

DESCRIPTION

ELEVATOR SYSTEM

5

TECHNICAL FIELD

[0001]

The present disclosure relates to an elevator system which can automatically recover when a failure occurs.

10

BACKGROUND

[0002]

When elevators fail, recovery within a minimum amount of time is desired. For this purpose, there is proposed a control apparatus of an elevator which stores failure data therein, estimates a cause of failure using the failure data, and provides the estimated cause to a maintenance worker or the like (for example, refer to Patent Document 1).

15

[0003]

Further, there is proposed a failure recovery system in which a monitoring center receives a failure signal of an elevator, the monitoring center refers to a failure history database, and the monitoring center transmits recovery content of the failure to a portable terminal held by a maintenance worker (refer to Patent Document 2).

20

CITATION LIST

PATENT LITERATURE

[0004]

25

Patent Document 1: JP H5-39179 A

Patent Document 2: JP 2003-104644 A

SUMMARY

[0005]

However, in the related art of Patent Documents 1 and 2, when the elevator fails, the maintenance worker or a field engineer must attend to the site and recover the elevator, and
5 there has been a problem in that time required until the recovery is long. On the other hand, there is an increasing demand for improving operation services of elevators.

[0006]

An advantage of the present disclosure lies in improvement of the operation service of the elevator.

10 [0007]

According to one aspect of the present disclosure, there is provided an elevator system comprising: a control board that executes drive control of an elevator; and a monitor panel that is placed near the control board, that is connected to the control board, that outputs to the control board, when a failure code and a failure state code are input from
15 the control board, a recovery command and a recovery diagnosis command according to the failure code and the failure state code, and that causes the control board to execute a recovery operation and a recovery diagnosis operation of the elevator, wherein the monitor panel comprises a monitor-side recovery process database which stores, in correlation with each other, a combination having a large number of cases of occurrences among
20 combinations of the failure codes and the failure state codes, a recovery command having a high recovery rate among recovery commands corresponding to the combination, and a recovery diagnosis command corresponding to the recovery command, and the monitor panel selects, when the failure code and the failure state code are input from the control board, a recovery command and a recovery diagnosis command by referring to the
25 monitor-side recover process database, and outputs to control board the selected recovery command and the recovery diagnosis command.

[0008]

According to another aspect of the present disclosure, the elevator system may further comprise a remote monitoring center that communicates with the monitor panel and that remotely monitors the elevator, the remote monitoring center may comprise: a recovery diagnosis database which stores, in correlation with each other, a number of cases of failure causes corresponding to a combination of a failure code and a failure state code, a recovery command, a recovery diagnosis command, and a recovery rate; and a center-side recovery process database which extracts, from the recovery diagnosis database, a combination having a large number of cases of occurrences among combinations of the failure code and the failure state code, and which stores, in correlation with each other, a recovery command having a high recovery rate among recovery commands corresponding to the combination, and a recovery diagnosis command corresponding to the recovery command, the remote monitoring center may transmit the center-side recovery process database to the monitor panel at a predetermined interval, and the monitor panel may update contents of the monitor-side recovery process database which is stored, with the received contents of the center-side recovery process database every time the center-side recovery process database is received from the remote monitoring center.

[0009]

According to another aspect of the present disclosure, in the elevator system, the control board may determine whether or not the elevator is recovered by a recovery diagnosis operation after a recovery operation executed according to a recovery command which is input from the monitor panel, and may output a determination result to the monitor panel, the monitor panel may send to the remote monitoring center the failure code, the failure state code, and the determination result which are input from the control board, and the remote monitoring center may update a number of cases of a failure cause corresponding to the combination of the failure code and the failure state code based on the determination result which is input from the monitor panel.

[0010]

According to another aspect of the present disclosure, in the elevator system, the remote monitoring center may update the recovery rate corresponding to the combination of the failure code and the failure state code based on the determination result which is input from the monitor panel.

5 [0011]

According to various aspects of the present disclosure, an operation service of elevator can be improved.

BRIEF DESCRIPTION OF DRAWINGS

10 [0012]

FIG. 1 is a system diagram showing a structure of an elevator system according to an embodiment of the present disclosure.

FIG. 2 is a functional block diagram of an elevator system according to an embodiment of the present disclosure.

15 FIG. 3 is a diagram showing a structure of a center-side maintenance database shown in FIG. 2.

FIG. 4 is a diagram showing a structure of a recovery diagnosis database shown in FIG. 2.

FIG. 5 is a diagram showing a structure of reception number-sorted data.

20 FIG. 6 is a diagram showing a structure of a center-side recovery process database.

FIG. 7 is a diagram showing a structure of a monitor-side maintenance database.

FIG. 8 is a diagram showing a structure of a monitor-side recovery process database.

FIG. 9 is a flowchart showing production of a center-side recovery process database and a monitor-side recovery process database of an elevator system according to an
25 embodiment of the present disclosure.

FIG. 10 is a flowchart showing operations of a control board and a monitor panel of an elevator system according to an embodiment of the present disclosure.

FIG. 11 is a flowchart showing an operation of a remote monitoring center of an elevator system according to an embodiment of the present disclosure.

DESCRIPTION OF EMBODIMENTS

5 [0013]

<Structure of Elevator System>

An elevator system 100 according to an embodiment of the present disclosure will now be described with reference to the drawings. As shown in FIG. 1, the elevator system 100 comprises a control board 200 which executes drive control of an elevator 20 placed in an ascending/descending path 11 of a building 10, a monitor panel 210 which is placed near the control board 200 and which is connected to the control board 200; and a remote monitoring center 300 which communicates with the monitor panel 210 and which remotely monitors the elevator 20. The number of the elevator(s) 20 monitored by the remote monitoring center 300 may be one or a plurality. In the case of a plurality of elevators 20, the plurality of elevators 20 may be placed in the same building 10 or in different buildings 10.

[0014]

The control board 200 is a computer which includes therein a CPU and a memory. When a failure occurs in the elevator 20, the control board 200 outputs a failure code and a failure state code to the monitor panel 210.

[0015]

The monitor panel 210 comprises a monitor-side communication apparatus 220, a monitor-side information processor 230, a monitor-side maintenance database 240, and a monitor-side recovery process database 250. The monitor-side information processor 230 is a computer which includes therein a CPU and a memory. The remote monitoring center 300 comprises a center-side communication apparatus 320, a center-side information processor 360, a center-side maintenance database 370, a recovery diagnosis database 380, a center-side recovery process database 390, and a monitoring board 330.

The center-side information processor 360, the center-side maintenance database 370, the recovery diagnosis database 380, and the center-side recovery process database 390 may be placed at the same location or may be placed at different locations and connected to each other via an Internet line or the like.

5 [0016]

When a failure of the elevator 20 occurs, the monitor-side information processor 230 of the monitor panel 210 receives input of the failure code and the failure state code which are output by the control board 200, refers to the monitor-side recovery process database 250, outputs a recovery command and a recovery diagnosis command to the control board
10 200 according to the failure code and the failure state code which are input, and causes the control board 200 to execute a recovery operation and a recovery diagnosis operation of the elevator 20.

[0017]

The monitor-side maintenance database 240 stores specification of the elevator 20,
15 and history data such as inspection, maintenance, repair, or the like. The monitor-side recovery process database 250 is a database which stores in correlation with each other a combination having a large number of cases of occurrences among combinations of the failure code and the failure state code, a recovery command having a high recovery rate among recovery commands corresponding to the combination, and a recovery diagnosis
20 command corresponding to the recovery command. The databases 240 and 250 will be described later in detail.

[0018]

The monitor-side communication apparatus 220 of the monitor panel 210 sends information produced by the monitor-side information processor 230 to a communication
25 network 30. The monitor-side communication apparatus 220 also receives information of the center-side recovery process database 390 produced by the center-side information processor 360 via the center-side communication apparatus 320 and the communication network 30, and outputs the received information to the monitor-side information

processor 230. The monitor-side communication apparatus 220 and the center-side communication apparatus 320 may be devices which execute wireless communication or devices which execute wired communication. Further, the communication network 30 may be an Internet communication network, or a telephone line network.

5 [0019]

The remote monitoring center 300 is equipped with the monitoring board 330 which exchanges data with the center-side information processor 360 and which monitors an operation status and a failure status of the elevator 20. On the monitoring board 330, there are provided a display 331 on which the operation status and the failure status of the elevator 20, a notification from the center-side information processor 360, or the like are displayed, and a switch 332 for manipulating the display on the display 331. In addition, a telephone 333 is provided on the monitoring board 330 for communicating with a service center 340 via a communication network 35.

[0020]

15 The center-side maintenance database 370 stores the specification of the elevator 20 and history data such as that pertaining to inspection, maintenance, repair, or the like. The recovery diagnosis database 380 is a database which correlates with each other a number of cases of causes of failure corresponding to the combination of the failure code and the failure state code which are output by the control board 200 when the elevator 20 fails, the recovery command, the recovery diagnosis command, and the recovery rate. 20 The center-side recovery process database 390 is a database which extracts, from the recovery diagnosis database 380, a combination having a large number of cases of occurrences among the combinations of the failure code and the failure state code, and which stores, in correlation with each other, a recovery command having a high recovery rate among the recover commands corresponding to the combination and a recovery diagnosis command corresponding to the recovery command. The center-side recovery process database 390 is produced by the center-side information processor 360. The 25 databases 370, 380, and 390 will be described in detail later.

[0021]

The center-side information processor 360 is a computer which includes therein a CPU and a memory. A failure signal which is output from the control board 200 when the failure occurs in the elevator 20, and information such as a recovery diagnosis result when the monitor panel 210 causes the control board 200 to execute the recovery operation of the elevator 20 or the like are input to the center-side information processor 360 via the monitor-side communication apparatus 220, the center-side communication apparatus 320, and the communication network 30. Based on the received information, the center-side information processor 360 updates the center-side maintenance database 370 and the recovery diagnosis database 380. In addition, when the recovery operation by the monitor panel 210 cannot be executed or when the recovery by the recovery operation of the monitor panel 210 is not successful, the center-side information processor 360 displays the result of these cases on the display 331 of the monitoring board 330.

[0022]

<Database Structure>

As shown in FIG. 2, the center-side maintenance database 370 stores elevator specification data 371, failure history data 372, and failure cause-classified data 373. Data structures of the elevator specification data 371, the failure history data 372, and the failure cause-classified data 373 will now be described with reference to FIG. 3.

[0023]

<Structure of Elevator Specification Data>

The elevator specification data 371 has a data structure which stores data of a management number of the elevator 20, a model of the elevator 20, a manufacturing date, a manufacturing number, a name of the building where installed, and usage of the building where installed. The usage of the building where installed is, for example, an office, a general residence, a restaurant, a school, or the like.

[0024]

<Structure of Failure History Data>

The failure history data 372 has a data structure which stores the management number of the elevator 20, a date of occurrence of the failure, a failure code, a failure state code, a recovery method, and a recovery determination result. The failure code is a number code or a number-alphabet code which is output from the control board 200 when a failure occurs in the elevator 20. A number of types of the failure codes is, for example, 1000 types. The failure state code is a code formed by terms indicating a failure state, and which is output along with the failure code from the control board 200 when a failure occurs in the elevator 20. The failure state codes include, for example, “unable to open door”, and “unable to close door”. There may be cases where one failure state code is output along with one failure code, and cases where a plurality of failure state codes are output along with one failure code. In the item of recovery method, for example, when a field engineer 350 attends to the site and executes inspection, checking, and recovery, a term such as “field engineer attended” is input. When the monitor panel 210 causes the control board 200 to execute a recovery operation of the elevator 20 for the recovery, a term such as “monitor-side automatic recovery” is input. In the item of the recovery determination result, when the elevator 20 is recovered and the operation is restarted, a term such as “recovery” is input. Further, in the item of the recovery determination result, when the recovery of the elevator 20 is not successful, a term such as “unsuccessful” is input.

[0025]

<Structure of Failure Cause-classified Data>

As shown in FIG. 3, the failure cause-classified data 373 stores a number of receptions of a certain failure state code when a certain failure code and the certain failure state code are output from the control board 200. Further, the failure cause-classified data 373 stores the failure code as a result of the attendance of the field engineer 350 on site and inspection and checking by the field engineer 350, a number of cases of causes of the failure corresponding to the failure state code, a failure code when the monitor panel 210 causes the control board 200 to execute the recovery operation of the elevator 20 for

recovery and the elevator 20 is recovered, and a total number of cases of the causes of the failure corresponding to the failure state code.

[0026]

For example, a case will be described in which the failure code is 0001 indicating a failure related to doors 13 and 26, and the failure state code of “unable to open door” is received A times. As a result of the checking by the field engineer 350 on the site, the cause of output of the failure code of “0001” and the failure state code of “unable to open door” is determined, which may be, for example, clogging with dirt on a doorsill (failure cause 1), loose contact of a switch of a door open/close device (failure cause 2), or another failure cause 3. The failure cause-classified data 373 is configured such that the data are arranged in the order of reducing number of cases in a data structure such as, when the failure code of “0001” and the failure state code of “unable to open door” are output, 100 cases for the clogging with dirt on the doorsill (failure cause 1), 50 cases for the loose contact of the switch of the door open/close device (failure cause 2), and 10 cases for the other failure causes 3. When the monitor panel 210 causes the control board 200 to execute the recovery operation of the elevator 20 for recovery, if the recovery of the elevator 20 is successful by the recovery command, the number of cases of the failure causes corresponding to the failure code and the failure state code forming basis for the recovery command is added to the number of cases of the causes of failure as a whole.

[0027]

Similarly, in a case where the failure code is 0001 indicating a failure related to the doors 13 and 26 and a failure state code of “unable to close door” is received B times, the causes for the output of the failure code of “0001” and the failure state code of “unable to close door” may be the clogging with dirt on the doorsill (failure cause 1), loose contact of the switch of the door open/close device (failure cause 2), or another failure cause 3. Thus, the failure cause-classified data 373 is configured such that the data are arranged in the order of reducing number of cases in a data structure such as, when the failure code of “0001” and the failure state code of “unable to close door” are output, 100 cases of the

clogging with dirt on the doorsill (failure cause 1), 50 cases of loose contact of the switch of the door open/close device (failure cause 2), and 10 cases of the other failure causes 3.

[0028]

This is similarly applicable to a case where two failure state codes of “unable to open door” and “unable to close door” are output along with the failure code of “0001”.

[0029]

In a case where the failure code is 0002 indicating a failure related to a control circuit and the failure state code is “unable to start”, as a result of the checking by the field engineer 350 on the site, the cause of the output of the failure code of “0002” is determined, and may be a defect of a relay attached to the control board 200 (failure cause 4), a defect of a relay driving circuit which drives the relay (failure cause 5), or another failure cause 6. As shown in FIG. 4, the failure cause-classified data 373 is configured such that the data are arranged in the order of reducing number of cases in a data structure such as, for example, when the failure code is “0002” and a state code of the elevator is “unable to start”, 100 cases of the relay defect (failure cause 4), 50 cases of the relay driving circuit defect (failure cause 5), and 10 cases of the other failure causes 6. This is similarly applicable when the failure code is 0002 indicating a failure related to the control circuit and the failure state code is “stopped between floors”.

[0030]

In the failure cause-classified data 373 shown in FIG. 3, the numbers of receptions are in the relationship of $A > B > C > D$.

[0031]

<Structure of Recovery Diagnosis Database>

As shown in FIG. 4, the recovery diagnosis database 380 stores, in the order of reducing number of cases of causes of failure corresponding to the failure code and the failure state code of the failure cause-classified data 373, a recovery diagnosis command set which is a set of the recovery command and the recovery diagnosis command, and a recovery rate (%), which is a ratio of recovery from the failure of the elevator 20 by the

execution of the recovery command. The recovery diagnosis database 380 is a database which links the recovery diagnosis command set and the recovery rate to the failure cause-classified data 373 described above.

[0032]

5 In the following, a data structure of the recovery diagnosis database 380 will be described for a case in which, as shown in FIG. 4, the failure code is “0001” indicating the failure related to the doors 13 and 26 and the failure state code is “unable to open door”. When the clogging with the dirt on the doorsill is the cause (failure cause 1), the recovery diagnosis data has a data structure in which a recovery diagnosis command set A which is a
10 set of two commands including “reset door circuit + open/close door with high torque” serving as the recovery command, and “door open/close diagnosis” serving as the recovery diagnosis command, and the recovery rate of a% due to the recovery operation by the recovery command are linked to case number data of the failure cause 1 in which the failure state code corresponds to “unable to open door”. In the case where the cause is
15 loose contact of the switch of the door open/close device (failure cause 2), the recovery diagnosis data has a data structure in which a recovery diagnosis command set B which is a set of two commands including “reset door circuit + retry door open/close” serving as the recovery command, and “door open/close diagnosis” serving as the recovery diagnosis command, and a recovery rate of b% due the recovery operation by the recovery command
20 are linked to case number data of the failure cause 2 in which the failure state code corresponds to “unable to open door”. Similarly, in the case of the failure cause 3, the recovery diagnosis data has a data structure in which a recovery diagnosis command set C and a recovery rate of c% are linked to case number data of the failure cause 3 in which the failure state code corresponds to “unable to open door”. In this manner, the recovery
25 diagnosis database 380 is a database storing in correlation with each other the failure code, the failure state code, the failure cause corresponding to the failure code and the failure state code, the number of cases of the failure cause, the recovery diagnosis command set which is a set of the recovery command and the recovery diagnosis, and the recovery rate.

In the present embodiment, the recovery rate a% is a numerical value larger than the recovery rates b% and c%, and the recovery diagnosis command set A has a higher recovery rate than the recovery diagnosis command sets B and C.

[0033]

5 Next, a data structure of the recovery diagnosis database 380 when the failure code is “0001” indicating the failure related to the doors 13 and 26, and the failure state code is “unable to close door” will be described. When the cause is the clogging with dirt on the doorsill (failure cause 1), the recovery diagnosis data has a data structure in which the recovery diagnosis command set A which is a set of two commands including “reset door
10 circuit + open/close door with high torque” serving as the recovery command, and “door open/close diagnosis” serving as the recovery diagnosis command, and a recovery rate of d% due to the recovery operation by the recovery command are linked to case number data of the failure cause 1 in which the failure state code corresponds to “unable to close door”. When the cause is loose contact of the switch of the door open/close device (failure cause
15 2), the recovery diagnosis data has a data structure in which the recovery diagnosis command set B which is a set of two commands including “reset door circuit + retry door open/close” serving as the recovery command, and a “door open/close diagnosis” serving as the recovery diagnosis command, and a recovery rate of e% due to the recovery operation by the recovery command are linked to case number data of the failure cause 2 in
20 which the failure state code corresponds to “unable to close door”. Similarly, for the failure cause 3, the recovery diagnosis data has a data structure in which the recovery diagnosis command set C and a recovery rate of f% are linked to case number data of the failure cause 3 in which the failure state code corresponds to “unable to close door”. In this manner, the recovery diagnosis database 380 is a database which stores in correlation
25 with each other the failure code, the failure state code, the failure cause corresponding to the failure code and the failure state code, the number of cases of the failure causes, the recovery diagnosis command set which is a set of the recovery command and the recovery diagnosis, and the recovery rate. In the present embodiment, the recovery rate e% is a

numerical value larger than the recovery rates d% and f%, and the recovery diagnosis command set B has a higher recovery rate than the recovery diagnosis command sets A and C.

[0034]

5 Next, a data structure of the recovery diagnosis database 380 will be described for a case in which the failure code is “0002” indicating a failure related to a control circuit, and the state code of the elevator is “unable to start”. When there is a defect in the relay (failure cause 4), the recovery diagnosis data have a data structure in which a recovery diagnosis command set D which is a set of two commands including “reset control circuit
10 + upward and downward operation at low speed” serving as the recovery command and “operate to stop at every floor, high-speed operation diagnosis” serving as the recovery diagnosis command, and a recovery rate of g% due to the recovery operation by the recovery diagnosis command are linked to case number data of the failure cause 4.

Similarly, when there is a defect in the relay driving circuit (failure cause 5), the recovery
15 diagnosis data have a data structure in which a recovery diagnosis command set E which is a set of two commands including “reset control circuit + operation between top and bottom floors” serving as the recovery command and “operate to stop at every floor, high-speed operation diagnosis” serving as the recovery command, and a recovery rate of h% due to the recovery operation by the recovery diagnosis command are linked to case number data
20 of the failure cause 5. Similarly, in the case of the failure cause 6, the recovery diagnosis data have a data structure in which a recovery diagnosis command set F and a recovery rate of i% are linked to case number data of the failure cause 6. In the present embodiment, the recovery rate is the highest for the recovery rate of g% corresponding to the recovery diagnosis command set D.

25 [0035]

The data structure of the recovery diagnosis database 380 when the failure code is “0002” indicating the failure related to the control circuit and the state code of the elevator is “stopped between floors” is similar to the data structure of the recovery diagnosis

database in the case in which the failure code is “0002” indicating the failure related to the control circuit and the state code of the elevator is “stopped between floors” described above, with the recovery rates being respectively j%, k%, and l%. The recovery rate is the highest for the recovery rate of k% corresponding to the recovery diagnosis command set E.

[0036]

<Structures of Center-side Recovery Process Database and Reception Number-sorted Data>

Next, with reference to FIGs. 5 and 6, data structures of reception number-sorted data 381 and the center-side recovery process database 390 will be described. The reception number-sorted data 381 is intermediate data for extracting data from the recovery diagnosis database 380 shown in FIG. 4 and for producing the center-side recovery process database 390.

[0037]

The reception number-sorted data 381 is a database extracting, from the failure cause-classified data 373, a combination of the failure code and the failure state code in the order of reducing number of receptions. As already described, the number of receptions in the failure cause-classified data 373 are in the relationship of A>B>C>D. The reception number-sorted data 381 stores a combination of the failure code of 0001 and the failure state code of “unable to open door” corresponding to the largest number of receptions, A, as a first rank, a combination of the failure code of 0001 and the failure state code of “unable to close door” having the second largest number of receptions, B, as a second rank, a combination of the failure code of 0002 and the failure state code of “unable to start” having the third largest number of receptions, C, as a third rank, and a combination of the failure code of 0002 and the failure state code of “stopped between floors” having the fourth largest number of receptions, D, as a fourth rank. The reception number-sorted data 381 stores, for example, data up to a 50th rank.

[0038]

As shown in FIG. 6, the center-side recovery process database 390 is a database in which a recovery diagnosis command set which is a set of a recovery command having a highest recovery rate among the recovery commands corresponding to the combination of the failure code and the failure state code, and the diagnosis corresponding to the recovery command is combined with the reception number-sorted data 381. For example, for the case of the failure code of 0001 and the failure state code of “unable to open door” which is the first rank, with reference to the recovery diagnosis database 380 shown in FIG. 4, the highest recovery rate is the recovery rate of a% corresponding to the recovery diagnosis command set A. Thus, the recovery diagnosis command set A is combined with the first rank of the reception number-sorted data 381. Similarly, for the case of the failure code of 0001 and the failure state code of “unable to close door” which is the second rank, with reference to the recovery diagnosis database 380 shown in FIG. 4, the highest recovery rate is the recovery rate of e% corresponding to the recovery diagnosis command set B, and the recovery diagnosis command set B is thus combined with the second rank of the reception number-sorted data 381. Similarly, for the case of the failure code of 0002 and the failure state code of “unable to start” which is the third rank, the recovery diagnosis command set D having the highest recovery rate, g%, is combined with the third rank of the reception number-sorted data 381, and, for the case of the failure code of 0002 and the failure state code of “stopped between floors” which is the fourth rank, the recovery diagnosis command set E of the highest recovery rate, k%, is combined with the fourth rank of the reception number-sorted data 381. In this manner, the center-side recovery process database 390 as shown in FIG. 6 is constructed. The center-side recovery process database 390 stores, for example, data up to the 50th rank, similar to the reception number-sorted data 381.

[0039]

<Structure of Monitor-side Maintenance Database>

The monitor-side maintenance database 240 will now be described with reference to FIG. 7. The monitor-side maintenance database 240 comprises elevator specification data

241, remote checking history data 242, irregularity history data 243, and failure history data 244.

[0040]

5 The elevator specification data 241 and the failure history data 244 are similar to the elevator specification data 371 and the failure history data 372 described above with reference to FIG. 3, and thus, will not be described again.

[0041]

10 The remote checking history data 242 has a data structure which stores the management number of the elevator 20, a remote checking date, a remote checking item, and a remote checking result. The remote checking of the elevator 20 is performed, for example, according to a preset schedule such as once per month, and by outputting a remote checking command from the monitor panel 210 to the control board 200. The control board 200 of the elevator 20 moves a car 22 of the elevator 20 shown in FIG. 1 to a predetermined floor. During this movement, it is checked whether or not there is
15 abnormality in an operation performance (acceleration, presence/absence of abnormal sound), door opening/closing, braking, an emergency battery, an external contact device, or the like, by various sensors attached on the elevator 20. A checking result is output from the control board 200 to the monitor panel 210, and is stored in the remote checking history data 242. Alternatively, the remote checking may be executed by a command
20 from the remote monitoring center 300.

[0042]

The irregularity history data 243 has a structure which stores the management number of the elevator 20, an irregularity occurrence date, an irregularity item, and an irregularity handling result. Irregularity of the elevator 20 refers to a case where a result
25 of the inspection, checking, and maintenance works by the field engineer 350 or a result of the remote checking does not show an abnormal value, but is varied from a normal value of the elevator 20. For example, when a result of inspection of a brake torque is within an

allowable range, but has a large deviation from previous checking or from past inspection results of the elevator 20, “brake torque” is recorded in the irregularity item.

[0043]

<Structure of Monitor-side Recovery Process Database>

5 A structure of the monitor-side recovery process database 250 is identical to that of the center-side recovery process database 390 described above with reference to FIG. 6.

[0044]

<Operation of Elevator System>

10 Next, with reference to FIGs. 9 to 11, an operation of the elevator system 100 when the elevator 20 fails, according to the present embodiment will be described.

[0045]

<Production of Center-side Recovery Process Database and Monitor-side Recovery Process Database>

[0046]

15 First, with reference to FIG. 9, production of the center-side recovery process database 390 and the monitor-side recovery process database 250 will be described.

As already described, the center-side recovery process database 390 is a database in which the recovery diagnosis command set including a recovery command having the highest recovery rate among the recovery commands corresponding to the combination of the failure code and the failure state code, and the diagnosis corresponding to the recovery command is combined with the reception number-sorted data 381.

[0047]

As shown by step S11 of FIG. 9, the center-side information processor 360 extracts, from the failure cause-classified data 373 shown in FIG. 3, combinations of the failure codes and the failure state codes in the order of reducing number of receptions, and produces the reception number-sorted data 381 shown in FIG. 5. In the present embodiment, the numbers of receptions in the failure cause-classified data 373 shown in FIG. 3 are in the relationship of $A > B > C > D$. The center-side information processor 360

extracts the combination of the failure code of 0001 and the failure state code of “unable to open door” having the highest number of receptions, A, from the failure cause-classified data 373, and stores the extracted data in a first rank of the reception number-sorted data 381. Further, the center-side information processor 360 stores the combination of the failure code of 0001 and the failure state code of “unable to close door” having the second largest number of receptions, B, in a second rank, the combination of the failure code of 0002 and the failure state code of “unable to start” having the third largest number of receptions, C, in a third rank, and the combination of the failure code of 0002 and the failure state code of “stopped between floors” having the fourth largest number of receptions, D, in a fourth rank. Similarly, the center-side information processor 360 extracts the combinations of the failure codes and the failure state codes from the failure cause-classified data 373 in the order of reducing number of receptions, and stores, for example, data up to a 50th rank in the reception number-sorted data 381.

[0048]

Next, as shown in step S12 of FIG. 9, while referring to the recovery diagnosis database 380, the center-side information processor 360 combines the recovery diagnosis command set having the highest recovery rate among the recovery commands corresponding to the combination of the failure code and the failure state code with the reception number-sorted data 381. For the case of the first rank with the failure code of 0001 and the failure state code of “unable to open door”, with reference to the recovery diagnosis database 380 shown in FIG. 4, the recovery diagnosis command set A having the highest recovery rate, a%, is combined with the first rank of the reception number-sorted data 381. Similarly, for the second rank with the failure code of 0001 and the failure state code of “unable to close door”, the recovery diagnosis command set B having the highest recovery rate, e%, is combined with the second rank of the reception number-sorted data 381. For the case of the third rank with the failure code of 0002 and the failure state code of “unable to start”, the recovery diagnosis command set D having the highest recovery rate, g%, is combined with the third rank of the reception number-sorted data 381, and, for

the case of the fourth rank with the failure code of 0002 and the failure state code of “stopped between floors”, the recovery diagnosis command set E having the highest recovery rate, k%, is combined with the fourth rank of the reception number-sorted data 381. In a similar manner, the recovery diagnosis command sets are combined up to a 5 50th rank. In this manner, the center-side information processor 360 produces the data set as shown in FIG. 6.

[0049]

The center-side information processor 360 stores the produced data set in the center-side recovery process database 390. In addition, the center-side information 10 processor 360 updates the center-side recovery process database 390 at an interval of a predetermined period, such as a week or a month.

[0050]

As shown in step S13 of FIG. 9, the center-side information processor 360 transmits contents of the center-side recovery process database 390 to the monitor-side information 15 processor 230 of the monitor panel 210 via the center-side communication apparatus 320, the communication network 30, and the monitor-side communication apparatus 220, at a timing of updating the center-side recovery process database 390.

[0051]

As shown in step S14 of FIG. 9, the monitor-side information processor 230 updates 20 contents of the monitor-side recovery process database 250 with the received contents of the center-side recovery process database 390. As such, the monitor-side recovery process database 250 stores data identical in contents to the center-side recovery process database 390.

[0052]

25 <Operation of Elevator System when Failure Occurs in Elevator>

Next, with reference to FIG. 10, an operation of the elevator system 100 when a failure occurs in the elevator 20 will be described.

[0053]

As shown in step S101 of FIG. 10, the monitor panel 210 waits until occurrence of a failure in the elevator 20. When a failure occurs in the elevator 20, the process proceeds to step S102, and the control board 200 outputs the failure code and the failure state code to the monitor panel 210.

5 [0054]

As shown in step S103 of FIG. 10, the failure code and the failure state code which are output by the control board 200 are input to the monitor-side information processor 230. As shown in step S104 of FIG. 10, the monitor-side information processor 230 determines whether or not it is possible to execute a recovery operation by the monitor panel 210; that is, whether or not monitor-side automatic recovery is possible. This determination is made in the following manner.

[0055]

First, the monitor-side information processor 230 checks whether or not there is a passenger inside the car 22 of the elevator 20 based on an output of the control board 200, for example, an output of a weight sensor of the car 22, an output of a camera in the car 22, an output of a human-sensing sensor in the car 22, or the like. When there is a passenger in the car 22, the monitor-side information processor 230 determines that the monitor-side automatic recovery is impossible. The process proceeds to step S105 of FIG. 10, and a signal indicating impossibility of the monitor-side automatic recovery, the failure code, and the failure state code are sent to the center-side information processor 360 via the monitor-side communication apparatus 220, the communication network 30, and the center-side communication apparatus 320. The process proceeds to step S114 of FIG. 10, the monitor-side maintenance database 240 is updated, and the operation is completed.

[0056]

When the monitor-side information processor 230 determines that there is no passenger in the car 22, the monitor-side information processor 230 determines whether or not a recovery diagnosis command set corresponding to the combination of the received failure code and the received failure state code is stored in the monitor-side recovery

process database 250. For example, as the combination of the failure code of 0001 and the failure state code of “unable to open door” is stored in the monitor-side recovery process database 250 shown in FIG. 8, the process proceeds to next condition determination. On the other hand, when the combination of the failure code and the failure state code is a combination which is not stored in the monitor-side recovery process database 250, the process proceeds to step S105 of FIG. 10, and the signal indicating impossibility of the monitor-side automatic recovery, the failure code, and the failure status code are sent to the center-side information processor 360 via the monitor-side communication apparatus 220, the communication network 30, and the center-side communication apparatus 320. The process then proceeds to step S114 of FIG. 10, the monitor-side maintenance database 240 is updated, and the operation is completed.

[0057]

When the monitor-side information processor 230 determines that the recovery diagnosis command set corresponding to the combination of the received failure code and the received failure state code is stored in the monitor-side recovery process database 250, the monitor-side information processor 230 refers to the failure history data 244 of the monitor-side maintenance database 240, to check whether or not the elevator 20 has recently sent the failure signal by the same failure code of “0001”.

[0058]

When the elevator 20 has recently sent the failure signal by the same failure code of “0001”, the monitor-side information processor 230 determines that it is better to send the field engineer 350 to the building 10 than to perform the monitor-side automatic recovery, and determines NO in step S104 of FIG. 10. The process proceeds to step S105 of FIG. 10, and the signal indicating impossibility of the monitor-side automatic recovery, the failure code, and the failure status code are sent to the remote monitoring center. The process proceeds to step S114 of FIG. 10, the monitor-side maintenance database 240 is updated, and the operation is completed.

[0059]

When the monitor-side information processor 230 determines that there is no passenger in the car 22, that the recovery diagnosis command set corresponding to the combination of the received failure code and the received failure state code is stored in the monitor-side recovery process database 250, and that the elevator 20 has not recently sent the failure signal by the same failure code of “0001”, the monitor-side information processor 230 determines that the monitor-side automatic recovery is possible in step S104 of FIG. 10. The process proceeds to step S106 of FIG. 10, and a recovery diagnosis command set which is a set of a recovery command and a recovery diagnosis command corresponding to the received failure code and the received failure state code is selected from the monitor-side recovery process database 250. As shown in step S107 of FIG. 10, the selected recovery diagnosis command set is output to the control board 200. For example, when the failure code is 0001 and the failure state code is “unable to open door”, while referring to the monitor-side recovery process database 250 shown in FIG. 8, the monitor-side information processor 230 selects the recovery diagnosis command set A. The recovery diagnosis command set A is a set of two commands including “reset door circuit + open/close door with high torque” serving as the recovery command, and the “door open/close diagnosis” serving as the recovery diagnosis command. Thus, the monitor-side information processor 230 outputs to the control board 200 the recovery command of “reset door circuit + open/close door with high torque” and the recovery diagnosis command of “door open/close diagnosis”.

[0060]

As shown in step S108 of FIG. 10, when the recovery command and the recovery diagnosis command are input from the monitor-side information processor 230, the control board 200 checks, as shown in step S109 of FIG. 10, that the elevator 20 is stopped, and that there is no passenger in the car 22 based on the output of the weight sensor of the car 22, the camera in the car 22, the human sensor in the car 22, or the like. When the control board 200 confirms that the elevator 20 is stopped and there is no passenger in the car 22,

the control board 200 makes an announcement from a speaker of a call device placed in the car 22 such as “remote recovery is starting now. Elevator door will open and close”.

[0061]

The process proceeds to step S110 of FIG. 10, and the control board 200 executes
5 the recovery operation. Because the received recovery command at this point is the recovery command of “reset door circuit + open/close door with high torque” included in the recovery diagnosis command set A, the control board 200 first resets a door circuit of the control board 200. This operation is an operation to reset a state in which the door circuit is detecting a closed state or half-open state while the door 13 or 26 cannot be
10 opened, to thereby enable opening and closing of the door 13 or 26. Next, the control board 200 sets a torque of the drive motor of the doors 13 and 26 to a value higher by 20~30% than the normal value, to execute open/close operation of the doors 13 and 26 with a force larger than the normal force. This operation is an operation to move from the doorsill the dirt clogged in the doorsill, to thereby recover the open/close operation of the
15 doors 13 and 26 to a normal state.

[0062]

In order to check whether or not the dirt clogged in the doorsill of the doors 13 and 26 is moved by the above-described operation and whether or not the opening/closing of the doors 13 and 26 are recovered, the control board 200 executes the “door open/close
20 diagnosis” which is the recovery diagnosis command, as shown in step S111 of FIG. 10. The control board 200 executes opening and closing of the doors 13 and 26 with a normal torque, and checks whether or not the open/close operation is executed with a predetermined open/close time and the current of the drive motor of the doors 13 and 26 is not increased in comparison to the normal time. Next, the control board 200 opens and
25 closes the doors 13 and 26 while reducing the torque of the drive motor to a value about 20% lower than the normal value, to check whether or not there is abnormality in the open/close time.

[0063]

After the execution of the recovery diagnosis operation is completed, the process proceeds to step S112 of FIG. 10, and the control board 200 outputs the determination result of the result of the recovery operation to the monitor-side information processor 230. When the control board 200 determines that the doors 13 and 26 are recovered to the normal state by the recovery diagnosis operation, the control board 200 outputs a determination result signal indicating that the elevator 20 is recovered to the monitor-side information processor 230. When the control board 200 determines that the doors 13 and 26 are not recovered to the normal state by the recovery diagnosis operation as a result of the recovery diagnosis operation, the control board 200 outputs a determination result signal indicating non-success of the recovery of the elevator 20.

[0064]

As shown in step S113 of FIG. 10, the monitor-side information processor 230 sends the determination result which is input from the control board 200, the failure code, and the failure status code to the center-side information processor 360 via the monitor-side communication apparatus 220, the communication network 30, and the center-side communication apparatus 320.

[0065]

The monitor-side information processor 230 updates the monitor-side maintenance database 240 based on the result of the process of the failure of the elevator 20, and completes the operation.

[0066]

Next, with reference to FIG. 11, an operation of the center-side information processor 360 will be described. As shown in steps S201 and S202 of FIG. 11, when the center-side information processor 360 receives the signal indicating impossibility of the monitor-side automatic recovery or the signal of unsuccessful recovery from the monitor-side information processor 230, the center-side information processor 360 displays the result on the display 331 of the remote monitoring center 300. As shown in step S205 of FIG. 11, when a monitoring person 334 confirms this display, the monitoring person 334

instructs stopping of the operation of the elevator 20 and makes an announcement.

Further, the monitoring person 334 instructs a service center 340 near the building 10 to send the field engineer 350 to the building 10 by telephone, as shown in step S206 of FIGs.

2 and 11. The center-side information processor 360 also updates the center-side

5 maintenance database 370 and the recovery diagnosis database 380, as shown in steps S203 and S204 of FIG. 11.

[0067]

When the center-side information processor 360 receives the determination signal indicating that the elevator 20 is recovered, the center-side information processor 360

10 determines YES in step S202 of FIG. 11, the process proceeds to steps S203 and S204 of FIG. 11, and the center-side information processor 360 updates the center-side maintenance database 370 and the recovery diagnosis database.

[0068]

The center-side information processor 360 updates the center-side maintenance
15 database 370 in the following manner.

[0069]

When the determination signal indicating that the elevator 20 is recovered is input, the center-side information processor 360 stores “monitor-side automatic recovery” in the item of the recovery method of the failure history data 372, and “recovery” in the item of
20 the recovery determination result. In addition, the center-side information processor 360 stores in the failure history data 372 of the center-side maintenance database 370 the received failure code which is “0001”, the received failure state code which is “unable to open door”, the management number of the elevator 20, and the failure occurrence date.

[0070]

25 The center-side information processor 360 updates the recovery diagnosis database 380 shown in FIG. 4 in the following manner.

[0071]

When the recovery of the elevator 20 is successful by the monitor-side automatic recovery, the center-side information processor 360 increases the number of cases of the failure cause corresponding to the combination of the failure code and the failure state code by 1, and increases the recovery rate of the corresponding recovery diagnosis command set by an amount corresponding to the success of the recovery. Further, the center-side information processor 360 increases the number of receptions of the combination of the failure code and the failure state code of the failure cause-classified data 373 shown in FIG. 3 by 1, and increases the number of cases of the failure cause similar to the recovery diagnosis database 380 by 1.

[0072]

On the other hand, when the recovery of the elevator 20 by the monitor-side automatic recovery is unsuccessful, the recovery rate of the corresponding recovery diagnosis command set is reduced by an amount corresponding to the non-success of the recovery. Moreover, the center-side information processor 360 increases the number of receptions of the combination of the failure code and the failure state code of the failure cause-classified data 373 shown in FIG. 3 by 1. In this process, the number of cases of the failure cause is not changed.

[0073]

In this manner, the recovery diagnosis database 380 is updated according to the result by the monitor-side automatic recovery. After a predetermined period elapses, the center-side recovery process database 390 is updated based on the updated recovery diagnosis database 380, and the monitor-side recovery process database 250 is also updated.

[0074]

With the process described above, the elevator system 100 of the present embodiment can execute the monitor-side automatic recovery of the elevator 20 by the recovery command corresponding to the failure code and the failure state code, and having a high recovery rate.

[0075]

In addition, in the elevator system 100 of the present embodiment, because the automatic recovery operation can be executed without transmitting the failure code and the failure state code to the remote monitoring center 300 or receiving the recovery command and the recovery diagnosis command when a failure of the elevator 20 having a high number of occurrences occurs, the elevator 20 can be recovered in a short period of time without sending the field engineer 350 to the site when the failure occurs in the elevator 20, and the operation service of the elevator 20 can thus be improved.

[0076]

Further, in the elevator system 100 of the present embodiment, because the maintenance data of the elevator 20 are stored in the monitor-side maintenance database in the monitor panel 210, a capacity of the center-side maintenance database 370 of the remote monitoring center 300 can be maintained low, and an amount of communication between the remote monitoring center 300 and the monitor panel 210 can be maintained low.

[0077]

The present disclosure is not limited to the embodiment described above, and includes all changes and modifications which fall within the scope or spirit of the present disclosure defined in the claims.

REFERENCE SIGNS LIST

[0078]

10 BUILDING; 11 ASCENDING/DESCENDING PATH; 12 LEVEL FLOOR; 13 DOOR; 20 ELEVATOR; 22 CAR; 23 WIRE; 24 DRIVE DEVICE; 25 WEIGHT; 26 DOOR; 27 FLOOR; 30, 35 COMMUNICATION NETWORK; 100 ELEVATOR SYSTEM; 200 CONTROL BOARD; 210 MONITOR PANEL; 220 MONITOR-SIDE COMMUNICATION APPARATUS; 230 MONITOR-SIDE INFORMATION PROCESSOR; 240 MONITOR-SIDE MAINTENANCE DATABASE; 241 ELEVATOR

SPECIFICATION DATA; 242 REMOTE CHECKING HISTORY DATA; 243
IRREGULARITY HISTORY DATA; 244 FAILURE HISTORY DATA; 250
MONITOR-SIDE RECOVERY PROCESS DATABASE; 300 REMOTE MONITORING
CENTER; 320 CENTER-SIDE COMMUNICATION APPARATUS; 330 MONITORING
5 BOARD; 331 DISPLAY; 332 SWITCH; 333 TELEPHONE; 334 MONITORING
PERSON; 340 SERVICE CENTER; 350 FIELD ENGINEER; 360 CENTER-SIDE
INFORMATION PROCESSOR; 370 CENTER-SIDE MAINTENANCE DATABASE; 371
ELEVATOR SPECIFICATION DATA; 372 FAILURE HISTORY DATA; 373 FAILURE
CAUSE-CLASSIFIED DATA; 380 RECOVERY DIAGNOSIS DATABASE; 381
10 RECEPTION NUMBER-SORTED DATA; 390 CENTER-SIDE RECOVERY PROCESS
DATABASE.

CLAIMS

1. An elevator system comprising:

a control board that executes drive control of an elevator; and

5 a monitor panel that is placed near the control board, that is connected to the control board, that outputs to the control board, when a failure code and a failure state code are input from the control board, a recovery command and a recovery diagnosis command according to the failure code and the failure state code, and that causes the control board to execute a recovery operation and a recovery diagnosis operation of the elevator, wherein

10 the monitor panel comprises a monitor-side recovery process database which stores in correlation with each other a combination having a large number of cases of occurrences among combinations of the failure codes and the failure state codes, a recovery command having a high recovery rate among recovery commands corresponding to the combination, and a recovery diagnosis command corresponding to the recovery command, and

15 the monitor panel selects, when the failure code and the failure state code are input from the control board, a recovery command and a recovery diagnosis command by referring to the monitor-side recovery process database, and outputs to the control board the selected recovery command and the recovery diagnosis command.

20 2. The elevator system according to claim 1, further comprising:

a remote monitoring center that communicates with the monitor panel and that remotely monitors the elevator, wherein

the remote monitoring center comprises:

25 a recovery diagnosis database which stores, in correlation with each other, a number of cases of failure causes corresponding to a combination of a failure code and a failure state code, a recovery command, a recovery diagnosis command, and a recovery rate, and

a center-side recovery process database which extracts, from the recovery diagnosis database, a combination having a large number of cases of occurrences among

combinations of the failure codes and the failure state codes, and which stores in correlation with each other a recovery command having a high recovery rate among recovery commands corresponding to the combination, and a recovery diagnosis command corresponding to the recovery command,

5 the remote monitoring center transmits the center-side recovery process database to the monitor panel at a predetermined interval, and

 the monitor panel updates contents of the monitor-side recovery process database which is stored, with the received contents of the center-side recovery process database every time the center-side recovery process database is received from the remote

10 monitoring center.

3. The elevator system according to claim 2, wherein

 the control board determines whether or not the elevator is recovered by a recovery diagnosis operation after a recovery operation executed according to a recovery command
15 which is input from the monitor panel, and outputs a determination result to the monitor panel,

 the monitor panel sends the failure code, the failure state code, and the determination result which are input from the control board to the remote monitoring center, and

 the remote monitoring center updates a number of cases of a failure cause
20 corresponding to the combination of the failure code and the failure state code based on the determination result which is input from the monitor panel.

4. The elevator system according to claim 3, wherein

 the remote monitoring center updates the recovery rate corresponding to the
25 combination of the failure code and the failure state code based on the determination result which is input from the monitor panel.