In the ascent mode, the ascent contactors 12a and 12b as well as high-speed contactors 10a to 10c are all closed, whereupon three-phase alternating current is applied to the high speed winding 5a on motor 5, which is then excited by the three phases to actuate the motor 5 in the direction in which the car 3 is raised. Since the brake contactor 12c in operative association with the ascent contactors 12a and 12b is closed, the electromagnetic coil 7a is excited to release the electromagnetic brake 7. The excitation of the three phases of the high speed winding continues until the motor is accelerated to a given speed, and this causes the car 3 is ascend at constant speed.

When the car 3 is raised to a point a predetermined distance below the proper floor, the contactors 10a to 10c are opened whereas the low speed contactors 11a to 11c are closed. As a result, the three phases of the

(13)

- 3 -

low speed winding 5b on the motor 5 are excited and the motor 5 is driven at low speed so that the car is decelerated and approaches the proper floor at a constant low speed. When the car platform is sufficiently close to the floor, the brake contactor 12c is opened and the electromagnetic brake 7 is actuated to bring the car 3 to a halt.

The elevator is controlled to descend by the following sequence. The descent contactors 13a and 13b as well as high speed contactors 10a to 10c are all closed and, at the same time, the brake contact 13c is closed to release the electromagnetic brake 7. As a result, the three phases of the high speed winding 5a on the motor 5 are excited, and the motor 5 is accelerated to a given speed in the direction in which the car descends, causing the car 3 to descend at constant speed. When the car 3 has descended to a point a predetermined distance above the proper floor, the contactors 10a to 10c are opened whereas the contactors 11a to 11c are closed, thereby supplying three-phase power to the low speed winding 5b on the motor 5, which is then excited by the three phases and the car 3 is decelerated. When the car platform is sufficiently close to the proper floor, the brake contact 13c is opened and the electromagnetic brake 7 is actuated to bring the car 3 to a halt at the proper point.

One great problem with the conventional system for controlling a two speed motor is that it requires many switch contactors on both the high speed and low speed windings for operating the elevator in either the ascending or the descending direction. The low speed winding on the two speed motor used in controlling the elevator has two functions to perform. One is to slow down the elevator as the car is approaching the proper

floor. When the car platform is sufficiently close to the floor, a brake is put on the elevator so that the car stops reasonably level to the floor. The other function of the low speed winding is to set the car speed below 30 m/s which is the maximum speed that ensures safety for operators who stand on the top of the car ascending or descending through the shaft for maintenance or installation operations.

It is an object of this invention to provide a new or improved system for controlling an AC elevator in which the above-mentioned problem is overcome or reduced.

According to this invention there is provided a system for controlling an elevator, said system including a two speed motor having a three phase high speed winding and a multi-polar single phase low speed winding, said motor being driven at a rated speed which permits operational maintenance of the elevator when the three phase high speed winding is excited, and said motor producing dampening torque when said low-speed winding is subjected to single phase excitation.

A low speed three phase winding is unnecessary for an elevator that is designed to operate normally at a rated speed of 30 m/s or less because this permits the elevator to be serviced or inspected at the rated speed. On the other hand, when the car is about to reach the proper floor during ascent or descent, the car can be dampened to a low speed by exciting the single phase low speed winding and driving the motor with an alternating magnetic field. Therefore, with an elevator having a low rated speed, its operational maintenance becomes possible by using a single phase and multipolar low speed winding.

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5 The motor used with this system has fewer turns in the low speed winding, and this is effective in reducing not only the size and cost of the motor but also the number of power control contactors connected to the low speed winding.

This invention will now be described in more detail, by way of example, with reference to the drawings in which:

Figure 1 is a circuit diagram of a conventional elevator control system;
10 Figure 2 is a circuit diagram of an elevator control system according to one embodiment of the present invention; and
Figure 3 is a graph showing the torque characteristics of the motor used in the present invention.

15 Figure 2 shows an embodiment of the elevator control system of the present invention, and the components which are the same as shown in Figure 1 are identified by like numerals. In Figure 2, the numeral 15 indicates
20 a motor coupled to a winch 1 by shaft 6. The motor 15 is provided with a three phase high speed winding 15a and a multi-polar single phase low speed winding 15b. When the high speed winding 15a is subjected to three phase excitation, the motor 15 is driven at a rated speed permitting the operational maintenance of the
25 elevator. When the low speed winding 15b is subjected to single phase excitation with the car 3 moving the motor produces a dampening torque which decelerates the car 3.

30 As in the conventional system shown in Figure 1, the high speed winding 15a on motor 15 is connected to power terminals 9R, 9S and 9T via three different lines. The line connecting the terminal 9R with the

high speed winding has an ascent contactor 12a, and the line connecting 9S with the high speed winding has an ascent contactor 12b. The two lines connected to terminals 9R and 9S are interconnected by descent contactors 13a and 13b. These three lines include rated speed connectors 16a, 16b and 16c. Power terminal 9R is connected to the low speed winding 15b through the descent contactor 13a and a single phase line and terminal 9S is connected to that winding through the ascent contactor 12b and the same single phase line. Power terminal 9T is connected to the low speed winding through another single phase line. The two single phase lines include decelerating contactors 17a and 17b. A single contactor 18 is connected in series with an electromagnetic coil 7a of an electromagnetic brake 7 and a DC power supply 8.

Figure 3 is a graph showing the speed versus torque characteristics of the motor 15. Curve I refers to the characteristics for the case when the high speed winding on the motor is subjected to three phase excitation, curve II refers to the case where the low speed winding is subjected to single phase excitation, curve III refers to the torque under load, and curve IV shows the torque characteristics for the case where a three phase low speed winding is subjected to three phase excitation and this curve is included in Figure 3 only for the purpose of comparison with the case where the multi-polar single phase low speed winding is subjected to single phase excitation.

The operation of the control system having the configuration shown in Figure 2 proceeds as follows. In the ascent mode, the ascent contactors 12a and 12b as well as the rated speed contactors 16a to 16c are all closed, and at the same time brake contactor 18 is

(17)

placed in the closed position. When the brake contactor 18 is in the closed position, the electromagnetic coil is excited to open the electromagnetic coil is excited to open the electromagnetic brake 7. Since the

5 contactors 12a, 12b and 16a to 16c are closed, three phase AC current is applied to the three phase high speed winding 15a, which is subjected to three phase excitation to cause actuation of the motor 15 in the direction in which the car 3 is raised. As a result, the

10 car 3 is accelerated in the ascent direction by the torque corresponding to the difference between the motor torque indicated by curve I and the load torque T_L shown by curve III. When the motor torque becomes equal to the load torque at point A_1 , the motor 15 runs at a constant

15 speed indicated by NA_1 , at which speed the car 3 is raised continuously.

When the car 3 has ascended to a point a predetermined distance below the proper floor, the rated speed contactors 16a to 16c are opened, and decelerating

20 contactors 17a and 17b are closed. As a result, single phase AC current is supplied to the multi-polar single phase low speed winding 15b which is subjected to single phase excitation. Then, the motor 15 produces a dampening torque corresponding to the distance between

25 points A_1 and B_1 in Figure 3, whereupon the speed of the motor 15 is gradually decreased from speed NA_1 to decelerate the ascending car 3. When the torque on curve II becomes equal to the load torque T_L at point B_2 , the motor rotates at speed NB_2 and causes the car 3 to

30 ascend toward the proper floor at a low speed. When the car 3 approaches a fixed point at the floor, decelerating contactors 17a and 17b are opened to cut off the power being supplied to the motor 15. At the same time, the brake contactor 18 is placed in opened

35 and the electromagnetic brake 7 is actuated to brake

the winch 1 hard, thereby bringing the car 3 to a halt at the proper point.

In the descent mode, the descending contactors 13a and 13b as well as the rating contactors 16a to 16c are all closed, and at the same time the brake contactor 18 is closed. Placing the brake contactor 18 in the closed position causes the electromagnetic brake 7 to open. Closing the contactors 13a, 13b and 16a to 16c causes three phase excitation of the three phase high speed winding 15a. As a result, as in the ascent mode shown above, the motor 15 is actuated and accelerates the car 3 until it descends at a constant rate MA_1 corresponding to point A_1 where the motor torque balances the load torque T_L . When the descending car 3 reaches a predetermined point above the proper floor, the contactors 16a to 16c are opened whereas the decelerating contactors 17a and 17b are closed. Then, as in the ascent mode, the single phase multipolar low speed winding 15b on the motor 15 is subjected to single phase excitation to put a regenerative brake on the motor 15. The car 3 is decelerated and descends toward the proper floor at a low speed of NB_2 corresponding to point B_2 where the single phase torque on the motor is equal to the load torque T_L . When the car reaches a predetermined point, the brake contactor 18 is opened and the electromagnetic brake 7 is actuated to brake the winch 1 hard, thereby bringing the car 3 to a halt at that predetermined point.

As shown above, the elevator control system of the present invention uses a two speed motor that is capable of maintenance of the elevator during operation at its normal rated speed and which has a multipolar single phase low speed winding in combination with the ordinary three phase high speed winding. Therefore,

(19)

- 9 -

fewer turns of coil are necessary for the low speed winding than the conventional three phase winding, and this leads to the possibility of using a smaller and cheaper motor. As a further advantage, the single phase
5 excitation of the low speed winding reduces the number of contactors that are used to control the supply of power to the low speed winding on the motor.



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CLAIMS:

1. A system for controlling an elevator, said system including a two speed motor having a three phase high speed winding and a multi-polar single phase low speed winding, said motor being driven at a rated speed which permits operational maintenance of the elevator when the three phase high speed winding is excited, and said motor producing dampening torque when said low-speed winding is subjected to single phase excitation.
2. A system as claimed in claim 1 including a set of three terminals for connection to a three phase AC power source, a set of three lines each of which is connected between a respective one of said three terminals and the high speed winding, a set of ascent and descent switches connected in two of said lines and which are switched on and off in turn to perform selection between the ascent mode and the descent mode of the elevator, three first switches connected in respective ones of said three lines between said set of ascent and descent switches and the high speed winding, and two second switches one of which is connected between one of the lines which includes the set of ascent and descent switches and the low speed winding and the other of which is connected between the remaining line and the low speed winding.
3. A system as claimed in claim 2 wherein said first switches are closed to excite said three phase high speed winding when the elevator is accelerated or running at constant speed, and said second switches are closed to excite said single phase low speed winding when the elevator is decelerating.

(21)



-11 -

4. A system as claimed in any one of claims 1 to 3, wherein said elevator has a brake to bring it to a halt, said braking having a single switch that controls its operation.

5 5. A system as claimed in claim 4, wherein said switch actuates said brake by being closed when the elevator reaches a predetermined point on the proper floor.

10 6. A system for controlling an elevator substantially as hereinbefore described with reference to and as shown in Figures 2 and 3 of the accompanying drawings.
