

DESCRIPTION

ELEVATOR CONTROL APPARATUS

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Technical Filed

The present invention relates to an elevator control apparatus which carries out a control operation corresponding to a change of weather such as a lightning strike, heavy wind and raining or snowing in an elevator for outside observation.

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Background Art

In a general elevator, a car is provided in a building, and thus, such an elevator is not directly affected by a change of weather. However, if the building is struck by lightning, for example, the lightning current is routed into an elevator passage, whereby an electrical system of an elevator control apparatus is destroyed, and one or more passengers may be tapped in the car. In addition, if the building is swung by a heavy wind, the car is swung concurrently, and the passengers tapped in the car may feel uneasy.

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Conventionally, in order to solve such a problem, an accident that one or more passengers are tapped in the car has been avoided by sensing an approach of lightning by a lightning sensor, for example, and causing the car to stop at the nearest floor with

emergency during such an approach of lightning. In addition, by sensing a heavy wind by a heavy wind sensor, an effect due to such a heavy wind has been avoided by carrying out a control operation such as a speed reducing operation, an intermediate floor standby operation, or a stopping operation according to the heavy wind level.

In recent years, with a diversified customer's need, an elevator for outside observation has been developed. The elevator for outside observation is such an elevator that a car has been provided outside. While the car is elevated, one or more passengers can observe an outside scenery. In such an elevator for outside observation, however, the car itself is provided outside. Thus, there is a problem that the elevator is directly subject to an effect due to a change of weather.

That is, for example, if a lightning strike occurs, there is a possibility that the lightning directly strikes the car. Thus, the passengers loaded in the car are jeopardized, and equipment may be damaged due to such a direct strike of lightning. In addition, during a heavy wind, the car is considerably swung, and there can occur an accident that an elevator rope is caught or is damaged due to a bump with the car. Further, if a large amount of rain or snow directly falls on the car, it is too dangerous to

continue normal operation as is.

As described above, in the elevator for outside observation, unlike a general elevator, the car itself is directly affected by such a change of weather, thus requiring a control operation considering such a change of weather. However, conventionally, no consideration has been taken into a possibility that lightning directly strikes a car exposed to the outside or a danger that the car is directly subject to an effect due to a heavy wind.

Disclosure of Invention

Example embodiments may provide an elevator control apparatus capable of carrying out a control operation considering an effect on a car due to a change of weather, thereby ensure one or more passenger's safety and preventing the damage of the car in an elevator for outside observation in which the car is provided at the outside.

Also disclosed is an elevator control apparatus for use in an elevator for outside observation in which a car is provided at the outside of a building, the apparatus comprising:

weather information detecting means for detecting information concerning a variety of weathers; and

control means for carrying out a control operation for avoiding a direct effect on the car due to a change

of weather based on the weather information detected by the weather information detecting means.

With such a construction, in example embodiments, information concerning a weather is detected, and a control operation for avoiding a direct effect on a car due to a change of weather is executed based on such weather information. The control operation for avoiding a direct effect on a car used here denotes that, for example, after detecting an approach of lightning, in the case where such a lightning strike can occur in the vicinity of the car, an operation is carried out such that the car is retracted to a specific floor free of an effect due to a direct strike of lightning. By such a control operation, the passenger's safety is ensured, and the damage of the car can be prevented.

According to a first aspect of the present invention, there is provided an elevator control apparatus for use in an elevator for outside observation in which a car is provided at the outside of a building, the apparatus characterized by comprising:

lightning detecting means for detecting an approach of lightning; and

control means for, in the case of remote lightning, indicating a caution or warning according to an approach state of lightning detected by the lightning detecting means to continue operation, and in the case of proximal lightning, retracting the car to a specific

floor to establish an operation stop state.

With such a construction, in example embodiments, in the case where an approach of lightning which may cause the possibility of a lightning strike has been detected, the car is retracted to a specific floor to establish an operation stop state. In this manner, a direct strike of lightning against the car is avoided, the passenger's safety is ensured, and the damage of the car can be prevented.

According to a second aspect of the present invention, there is provided an elevator control apparatus for use in an elevator for outside observation in which a car is provided at the outside of a building, the apparatus characterized by comprising:

wind speed detecting means for detecting a wind speed; and

control means for, in the case where the wind speed detected by the wind speed detecting means is a first wind speed level or more and less than a second wind speed level, reducing an operation speed of the car to a predetermined speed to continue operation, and in the case where the wind speed is the second wind speed level or more, retracting the car to a specific floor to establish an operation stop state.

With such a construction, in example embodiments, in the case where a wind speed of a first wind speed level or more and less than a second wind speed level has been detected, a

deceleration operation is carried out. In this manner, operation can be continued while the swinging of the car during a heavy wind is restrained. In addition, in the case where a wind speed of the second wind speed level or more has been detected, the car is retracted to a specific floor to establish an operation stop state. In this manner, an effect on the car due to a heavy wind is avoided, the passenger's safety is ensured, and the damage of the car can be prevented.

According to a third aspect of the present invention, there is provided an elevator control apparatus for use in an elevator for outside observation in which a car is provided at the outside of a building, the apparatus characterized by comprising:

15 rainfall or snowfall detecting means for detecting an amount of rainfall or snowfall; and

 control means for, in the case where an amount of rainfall or snowfall equal to or greater than a first level is detected by the rainfall or snowfall detecting means, carrying out a landing operation while a specific floor is defined as a reference floor, and in the case where the amount of rainfall or snowfall reaches an amount of snowfall or rainfall equal to or greater than a second level such that a pit portion is immersed in water, retracting the car to the specific floor to establish an operation stop state.

25 With such a construction, in example embodiments, in the case where an

amount of rainfall or snowfall equal to or greater than a predetermined amount has been detected, a landing operation is carried out while a specific floor is defined as a reference floor. In this manner, the car can be prevented from being exposed to rainfall while the car is in a standby state. In addition, in the case where an amount of rainfall or snowfall reaches an amount such that a pit portion is immersed in water, the car is retracted to a specific floor to establish an operation stop state. In this manner, an affect on the pit portion due to water immersion can be avoided during a heavy rainfall or snowfall.

According to a fourth aspect of the present invention, there is provided an elevator control apparatus for use in an elevator for outside observation in which a car is provided at the outside of a building, the apparatus characterized by comprising:

weather information detecting means for detecting information concerning a variety of weathers which include at least an approach of lightning, a wind speed, and an amount of rainfall or snowfall; and

control means for carrying out a control operation for avoiding a direct effect on the car due to a change of weather based on a variety of weather information detected by the weather information detecting means.

With such a construction, in example embodiments, a control operation for avoiding a direct effect on the car is executed based

on information concerning a variety of weathers such as approach of lightning, wind speed, or an amount of rainfall or snowfall. Thus, safety operation service in accordance with a current weather environment can be provided.

Brief Description of Drawings

FIG. 1 is a diagram showing a construction of an elevator for outside observation to which an elevator control apparatus of the present invention is applied;

FIG. 2 is a diagram illustrating a refuge floor of a car provided at the elevator for outside observation;

FIG. 3 is a flow chart showing lightning control operation processing of an elevator control apparatus according to a first embodiment of the present invention;

FIG. 4 is a flow chart showing heavy wind control operation processing of an elevator control apparatus according to a second embodiment of the present invention;

FIG. 5 is a flow chart showing rainfall or snowfall quantity control operation processing of an elevator control apparatus according to a third embodiment of the present invention; and

FIG. 6 shows a construction of a priority table of an elevator control apparatus according to a fourth embodiment of the present invention.

Best Mode for Carrying Out the Invention

Hereinafter, preferred embodiments of the present invention will be described with reference to the accompanying drawings.

5 (First Embodiment)

FIG. 1 is a diagram showing a construction of an elevator for outside observation to which an elevator control apparatus of the present invention is applied. In the figure, reference numeral 1 denotes a car; 2 denotes a hoisting machine; 3 denotes a main rope; 4 denotes a balancing weight; 5 denotes a car control device; 6 denotes a display device in a car; and 7 denotes an announcing device in a car.

15 In such an elevator for outside observation, the car 1 is provided at the outside of a building. The car 1 is elevated from the top floor to the bottom floor of the building. In addition, a specific floor of the landing floors is prepared as a refuge floor 8. This refuge floor 8 is provided at the top floor, as shown in FIG. 2, for example. This refuge floor 8 is covered from the outside, and exists as a service floor capable of avoiding a direct strike of lightning or the like.

25 Here, an elevator control apparatus 11 is installed together with a hoisting machine 2 in a machine room 10 which is provided in place higher than the top floor of the building. This elevator control

apparatus 11 comprises a CPU (main microcomputer device) 110, an input and output device 111, and a priority table 112.

5 The CPU 110 is provided to control the entire elevator. This CPU 110 reads out a program, thereby executing predetermined processing in accordance with procedures described in the program. For example, when a call from a landing floor occurs, the CPU 110 drives the hoisting machine 2 via an inverter (motor driver device) 12, and moves the car 1 to a floor from which
10 such a call occurs.

The input and output device 111 carries out input and output processing of a variety of signals. A variety of devices including a display device 14 of a monitor room 13 are connected to the input and output
15 device 111. In addition, a weather information detecting device 15, an earthquake sensor 16, and a fire sensor 17 are connected to the input and output device 111.

20 The priority table 112 is a table in which the priorities of respective control operations are specified. A detailed description of the priority table 112 will be given later with reference to FIG. 6.

25 The weather information detecting device 15 is a device for detecting a whether condition. The weather information detecting device 15 comprises a lightning detector 15a, a heavy wind detector 15b, and a rainfall

or snowfall detector 15c.

5 The lightning detector 15a includes a lightning sensor, for example. When this lightning detector 15a detects an approach of lightning, the detector outputs a lightning caution level signal S1 or a lightning warning level signal S2 to the elevator control apparatus 11 according to an approach distance of the lightning at that time. The heavy wind detector 15b includes a wind speed meter, for example. When the heavy wind detector 15b detects a wind speed in the vicinity of elevation of the car 1, the detector outputs a first heavy wind level signal S3 or a second heavy wind level signal S4 to the elevator control apparatus 11 according to the wind speed level. The rainfall or snowfall detector 15c includes a rainfall or snowfall quantity meter, for example. Snow is changed into water by means of a heater, and then, an amount of snowfall is converted into an amount of rainfall by means of a heater. The rainfall or snowfall operation detector 15c outputs a snowfall or rainfall operation level signal S5 to the elevator control apparatus 11 in the case where the detector has detected an amount of snowfall or rainfall equal to or greater than a first level. In addition, the rainfall or snowfall detector 15c outputs a water immersion level signal S6 to the elevator control apparatus 11 in the case where the detector has detected an amount of

rainfall or snowfall equal to or greater than the first level such that a pit portion 9 shown in FIG. 2 is immersed in water.

5 In addition, the earthquake sensor 16 senses an earthquake which occurs in the periphery of the building, and outputs an earthquake sensing signal to the elevator control apparatus 11. The fire sensor 17 senses a fire in the building, and outputs a fire sensing signal to the elevator control apparatus 11.

10 In such a construction, in accordance with the first embodiment, the present invention is featured by detecting an approach of lightning using the lightning detector 15a provided at the weather information detecting device 15, thereby carrying out a control
15 operation at two stages consisting of a remote lightning stage and a proximal lightning stage. The remote lightning used here denotes lightning such that a thunder cloud takes place in the range of 15 km to 30 km, and approaches the vicinity within the range of
20 30 minutes to 60 minutes. The proximal lightning used here denotes lightning such that a thunder cloud takes place in a very close distance, and a lightning strike can occur within the range of 10 minutes to 20 minutes.

25 FIG. 3 is a flow chart showing lightning control operation processing of the elevator control apparatus 11 in accordance with the first embodiment of the present invention.

While in elevator operation, if an approach of a thunder cloud is detected by the lightning detector 15a provided at the weather information detecting device 15, the weather information detecting device 15 outputs a signal indicating an approach of lightning to the elevator control apparatus 11 via the input and output device 111 (step A11). In more detail, the thunder cloud access range and the magnetic field strength in air are set at the lightning detector 15a. The weather information detecting device 15 compares an actually detected value with the set value, and determines whether a current lightning state is remote lightning or proximal lightning. In the case of remote lightning, the detecting device outputs the lightning caution level signal S1. In the case of proximal lightning, the detecting device outputs the lightning warning level signal S2.

Here, when the lightning caution level signal S1 has been inputted ("No" of step A12), the elevator control apparatus 11 displays a lightning caution on the display device 14 installed in the monitor room 13 and indicates a warning buzzer or a voice message as required (step A13). In this manner, an approach of lightning is notified to an person involved in operation control. Such a control operation carried out at the lightning caution level is referred to as a "lightning control operation 1".

On the other hand, when the lightning warning level signal S2 has been inputted from the lightning detector 15a to the elevator control apparatus 11 ("Yes" of step A12), there is a possibility that a lightning strike occurs in the vicinity of the building. In such a case, the elevator control apparatus 11 notifies to one or more passengers in the car 1 that an operation is stopped due to an approach of lightning by using the display device 6 or announcing device 7 and the like, and prompts the passengers to unload the car (step A14). Subsequently, the elevator control apparatus 11 checks the running state of the car 1 (step A15). Then, when the car 1 stops ("No" of step A15), the elevator control apparatus 11 determines whether or not the car stops at a landing floor at which there is the lowest possibility of a direct strike of lightning, namely, at a refuge floor 8 (step A16). When the car 1 stops at the refuge floor 8 ("No" of step A16), the elevator control apparatus 11 stops operation at the refuge floor 8 and enters a standby state (step A18).

In addition, when the car 1 stops at a floor other than the refuge floor 8 ("Yes" of step A16), the elevator control apparatus 11 cancels the destination call, causes the car 1 to move to the refuge floor 8 which is safe, and enters a standby state (step A19). At this time, there is a possibility that one or more

passengers are still loaded in the car 1. Thus, the elevator control apparatus notifies that the elevator's service is stopped by using the display device 6, announcing device 7 and the like, and prompts the passengers to unload the car.

In addition, when the car 1 is running ("Yes" of step A15), the elevator control apparatus 11 determines whether or not the car 1 is running in the direction of the refuge floor 8 (step A17). When the car 1 is running in the direction of the refuge floor 8 ("Yes" of step A17), the elevator control apparatus 11 cancels a call from a floor which is present from the current floor to the refuge floor 8, and causes the car 1 to move to the refuge floor 8. At this time, there is a possibility that one or more passengers are still loaded in the car 1. Thus, the elevator control apparatus notifies the passengers loaded in the car 1 that an operation is stopped due to an approach of lightning by using the display device 6, announcing device 7 and the like, and prompts the passengers to unload the car. Then, the control apparatus closes the door of the car 1 and stops an operation after a predetermined period of time has elapsed (step A21).

In addition, when the car 1 is running toward a direction opposite to the refuge floor 8 ("No" of step A17), the elevator control apparatus 11 opens the door after landing at a first target floor, notifies the

passengers loaded in the car 1 that an operation is stopped due to an approach of lightning by using the display device 6, announcing device 7 and the like, and prompts the passengers to unload the car. Thereafter, the control device cancels a call, and carries out an operation for returning to the refuge floor 8. After landing at the refuge floor 8, the door closes after a predetermined period of time, and an operation is stopped (step A20).

There is a possibility that one or more passengers are still loaded in the loading case 1 during such a returning operation. The elevator control apparatus notifies the passengers loaded in the car 1 again that an operation is stopped due to an approach of lightning by using the display device 6, announcing device 7 and the like, and prompts the passengers to unload the car. After landing at the refuge floor 8 and door opening, the door of the car is closed after a predetermined period of time, and an operation is stopped. Such a control operation carried out at a lightning warning level is referred to as a "lightning control operation 2".

The state of lightning is monitored by this "lightning control operation 2" while the car 1 is standby at the refuge floor 8. For example, after a thunder cloud is far away or the like, when the lightning warning level signal S2 or lightning caution

level signal S1 is released ("Yes" of step A23), if nothing is sensed again within a predetermined period of time ("No" of step A23), a normal operation is restored (step A24).

5 As described above, in the elevator for outside observation, when an approach of lightning is detected, if there is no possibility of a lightning strike in the vicinity of the building and only a thunder cloud is approaching (when remote lightning occurs), the
10 elevator control apparatus notifies a person involved in operation control of the fact and prompts him to take care of it. On the other hand, when there is a possibility of a lightning strike in the vicinity of the building (when proximal lightning occurs), the
15 elevator control apparatus causes the car 1 exposed to the outside to move to the refuge floor 8 serving as a "service floor" at which there is the lowest possibility of a direct strike of lightning. In this manner, the passenger's safety can be ensured during an
20 approach of lightning and the damage of equipment due to a lightning strike can be prevented.

(Second Embodiment)

Now, a second embodiment of the present invention will be described here.

25 In the second embodiment, in the construction of FIG. 1 described previously, the present invention is featured by detecting a wind speed using the wind speed

detector 15b provided at the weather information detecting device 15, thereby carrying out a control operation at two stages according to the value of wind speed. FIG. 4 shows a processing operation thereof.

5 FIG. 4 is a flow chart showing heavy wind control operation processing of an elevator control apparatus 11 in accordance with the second embodiment of the present invention.

10 While in elevator operation, the wind speed in the vicinity of elevation of the car 1 is detected by the wind speed detector 15b provided at the weather information detecting device 15 (step B11). The wind speed detected by the wind speed detecting device 15 is less than A (m/s) ("No" of step B12), the elevator control apparatus 11 carries out a normal operation at a rated speed (m/min) (step B13). The rated speed "a" is 360 m/min, for example.

15 Here, when the wind speed A (m/s) or more has been detected by the wind speed detector 15b ("Yes" of step B12), the weather information detecting device 15
20 outputs a heavy wind detecting signal to the elevator control apparatus 11 via the input and output device 111. In this case, several stages of heavy wind detecting levels can be set by the wind speed detector
25 15b. In the present embodiment, two stages of heavy wind detecting levels are set. When the wind speed is A (m/s) or more and less than B (m/s) ("No" of step

B14), the weather information detecting device 15 outputs a first heavy wind level signal S3 to the elevator control apparatus 11. When the wind speed is B (m/s) ("Yes" of step B14), the weather information
5 detecting device 15 outputs a second heavy wind level signal S4 to the elevator control apparatus 11. Specifically, the wind speed A is 15 m/s, and the wind speed B is 20 m/s.

When the first heavy wind level signal S3 is
10 inputted to the elevator control apparatus 11, the elevator control apparatus 11 reduces a rated speed "a" (m/min) to a predetermined speed b (m/min), and continues operation (step B15). The speed "b" is 1/2 of the rated speed "a", for example, and is
15 specifically 180 m/min. In this case, when the first heavy wind level signal S3 is detected, if the car 1 stops, operation is started by changing the current speed to the above speed "b" at a time when operation is carried out in response to the next call. In
20 addition, when the first heavy wind level signal S3 is detected, in the case where the car 1 is running, the car runs up to the current target floor while maintaining the rated speed "a" before inputting the first heavy wind level signal S3. Then, after the car
25 has reaches the target floor, operation is carried out by changing the current speed to the speed "b" when and after a response to the next call is made. Such a

control operation carried out at the first heavy wind level is referred to as a "heavy wind control operation 1".

5 In addition, after the wind speed B or more is sensed by the wind speed detector 15b, when the second heavy wind level signal S4 is inputted to the elevator control apparatus 11, the elevator control apparatus 11 causes the car 1 to move to the refuge floor 8 serving as a "service floor" where an effect due to heavy wind is the least significant (step B16). In this case, 10 when the second heavy wind level signal S4 is inputted, if the car 1 is landed at the service floor, the elevator control apparatus notifies the passengers that the elevator's service is stopped by means of the display device 6, announcing device 7 and the like, and 15 causes the car 1 to move to the refuge floor 8 after the car door has been opened for a predetermined period of time.

Moreover, there is a possibility that the 20 passengers are still loaded in the car 1 even while the car 1 moves to the refuge floor 8. Then, after landing and door opening at the refuge floor, the elevator control apparatus notifies that the elevator's service is stopped by the display device 6, announcing device 7 and the like. After prompting the passenger to unload 25 the car, the door is closed after a predetermined period of time, and an operation is stopped (step B17).

Such a control operation carried out at the second heavy wind level is referred to as a "heavy wind control operation 2".

Even if an operation is stopped by the "heavy wind control operation 2", the elevator control apparatus 11 monitors a signal from the heavy wind detector 15b (step B18). Then, after the wind speed is reduced to be less than B within a predetermined period of time (for example, 10 minutes), if the second heavy wind level signal S4 is released ("No" of step B19), the elevator control apparatus 11 restarts an operation of the car 1 at a speed "b" from the refuge floor 8 (step B20). In this case, if the wind speed is continued to be A or more and less than B ("No" of steps B21 to B22), an operation at the speed "b" is continued as it is.

On the other hand, when the wind speed is equal to or greater than B ("Yes" of step B22), processing reverts to the step B16 in which operation for reaching the refuge floor 8 is carried out again as the "heavy wind control operation 2". In addition, in the above step B21, if the wind speed A or more is not detected within a predetermined period of time, a normal operation at the rated speed "a" is restored (step B23).

As described above, in the elevator for outside observation, in the case where a heavy wind level equal

to or greater than a certain set value, an operation is continued by reducing a speed lower than normal, whereby the swinging of the running car 1 is restrained so that the passenger does not feel uneasy. In addition, there is a possibility that the car 1 exposed to the outside or the rope 3, balancing weight 4 and the like are swung by a heavy wind, and breakage occurs due to the rope being caught in other equipment. In the case where the wind speed at a level higher than the above heavy wind level has been detected, the elevator control apparatus causes the car 1 to move to the refuge floor 8 serving as a "service floor" where an effect due to heavy wind is the least significant. In this manner, the passenger's safety can be ensured, and equipment breakage due to a heavy wind can be prevented.

(Third Embodiment) .

Now, a third embodiment of the present invention will be described here.

In the third embodiment, in the construction of FIG. 1 described previously, the present invention is featured by detecting an amount of rainfall or snowfall using the rainfall or snowfall detector 15c provided at the weather information detecting device 15, thereby carrying out a control operation according to the amount of rainfall or snowfall. FIG. 5 shows a processing operation thereof.

FIG. 5 is a flow chart showing rainfall or snowfall quantity control operation processing of an elevator control apparatus 11 in accordance with the third embodiment of the present invention.

5 While the elevator's operation is under its way, an amount of rainfall or snowfall is detected by the rainfall or snowfall detector 15c provided at the weather information detecting device 15 (step C11). The above rainfall or snowfall detector 15c includes a
10 rainfall or snowfall meter for measuring an amount of rainfall or snowfall, for example. Snow is changed to water by means of a heater, and then, an amount of snowfall is converted into an amount of rainfall.

 When an amount of rainfall or snowfall is detected
15 to be equal to or greater than a predetermined first level (for example, 10 mm/h) ("Yes" of step C11), a rainfall or snowfall operation level signal S5 is outputted from the rainfall or snowfall detector 15c. The elevator control apparatus 11 inputs this rainfall
20 or snowfall operation level signal S5 via the input and output device 111, thereby changing the current operation into a landing operation (home landing operation) in which the refuge floor 8 serving as a "service floor" where an effect due to rainfall or
25 snowfall is the least significant, is defined as a reference floor (step C12). Such a landing operation carried out according an amount of rainfall or snowfall

is referred to as a "rainfall or snowfall control operation".

5 In this "rainfall or snowfall control operation", the car 1 is made standby at the refuge floor 8. When a call from a car or a landing floor occurs, operation is carried out as usual in response to such a call, and the car is made standby again at the refuge floor 8 after the operation. If no call from a car or a landing floor occurs, the car 1 is made standby at the
10 refuge floor 8 as is, and is prevented from being exposed to rainfall.

In addition, even while in "rainfall or snowfall control operation", the monitoring of an amount of rainfall or snowfall is continuously carried out by the
15 rainfall or snowfall detector 15c. When an amount of rainfall equal to or greater than the above first level has been detected again within a predetermined period of time (for example, 10 minutes) ("No" of step C13), the elevator control apparatus 11 extends the "rainfall or snowfall control operation". On the other hand,
20 even after the predetermined period of time has elapsed, if the amount of rainfall equal to or greater than the first level is not detected ("Yes" of step C13), a normal operation is restored (step C14).

25 In addition, after a large amount of rain or snow has fallen, when the amount of rainfall or snowfall reaches a second level or more such that a pit portion

9 is immersed in water ("Yes" of step C15), a water immersion level signal S6 is outputted from the rainfall or snowfall detector 15c to the elevator control apparatus 11. In this manner, the elevator control apparatus 11 controls the car to unload the passengers at the nearest floor, retract to the refuge floor 8, and then, enter the operation stop state (step C16).

As described above, in the elevator for outside observation, when an amount of rainfall equal to or greater than a predetermined amount is detected, operation is carried out while the refuge floor 8 is defined as a reference floor. If a call from a car or a landing floor does not occur, the car is made standby at the refuge floor 8 as is, whereby the car 1 can be prevented from being exposed to rainfall. In addition, when an amount of rainfall reaches such an amount that the pit portion can be immersed in water, the passengers are unloaded, and the car 1 is retracted to the refuge floor 8, whereby the passenger's safety is ensured, and the damage of equipment due to water immersion can be prevented.

(Fourth Embodiment)

Now, a fourth embodiment of the present invention will be described here.

In the above described first to third embodiments, descriptions have been given with respect to control

operation when each of the lightning detector 15a, wind speed detector 15b, and rainfall or snowfall detector 15c provided at the weather information detecting device 15 is used. By using these detectors 15a to
5 15c, it is possible to carry out a control operation adapted to a current weather environment. Further, a control operation can be carried out by additionally providing the earthquake sensor 16 and the fire sensor 17 installed for a purpose other than weather forecast.

10 In the following, a description will be given with respect to a case in which a control operation is carried out based on a variety of weather information and earthquake or fire information by using: the lightning detector 15a, wind speed detector 15b, and
15 rainfall or snowfall detector 15c provided at the weather information detecting device 15; and an earthquake sensor 20 and the fire sensor 17.

As described above, as control operations using the lightning detector 15a, there are exemplified a
20 "lightning control operation 1" (in which an operation is continued after a lightning caution has been notified to a person involved in operation control) and a "lightning control operation 2" (in which an operation is stopped after the car 1 has been retracted
25 to the refuge floor 8). In addition, as control operations using the wind speed detector 15b, there are exemplified a "heavy wind control operation 1" (in

which an operation is continued after deceleration) and a "heavy wind control operation 2" (in which an operation is stopped after the car 1 has been retracted to the refuge floor 8). Moreover, control operations using the rainfall or snowfall detector 15c, there is exemplified a "rainfall or snowfall control operation" (in which a home landing operation is carried out while the refuge floor is defined as a reference floor).

Apart from these control operations concerning a variety of weathers, there are exemplified an "earthquake control operation" using the earthquake sensor 20 and a "fire control operation" using the fire sensor 17. The priorities of these control operations are stored in the priority table 112. FIG. 6 shows an example thereof.

FIG. 6 shows a construction of a priority table 112 of an elevator control apparatus 11 in accordance with the fourth embodiment of the present invention. The priorities are predetermined in order of the "earthquake control operation", "fire control operation", "lightning control operation 2", "heavy wind control operation 2", and "rainfall or snowfall control operation". The "lightening control operation 1" and "heavy wind control operation 1" are control operations in which the priorities cannot be assigned. With respect to these two control operations, information indicating whether or not they can be

executed at the same time for the above control operations having their priorities is added. In the figure, "O" denotes that simultaneous execution is enabled, and "X" denotes that simultaneous execution is disabled.

In the thus constructed priority table 112, if an earthquake occurs, the highest priority is given the "earthquake control operation". In the "earthquake control operation", use of an elevator is inhibited if an earthquake occurs (that is, all calls are canceled). In addition, emergency stop on the spot, stop at the nearest floor or the like is carried out in order to ensure the safety of one or more passengers loaded on the car 1 according to the earthquake level detected by the earthquake sensor 20. Subsequently, the "fire control operation" is executed. In the "fire control operation", when a fire is detected by the fire sensor 17, an operation for returning to a floor which is the most suitable to evacuation of passengers loaded on the car 1 is carried out.

The "lightning control operation 2" and "heavy wind control operation 2" are operations for moving the car 1 to the refuge floor 8 where an effect due to lightning or heavy wind is the least significant, and then, stopping service. Thus, the priority of this operation follows that of the "earthquake control operation" or "fire control operation" in which saving

or unloading of the passenger(s) is prioritized. The "rainfall or snowfall control operation" is an operation in which normal service is carried out while the refuge floor 8 at which the car 1 is not exposed to rainfall is defined as a reference floor. Thus, this operation is given the lowest priority.

In addition, the "lightning control operation 1" and "heavy wind control operation 1" are executed at the same time when another control operation is executed in order to continue the operation itself.

As described above, control operations concerning a variety of weathers and earthquake or fire control operations are executed in combination in accordance with their priorities. In this manner, in the elevator for outside observation in which the car 1 is exposed to the outside, a safe operation can be achieved.

Industrial Applicability

In the above described first to third embodiments, information concerning a variety of weathers such as lightning, wind, and rainfall or snowfall is acquired by using the dedicated detectors 15a to 15c, respectively. In another embodiment, for example, by using Internet, information concerning a variety of weathers such as lightning, wind, and rainfall or snowfall may be acquired from a specific server for providing weather forecast service. This acquisition can be achieved with a construction in which a terminal

device for providing an access to the above specific server via Internet is installed, the terminal device being connected to the elevator control apparatus 11. However, in such a construction that information concerning a variety of weathers is acquired from the outside, the information may not coincide with the weather information on the periphery of the building. Therefore, as has been described in the embodiments each, it is preferable to provide a construction such that the weather information on the periphery of the building can be reliably acquired by using the dedicated detectors 15a to 15c installed in the building.

Claims:

1. An elevator control apparatus for use in an elevator for outside observation in which a car is provided at the outside of a building, the apparatus characterized by comprising:
 - lightning detecting means for detecting an approach of lightning; and
 - control means for, in the case of remote lightning, indicating a caution or warning according to an approach state of lightning detected by the lightning detecting means to continue operation, and in the case of proximal lightning, retracting the car to a specific floor to establish an operation stop state.
2. An elevator control apparatus for use in an elevator for outside observation in which a car is provided at the outside of a building, the apparatus characterized by comprising:
 - wind speed detecting means for detecting a wind speed; and
 - control means for, in the case where the wind speed detected by the wind speed detecting means is a first wind speed level or more and less than a second wind speed level, reducing an operation speed of the car to a predetermined speed to continue operation, and in the case where the wind speed is the second wind speed level or more, retracting the car to a specific floor to establish an operation stop state.
3. An elevator control apparatus for use in an elevator for outside observation in which a car is provided at the outside of a building, the apparatus characterized by comprising:
 - rainfall or snowfall detecting means for detecting an amount of rainfall or snowfall; and
 - control means for, in the case where an amount of rainfall or snowfall equal to or greater than a first level is detected by the rainfall or snowfall detecting means, carrying out a landing operation while a specific floor is defined as a reference floor, and in the case where the amount of rainfall or

snowfall reaches an amount of snowfall or rainfall equal to or greater than a second level such that a pit portion is immersed in water, retracting the car to the specific floor to establish an operation stop state.

4. An elevator control apparatus for use in an elevator for outside observation in which a car is provided at the outside of a building, the apparatus characterized by comprising:

weather information detecting means for detecting information concerning a variety of weathers which include at least an approach of lightning, a wind speed, and an amount of rainfall or snowfall; and

control means for carrying out a control operation for avoiding a direct effect on the car due to a change of weather based on a variety of weather information detected by the weather information detecting means.

5. An elevator control apparatus according to claim 4, characterized by comprising:

earthquake sensing means for sensing an earthquake apart from the weather information detecting means; and

fire sensing means for sensing a fire, wherein the control means carries out a control operation for avoiding a direct effect on the car due to a change of weather based on a variety of weather information detected by the weather information detecting means and carries out a control operation during an earthquake and during a fire based on each item of information detected by the earthquake sensing means and the fire sensing means.

6. An elevator control apparatus according to claim 5, characterized in that the control means executes control operations during an earthquake and during a fire in preference to a control operation concerning a variety of weathers.

A B S T R A C T

A weather information detecting device (15) for detecting information concerning a variety of weathers is provided. An elevator control apparatus (11) carries out a control operation for avoiding a direct effect on a car (1) due to a change of weather based on weather information detected by the weather information detecting device (15). For example, the elevator control device (11) detects an approach of lightning by a lightning detector (15a) of the weather information detecting device (15). In the case where there is a possibility of a lightning strike in the vicinity of a building, the elevator control device (11) controls the car (1) to be retracted to a refuge floor (8) free of an effect due to a direct strike of lightning. In this manner, the passenger's safety is ensured, and the damage of the car can be prevented.