

PATENT SPECIFICATION

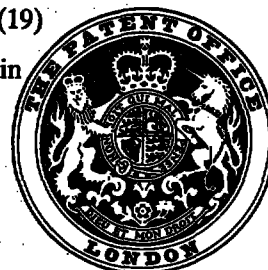
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(54) ELEVATOR LANDING CONTROL APPARATUS

(71) We, MITSUBISHI DENKI KABUSHIKI KAISHA, a Japanese Company, of 2-3, Marunouchi 2-chome, Chiyoda-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to an improvement of an apparatus for controlling a cage of an elevator at a landing.

In an elevator for high travelling height equipped in a high building or a very high building, the main rope for suspending the cage is very long. Accordingly, when the cage is at a lower floor the main rope is stretched and contracts when passengers enter and leave and the cage oscillates vertically even though the winding motor is held by a brake. As a result, the passengers feel uneasy.

It is an object of the present invention to provide an elevator landing control apparatus which overcomes the above-mentioned difficulty.

According to the invention there is provided an elevator landing control apparatus for a building having upper and lower floors, the apparatus including a cage connected to one end of a main rope and a counter-weight connected to the other end of the main rope in a suspended condition for vertical travel in a hoistway, a winding motor which drives a driving sheave on which the main rope is wound so as to produce vertical travel of the cage and the counter-weight, a brake for holding the cage by holding the motor armature when the cage is stopped, a landing device, which controls the motor to generate the output torque required to hold the cage by the motor at a floor; a lower floor detecting circuit which detects the presence of the cage at a lower floor, where stretching of the

rope would cause undesirable oscillation, and is actuated thereby; a "door open" detecting circuit which detects when the door of the cage is open and is actuated thereby; and a control circuit which actuates the landing device, without holding the motor armature by the brake, only when the lower floor detecting circuit and the door open detecting circuit are in the actuated condition.

The invention will further be described with reference to the accompanying drawings, of which:-

Figure 1 is a diagram of one embodiment of an elevator landing control apparatus according to the present invention;

Figure 2 is a control circuit diagram for the embodiment of Figure 1;

Figure 3 is an output characteristic curve of a speed command generator for the embodiment of Figure 1;

Figure 4 is an output characteristic curve of a landing command generator for the embodiment of Figure 1;

Figure 5 is a diagram of another embodiment of the present invention; and

Figure 6 is a control circuit diagram corresponding to Figure 2.

Referring to Figures 1 to 4, one embodiment of the present invention will be illustrated.

In Figures 1 and 2, the reference numeral (1) designates a speed command generator such as the selector, the transducer and the acceleration device shown in Figure 4A in USP 3,207,265 and (1a) designates an output thereof; (2) designates a switch circuit; (3) designates a field current control device; (3a) designates an AC power source; (R₁) and (R₂) designates resistors; (TR₁) designates a transformer; (CH₁) and (CH₂) designate choking coils; (AMP₁) designates an amplifier using SCRs; (4) designates a generator field winding; (5) designates a generator armature; (6) designates a motor

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armature to which a DC power is fed from the armature (5); (7) designates a tachogenerator; (7a) designates an output thereof; (8) designates a driving sheave driven by the armature (6); (9) designates a friction brake for braking the armature (6) by way of the driving sheave (8); (10) designates a deflector sheave; (11) designates a main rope wound on the driving sheave (8) and the deflector sheave (10); (12) designates a cage; (13) designates a counter-weight; (14) designates a landing command generator which is disposed in the cage and generates the landing command shown in Figure 4 by electromagnetic coupling with an inductor plate (not shown) disposed in a hoistway such as the hoistway transducer shown in Figure 4A of USP 3,207,265; (14a) designates the output of the landing command generator; (15a) designates a lower floor of a building; (15b) designates a middle floor; (15c) designates an upper floor; (+), (-) designate a DC power source; (20) designates a door openable zone detecting circuit which is closed by travelling the cage (12) in each door openable zone for each floor (about 250 mm from the floor level in both upper and lower directions); (21) designates a door opening detecting relay contact which closes in the case of door opening and opens in the case of door closing; (22) designates a speed command relay; (22a) - (22c) designate normally opened contacts and (22d) designates also a normally opened contact of relay 22; (23a) and (23b) designate deceleration selecting relay contacts which close when the cage (12) reaches the predetermined distance from the landing floor level and opens when the cage stops; (24) designates a lower floor detecting circuit which closes when the cage (12) is at the lower floor (15a); (25) designates a lower floor detecting relay; (25a) designates a normally opening contact; (26a) and (26b) designate travel command relay contacts which close by the travel command and open after stopping the cage; (27) designates a brake coil which releases the armature by releasing the brake (9) when energised and holds the armature by actuating the brake (9) when de-energised.

The operation of the embodiment will be illustrated.

The speed command generator (1) generates the output (1a) shown in Figure 3. At the start of movement of the cage (12), the deceleration selecting relay contacts (23a), (23b) are in OFF state and the door opening detecting relay contact (21) is in OFF state because of closing of the door. Accordingly, the speed command relay (22) is de-energised whereby the contact (22d) is in ON state and the contact (22c) is in OFF state. When the cage (12) is not at the lower floor (15a), the lower floor detecting circuit

(24) is in OFF state and the lower floor detecting relay (25) is de-energised and the contact (25a) is in OFF state.

Both the travel command relay contact (26a) and the speed command relay contact (22b) are in OFF state whereby the brake coil (27) is non-excited and the armature (6) is held by the brake (9).

When the travel command is given to close the travel command relay contact (26b), the output (1a) of the speed command generator is fed through the circuit of (22d) - (26b) to the field current control device (3). Also, the contact (26a) is closed and the brake coil (27) is excited to release the armature (6). The control device (3) compares the output (1a) with the output (7a) of the generator which provides a speed indicator and the generator field winding (4) is excited by the deviation signal and the speed of the armature (6) is automatically held by the known Ward-Leonard control device to control the speed of the cage (12).

When the cage (12) reaches the predetermined distance from the object landing floor, the deceleration selecting relay contacts (23a), (23b) are closed. When the cage (12) further approaches to the object landing floor to reach the end (d₁) of the door openable zone, the door openable zone detecting circuit (20) is closed.

The speed command relay (22) is actuated by the circuit of (+) - (20) - (23b) - (22) - (-) and it is self-sustained by closing the contact (22a) at the same time, the contact (22b) is closed. The contact (22d) is opened and the contact (22c) is closed whereby the speed command is switched from the speed command generator (1) to the landing command generator (14). The landing command generator (14) generates the output (14a) shown in Figure 4.

In Figure 4, the reference 0 designates the object floor and the output (14a) correspond at a ratio of 1 to 1 to the distance to the object floor in the door openable zone d₁, d₂. The speed of the armature (6) is controlled depending upon the output (14a) and the cage (12) is decelerated to stop at the object floor.

When the cage (12) is stopped, the contacts (23a), (23b) are opened to de-energise the speed command relay (22) and the contact (22b) is opened and at the same time, the contact (26a) is opened whereby the brake coil (27) is de-energised to hold the armature (6).

When the cage (12) is landed at the lower floor, the lower floor detecting circuit (24) is closed and the lower floor detecting relay (25) is actuated to close the contact (25a). If the door opens at this moment, the door open detecting relay contact (21) is closed. The speed command relay (22) is actuated by the circuit of (+) - (25a) - (21) - (22) - (-)

to open the contact (22d) and to close the contact (22c).

The output (14a) of the landing command generator is input to the field current control device (3). On the other hand, the contact (22b) is closed, whereby brake coil (27) is energized to release the armature (6) and accordingly, the cage (112) is electrically held by the speed command. That is, the output (14a) is automatically controlled to be zero when the cage (12) in spite of potential upward or downward movement on riding and leaving of passengers whereby the level of the cage floor is kept in the same level of the floor. As the result, the cage (12) is not substantially moved in vertical direction.

When the door is closed for starting the cage (12), the contact (21) is opened to inactivate the speed command relay (22).

When the door of the cage (12) is closed or the cage (12) is at the middle floor (15b) of the upper floor (15c), the speed command relay (22) is not actuated whereby the electrical holding is not performed, because the riding or leaving of passengers is not caused and the stress of the main rope (11) is not caused when the door is closed.

When the cage (12) is at the middle floor (15b) or the upper floor (15c), the length from the main rope (11) of the driving sheave (8) is shorter whereby the vertical oscillation of the cage (12) is not a serious problem. It is not preferable to electrically hold the cage (12) in such states because of increase of the heating of the generator and the motor.

In said embodiment, the condition of the electrical holding of the cage is limited whereby the heating of the generator and the motor can be reduced.

Figures 5 and 6 show another embodiment of the present invention. In Figures 5 and 6, the reference (17) designates a differentiating circuit which differentiates the output (7a) of the tacho-generator (7), and (17a) designates an output thereof.

In the embodiment, the switch circuit (2) and the landing command generator (14) shown in Figure 1 are not used.

As it is clear from the drawings, the output (17a) of the differentiating circuit (17) which differentiates the output from the tacho-generator 7 corresponds to the acceleration of the cage (12). That is, the acceleration control circuit of the cage (12) is used for control purposes. When the door is in the open condition, the contacts (25a), (21) are closed and the brake coil (27) is actuated and the armature (6) is released. The cage (12) is controlled by the acceleration control circuit whereby the vertical oscillation of the cage (12) is controlled. Accordingly, in this embodiment, the landing command generator (14) shown in Figure 1

need not be used.

In these embodiments, it is easy to eliminate the electrical holding of the cage when the temperature of the generator or the motor rises too high, and so control the heating of the generator and the motor.

As described above, when the cage is at the lower floor and the door is in the open condition, the brake is released to generate the torque for holding the cage in the generator by the landing device.

When the brake is released, the motor is controlled by the accelerator control circuit.

By use of the present invention, the vertical oscillation of the cage caused by passengers entering and leaving is reduced to eliminate uneasy feeling of passengers.

WHAT WE CLAIM IS:

1. An elevator landing control apparatus for a building having upper and lower floors, the apparatus including a cage connected to one end of a main rope and a counter-weight connected to the other end of the main rope in a suspended condition for vertical travel in a hoistway, a winding motor which drives a driving sheave on which the main rope is wound so as to produce vertical travel of the cage and the counter-weight, a brake for holding the cage by holding the motor armature when the cage is stopped, a landing device which controls the motor to generate the output torque required to hold the cage by the motor at a floor; a lower floor detecting circuit which detects the presence of the cage at a lower floor, where stretching of the rope would cause undesirable oscillation, and is actuated thereby; a "door open" detecting circuit which detects when the door of the cage is open and is actuated thereby; and a control circuit which actuates the landing device, without holding the motor armature by the brake, only when the lower floor detecting circuit and the door open detecting circuit are in the actuated condition.

2. An elevator landing control apparatus according to claim 1 wherein the landing device is a landing command generator disposed in the cage to generate the landing command signal by electromagnetic coupling with an inductor plate disposed in the hoistway.

3. An elevator landing control apparatus wherein the landing device is a cage acceleration control circuit.

4. An elevator landing control apparatus according to claim 3 wherein the cage acceleration control circuit is a differentiating circuit which differentiates an output of a tacho-generator driven by the motor.



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to open the contact (22d) and to close the contact (22c).

The output (14a) of the landing command generator is input to the field current control device (3). On the other hand, the contact (22b) is closed, whereby brake coil (27) is energised to release the armature (6) and accordingly, the cage (112) is electrically held by the speed command. That is, the output (14a) is automatically controlled to be zero when the cage (12) in spite of potential upward or downward movement on riding and leaving of passengers whereby the level of the cage floor is kept in the same level of the floor. As the result, the cage (12) is not substantially moved in vertical direction.

When the door is closed for starting the cage (12), the contact (21) is opened to inactuate the speed command relay (22).

When the door of the cage (12) is closed or the cage (12) is at the middle floor (15b) of the upper floor (15c), the speed command relay (22) is not actuated whereby the electrical holding is not performed, because the riding or leaving of passengers is not caused and the stress of the main rope (11) is not caused when the door is closed.

When the cage (12) is at the middle floor (15b) or the upper floor (15c), the length from the main rope (11) of the driving sheave (8) is shorter whereby the vertical oscillation of the cage (12) is not a serious problem. It is not preferable to electrically hold the cage (12) in such states because of increase of the heating of the generator and the motor.

In said embodiment, the condition of the electrical holding of the cage is limited whereby the heating of the generator and the motor can be reduced.

Figures 5 and 6 show another embodiment of the present invention. In Figures 5 and 6, the reference (17) designates a differentiating circuit which differentiates the output (7a) of the tacho-generator (7), and (17a) designates an output thereof.

In the embodiment, the switch circuit (2) and the landing command generator (14) shown in Figure 1 are not used.

As it is clear from the drawings, the output (17a) of the differentiating circuit (17) which differentiates the output from the tacho-generator 7 corresponds to the acceleration of the cage (12). That is, the acceleration control circuit of the cage (12) is used for control purposes. When the door is in the open condition, the contacts (25a), (21) are closed and the brake coil (27) is actuated and the armature (6) is released. The cage (12) is controlled by the acceleration control circuit whereby the vertical oscillation of the cage (12) is controlled. Accordingly, in this embodiment, the landing command generator (14) shown in Fi-

gure 1 need not be used.

In these embodiments, it is easy to eliminate the electrical holding of the cage when the temperature of the generator or the motor rises too high, and so control the heating of the generator and the motor.

As described above, when the cage is at the lower floor and the door is in the open condition, the brake is released to generate the torque for holding the cage in the generator by the landing device.

When the brake is released, the motor is controlled by the accelerator control circuit.

By use of the present invention, the vertical oscillation of the cage caused by passengers entering and leaving is reduced to eliminate uneasy feeling of passengers.

WHAT WE CLAIM IS:

1. An elevator landing control apparatus for a building having upper and lower floors, the apparatus including a cage connected to one end of a main rope and a counter-weight connected to the other end of the main rope in a suspended condition for vertical travel in a hoistway, a winding motor which drives a driving sheave on which the main rope is wound so as to produce vertical travel of the cage and the counter-weight, a brake for holding the cage by holding the motor armature when the cage is stopped, a landing device which controls the motor to generate the output torque required to hold the cage by the motor at a floor; a lower floor detecting circuit which detects the presence of the cage at a lower floor, where stretching of the rope would cause undesirable oscillation, and is actuated thereby; a "door open" detecting circuit which detects when the door of the cage is open and is actuated thereby; and a control circuit which actuates the landing device, without holding the motor armature by the brake, only when the lower floor detecting circuit and the door open detecting circuit are in the actuated condition.

2. An elevator landing control apparatus according to claim 1 wherein the landing device is a landing command generator disposed in the cage to generate the landing command signal by electromagnetic coupling with an inductor plate disposed in the hoistway.

3. An elevator landing control apparatus wherein the landing device is a cage acceleration control circuit.

4. An elevator landing control apparatus according to claim 3 wherein the cage acceleration control circuit is a differentiating circuit which differentiates an output of a tacho-generator driven by the motor.

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5. An elevator landing control apparatus substantially as hereinbefore described with reference to Figures 1 to 4 or 5 and 6 of the accompanying drawings.

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