

[DESCRIPTION]

[Title of Invention] PASSENGER CONVEYOR MONITORING APPARATUS AND METHOD

[Technical Field]

[0001]

The present invention relates to a passenger conveyor monitoring apparatus and method. Particularly, it relates to a passenger conveyor monitoring apparatus for automatically monitoring execution/non-execution of test operation after maintenance work, and a monitoring method executed by the apparatus.

[Background Art]

[0002]

As a passenger conveyor monitoring apparatus of this type, for example, there has been known a technique described in Patent Literature 1. In order to prevent resumption of a monitoring target from being forgotten, the technique includes a switching unit which switches a mode between a monitoring mode in which a plurality of escalators as monitoring targets are monitored and warning is issued when abnormality is detected and a maintenance mode in which monitoring the monitoring targets is suspended, a storage unit which stores an input of an instruction to invalidate one of the monitoring targets or resume the invalidated monitoring target from the invalidation when the instruction is inputted after the mode is switched to the maintenance mode, a control unit which outputs a signal when the monitoring target stored

in the storage unit is not resumed but kept invalid after the mode is switched from the maintenance mode to the monitoring mode, and a warning unit which operates in response to the output of the control unit. That is, this background-art apparatus automatically determines whether monitoring setting has been resumed correctly or not when the mode is switched from the maintenance mode to the normal monitoring mode, and automatically issues warning when the monitoring setting has not been resumed correctly.

[Citation List]

[Patent Literature]

[0003]

[Patent Literature 1] JP-A-2010-24040

[Summary of Invention]

[Technical Problem]

[0004]

According to the technique described in Patent Literature 1, when the mode is switched from the maintenance mode to the normal monitoring mode, whether the monitoring setting has been resumed correctly or not is determined automatically, and warning is automatically issued when the monitoring setting has not been resumed correctly. Thus, human errors such as forgetting to resume can be prevented. In this technique, however, only whether the monitoring setting has been resumed to its original state correctly or not is determined automatically. It is impossible to prevent

human errors such as forgetting to execute test operation for confirming correct resumption after adjustment in maintenance work or disassembling into parts.

[0005]

Therefore, a problem to be solved by the invention is to prevent execution of test operation for confirming correct resumption after adjustment in maintenance work or disassembling into parts from being forgotten due to human errors.

[Solution to Problem]

[0006]

In order to solve the foregoing problem, according to the invention, there is provided a passenger conveyor monitoring apparatus including a changeover switch which performs switching for executing exclusive operation for maintenance such as intermittent operation during maintenance work so that the state of a passenger conveyor is monitored based on a signal from the changeover switch, characterized in that: the monitoring apparatus further includes an operation mode identifying unit which identifies whether an operation mode is a maintenance mode or a normal running mode; a test operation execution determining unit which monitors whether continuous operation is executed within a predetermined time or not after the state is switched from the maintenance mode to the normal running mode, so as to determine execution of test operation; and a warning unit which gives

warning to a worker when determination is made that the test operation is forgotten.

[Advantageous Effects of Invention]

[0007]

According to the invention, execution of the test operation for confirming correct resumption after adjustment in maintenance work or disassembling into parts can be prevented from being forgotten due to human errors.

[Brief Description of Drawings]

[0008]

[Fig. 1] A front view showing a configuration for driving an escalator as an example of a passenger conveyor according to an embodiment of the invention.

[Fig. 2] A functional block diagram showing the configuration of a monitoring apparatus according to Example 1.

[Fig. 3] A flow chart showing an escalator monitoring procedure in the monitoring apparatus according to Example 1.

[Fig. 4] A functional block diagram showing the configuration of a monitoring apparatus according to Example 2.

[Fig. 5] A flow chart showing an escalator monitoring procedure in the monitoring apparatus according to Example 2.

[Fig. 6] A chart showing an example of operation data stored in

Step S11 in Example 2.

[Fig. 7] A chart showing another example of operation data stored in Step S11 in Example 2.

[Fig. 8] A chart showing a further example of operation data stored in Step S11 in Example 2.

[Fig. 9] A functional block diagram showing the configuration of a monitoring apparatus according to Example 3.

[Fig. 10] A flow chart showing an escalator monitoring procedure in the monitoring apparatus according to Example 3.

[Description of Embodiments]

[0009]

An embodiment of the invention will be described below with reference to the drawings.

[0010]

Fig. 1 is a front view showing a configuration for driving an escalator as an example of a passenger conveyor according to an embodiment of the invention. In Fig. 1, an escalator E is fundamentally constituted by steps 1, a step chain 2, upper and lower sprockets 3 and 4, a drive motor 5 and a drive torque control unit 6.

[0011]

The steps 1 are pivotally supported on the step chain 2 which is connected endlessly. The step chain 2 is wound around the upper sprocket

3 and the lower sprocket 4. The upper sprocket 3 is driven to rotate by the drive power of the drive motor 5. Thus, when the drive motor 5 is driven, the upper sprocket 3 rotates so that the step chain 2 receiving the drive power rotates. The steps 1 rotate and run integrally with the rotation of the step chain 2.

[0012]

In addition, the escalator E is provided with a handrail 14 which can be grasped by hands of passengers. The handrail 14 fundamentally rotates in sync with the steps 1. The drive torque control unit 6 controls acceleration, velocity, torque, etc. of the drive motor 5. Therefore, the running of the steps 1 is controlled by the drive torque control unit 6. Further, a brake unit for braking the running of the upper sprocket 3 and hence braking the running of the step chain 2 is provided on the rotary shaft of the upper sprocket 3. Further, not-shown velocity sensors for detecting the running velocities of the steps 1 and the handrail 14 are disposed along the running positions of the steps 1 and the handrail 14. The outputs of the velocity sensors are supplied to a control portion which will be described later, and the braking operation of the brake unit is executed in accordance with an instruction from a CPU which will be described later.

[0013]

Maintenance work is performed after the mode is switched by an

operation mode changeover switch 7 to a maintenance operation mode in which the escalator E runs only when an operation key is kept up and operation of the escalator E is suspended when the operation key is released.

[Example 1]

[0014]

Fig. 2 is a functional block diagram showing the configuration of Example 1 in the embodiment. The escalator driving configuration itself is the same as that in Fig. 1.

[0015]

As shown in Fig. 2, a passenger conveyor monitoring apparatus (hereinafter referred to as "monitoring apparatus" simply) 100 in this Example is constituted by an operation mode identifying portion 9, a test operation execution determining portion 10 and a warning portion 11.

[0016]

The operation mode identifying portion 9 detects an operation instruction issued by an operator 8, and identifies an operation mode based on a signal from the operation mode changeover switch 7. The test operation execution determining portion 10 determines whether test operation has been executed or not after the mode is switched from a maintenance operation mode to a normal operation mode. The warning portion 11 gives warning to an operation monitor or a maintainer's portable terminal when the test operation execution determining portion 10 determines that the test

operation has not been executed.

[0017]

The operation mode identifying portion 9, the test operation execution determining portion 10 and the warning portion 11 are set in a not-shown control portion including a CPU, a ROM, a RAM, an EPROM, etc. in the monitoring apparatus 100. The CPU is a central control unit, which reads program codes stored in the ROM, expands the program codes on the RAM, and executes a program using the RAM as a work area so as to control each portion. The RAM is also used as a data buffer. The EPROM stores data that are used for control by the CPU.

[0018]

Fig. 3 is a flow chart showing an escalator monitoring procedure in the monitoring apparatus 100. The procedure is executed by the CPU.

[0019]

In this Example, when a monitoring process is started, determination is first made as to whether the state of the maintenance operation mode has been continued for at least a predetermined time or not (Step S1). When the state of the maintenance operation mode has been continued for a time shorter than one minute, diagnosis is terminated (No in Step S1). It is because disassembling into parts, instrumental adjustment, or the like, cannot be generally carried out in a time shorter than one minute so that there is no fear that danger will be generated even if normal operation

is executed without execution of test operation. Thus, one minute is set as the predetermined time in Step S1.

[0020]

When determination is made in Step S1 that the state of the maintenance operation mode has been continued for at least the predetermined time, determination is made as to whether the mode has been resumed to the normal operation mode or not (Step S2). When the mode has been resumed to the normal operation mode (Yes in Step S2), determination is made as to whether continuous operation has been executed after the resumption or not (Step S3). When continuous operation has not been executed, determination is made as to whether non-execution of the continuous operation has been continued for at least a predetermined time or not (Step S4).

[0021]

When non-execution of the continuous operation has been continued for at least the predetermined time (Yes in Step S4), warning about non-execution of test operation after execution of the maintenance work is given to the operation monitor, the maintainer's portable terminal or the like (Step S5). Then, the diagnosis is terminated.

[0022]

When monitoring is performed in such a monitoring procedure, the monitoring process is automatically executed by the control portion side even if the maintainer has forgotten to execute test operation after the

work of disassembling into parts or the work of instrumental adjustment. Accordingly, forgetting to execute test operation can be detected and warning thereof can be given to the maintainer side. It is therefore possible to prevent human errors and perform monitoring superior in safety during escalator maintenance.

[Example 2]

[0023]

Fig. 4 is a functional block diagram showing the configuration of Example 2 in the embodiment. The escalator driving configuration itself is the same as that in Fig. 1.

[0024]

As shown in Fig. 4, a monitoring apparatus 200 in Example 2 is formed in such a manner that a maintenance operation information storing portion 12 for storing real operation information during the maintenance operation mode is provided at a stage posterior to the operation mode identifying portion 9 and anterior to the test operation execution determining portion 10 in Example 1. The other portions are similar to those in Example 1.

[0025]

Fig. 5 is a flow chart showing an escalator monitoring procedure in Example 2. In this Example, when a monitoring process is started, operation information during the maintenance operation mode is first stored (Step S11). Figs. 6 to 8 are charts showing operation data showing the

operation information stored in Step S11. The abscissa designates time, and the ordinate designates velocity. Operating states in Figs. 6 to 8 are as follows.

[0026]

From the operating state shown in Fig. 6, it can be understood that suitable operation was executed immediately after the start of the maintenance operation mode, a standby state was then continued for a while, and finally operation was executed and resumed. In this case, it can be inferred that it is likely that the steps 1 were removed and internal devices were disassembled and adjusted.

[0027]

In the operating state shown in Fig. 7, a standby state was rare but operation was repeated frequently. From the operating state, it can be inferred that the running velocity or the like was checked without disassembling parts on a large scale.

[0028]

The operating state shown in Fig. 8 was mostly a standby state. From the operating state, it can be conceived that it is likely that a brake in a machine room was disassembled for overhaul.

[0029]

From the operation-to-operation intervals or the lengths of standby periods acquired from the operation information in Figs. 6 to 8, it can

be roughly inferred what kind of maintenance work was performed.

[0030]

Next, determination is made as to whether the mode has been resumed to the normal operation mode or not (Step S12). When the mode has been resumed to the normal operation mode (Yes in Step S12), determination is further made as to whether continuous operation has been executed after the resumption or not (Step S13). When determination is made that continuous operation has not been executed, determination is made as to whether non-execution of the continuous operation has been continued for at least a predetermined time or not (Step S14). When non-execution of the continuous operation has been continued for at least the predetermined time, warning about non-execution of test operation after execution of the maintenance work and the operation information during the maintenance operation mode (Fig. 6 to Fig. 8) are given to the operation monitor, the maintainer's portable terminal, or the like (Step S15). Then, the monitoring process is terminated.

[0031]

When monitoring is performed in such a monitoring procedure, a person who does not take charge of the maintenance work of the escalator to be maintained can infer what kind of maintenance work was performed on the escalator if the person is informed of non-execution of test operation. It is therefore possible to perform confirmation work efficiently before

test operation. Further, suitable test operation to the maintenance work can be executed so as not to depend on a specific worker. Accordingly, monitoring during escalator maintenance can be performed to superiorly reduce the downtime.

[Example 3]

[0032]

Fig. 9 is a functional block diagram showing the configuration of Example 3 in the embodiment. The escalator driving configuration itself is the same as that in Fig. 1.

[0033]

As shown in Fig. 9, a monitoring apparatus 300 in Example 3 is formed in such a manner that an automatic diagnostic operation portion 13 is provided in a stage posterior to the warning portion 11 in Example 2. The other portions are similar to those in Examples 1 and 2.

[0034]

When test operation is not executed but start-up operation is executed without removal of the warning state, the automatic diagnostic operation portion 13 carries out diagnostic operation automatically to operate the escalator with gentler acceleration than in normal operation and make diagnosis as to whether the starting torque of the drive motor 5 exceeds a reference value or not, whether the operation response time of the brake unit is longer than a reference value or not, whether the difference between

the running velocity of the handrail 14 and the running velocity of the steps 1 is larger than a predetermined value or not, etc.

[0035]

The starting torque of the drive motor 5 is detected from the drive torque control unit, and the running velocity of the handrail 14 and the running velocity of the steps 1 are detected by the aforementioned velocity sensors. The starting torque and the running velocities are supplied to a not-shown control portion, and then processed by the automatic diagnostic operation portion 13. The operating state of the brake unit is also supplied to the control unit, and then processed by the automatic diagnostic operation portion 13.

[0036]

Fig. 10 is a flow chart showing an escalator monitoring procedure in Example 3. In this Example, when a monitoring process is started, operation information during the maintenance operation mode is first stored (Step S21). Next, determination is made as to whether the mode has been resumed to the normal operation mode or not (Step S22). When the mode has been resumed to the normal operation mode, determination is made as to whether continuous operation has been executed after the resumption or not (Step S23).

[0037]

When continuous operation has not been executed, determination is

made as to whether non-execution of the continuous operation has been continued for at least a predetermined time or not (Step S24). When non-execution of the continuous operation has been continued for at least the predetermined time, warning about non-execution of test operation after execution of the maintenance work and the operation information during the maintenance operation mode (Fig. 6 to Fig. 8) are given to the operation monitor, the maintainer's portable terminal, or the like (Step S25). Further, determination is made as to whether the warning state has been removed or not (Step S26).

[0038]

When the warning state has been removed (Yes in Step S26), the diagnosis is terminated because judgment can be made that the maintainer has checked the escalator. When the warning state has not been removed (No in Step S26), determination is made as to whether a normal start-up instruction has been received or not (Step S27).

[0039]

When a normal start-up instruction has been received (Yes in Step S27), the start-up instruction was issued without removal of the warning state. Judgment can be therefore made that another equipment manager than the maintainer executed start-up operation for opening the store, or the maintainer issued the start-up instruction on purpose to execute automatic diagnosis. Thus, the escalator is started up with gentler acceleration

than in normal operation in response to the start-up instruction. On this occasion, the existence of abnormality is automatically diagnosed by comparing the torque value of the drive motor 5, the operating time of the brake unit, the velocity difference between the handrail and the steps 1, etc. with their reference values (Step S28).

[0040]

Next, determination is made as to whether abnormality has been detected or not (Step S29). When no abnormality has been detected (No in Step S29), the escalator starts to be operated with a rated velocity in accordance with the start-up instruction. Then, the diagnosis is terminated. When abnormality has been detected (Yes in Step S29), operation of the escalator is suspended quickly, and an abnormality signal is given to the maintainer's portable terminal or a control terminal in a remote site (Step S30). Then, the diagnosis is terminated.

[0041]

In this manner, according to Example 3, when a normal start-up instruction is issued without execution of test operation after maintenance work, the escalator is not operated with normal acceleration at once, but operated with gentler acceleration than in normal operation in order to automatically diagnose the existence of instrumental abnormality. Thus, monitoring superior in safety can be performed during escalator maintenance.

[0042]

Thus, according to the embodiment, execution of test operation for confirming correct resumption after adjustment in maintenance work or disassembling into parts can be prevented from being forgotten due to human errors.

[0043]

The passenger conveyor in the scope of claims corresponds to the escalator E; the monitoring apparatus corresponds to the reference sign 100, 200, 300; the changeover switch corresponds to the reference sign 7; the operation mode identifying unit corresponds to the operation mode identifying portion 9; the test operation execution determining unit corresponds to the test operation execution determining portion 10; the warning unit corresponds to the warning portion 11; the maintenance operation information storing unit corresponds to the maintenance operation information storing portion 12; the automatic diagnostic operation unit corresponds to the automatic diagnostic operation portion 13; the drive motor corresponds to the reference sign 5; the handrail corresponds to the reference sign 14; and the steps corresponds to the reference sign 1.

[0044]

Further, the present invention is not limited to the aforementioned embodiment, but various modifications can be made on the invention without departing from the gist of the invention, and all the technical items included in the technical ideas stated in the scope of claims are the subject matters

of the invention. The aforementioned Examples show preferred examples.

From the contents disclosed herein, those skilled in the art can make various alternatives, revisions, modifications or improvements, which are included in the technical scope stated in the scope of accompanying claims.

[Reference Signs List]

[0045]

- 1 step
- 5 drive motor
- 7 changeover switch
- 9 operation mode identifying portion
- 10 test operation execution determining portion
- 11 warning portion
- 12 maintenance operation information storing portion
- 13 automatic diagnostic operation portion
- 14 handrail
- 100, 200, 300 monitoring apparatus
- E escalator

[CLAIMS]

[Claim 1]

A passenger conveyor monitoring apparatus for automatically monitoring execution/non-execution of test operation after maintenance work, characterized by comprising:

a changeover switch which performs switching for executing exclusive operation for maintenance during maintenance work of a passenger conveyor;

an operation mode identifying unit which identifies whether an operation mode is a maintenance operation mode or a normal running mode;

a test operation execution determining unit which monitors whether continuous operation is executed within a predetermined time or not after the state is switched from the maintenance operation mode to the normal running mode, so as to determine execution of test operation; and

a warning unit which gives a worker warning about non-execution of the test operation when the test operation execution determining unit determines that the test operation is not executed.

[Claim 2]

A passenger conveyor monitoring apparatus according to Claim 1, characterized by further comprising:

a maintenance operation information storing unit which stores operation information during the maintenance operation mode in order to add information from which a maintainer as a third person can infer contents

of the maintenance work when the warning about non-execution of the test operation is given to the maintainer by the warning unit.

[Claim 3]

A passenger conveyor monitoring apparatus according to Claim 1 or 2, characterized by further comprising:

an automatic diagnostic operation unit which permits test operation after a state of the warning given by the warning unit is removed.

[Claim 4]

A passenger conveyor monitoring apparatus according to Claim 3, characterized in that:

when start-up operation is executed without removal of the warning state, the automatic diagnostic operation unit starts up the passenger conveyor with gentler acceleration than in normal operation, diagnoses predetermined diagnostic elements to confirm no diagnostic element abnormal, and then starts operation of the passenger conveyor with normal acceleration.

[Claim 5]

A passenger conveyor monitoring apparatus according to Claim 4, characterized in that:

the diagnostic elements include at least one state of starting torque of a drive motor driving the passenger conveyor, operating time of a brake unit, and a velocity difference between a handrail and steps.

[Claim 6]

A passenger conveyor monitoring method for automatically monitoring execution/non-execution of test operation after maintenance work, characterized by comprising:

a first step of identifying whether an operation mode is a maintenance operation mode or a normal running mode during maintenance work of a passenger conveyor;

a second step of monitoring whether continuous operation is executed within a predetermined time or not after the state is switched from the maintenance operation mode to the normal running mode, so as to determine execution of test operation; and

a third step of giving a worker warning about non-execution of the test operation when determination is made in the second step that the test operation is not executed.