

DESCRIPTION

DEVICE FOR MEASURING STEP BRAKING DISTANCE OF PASSENGER CONVEYOR AND METHOD THEREFOR

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of and priority to Japanese Patent Application No. 2022-096350 filed on June 15, 2022, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

An embodiment of the present invention relates to a device for measuring a step braking distance of a passenger conveyor and a method therefor.

2. Description of Related Art

In safety inspection of passenger conveyors such as an escalator and a moving walkway, a wear condition of a brake pad in a disc brake or a drum brake that stops a step is inspected. In this inspection method, the step runs at a normal speed and is stopped. Then, a braking distance of the step at the time is measured, and it is determined whether the braking distance is within a reference distance.

SUMMARY OF THE INVENTION

In the case where the braking distance of the step is measured as described above, visual inspection of such measurement by a worker who performs the safety inspection causes an error depending on a difference in a technical skill. The following method is also available. In the method, a measuring device such as a pulse generator is installed in advance in a motor for driving the step, or the like. Then, the measuring device measures the braking distance. However, the installment of the measuring device in each of the passenger conveyors increases cost, and a major additional modification is required for the existing passenger conveyor.

In view of the above, the embodiment of the invention has a purpose of providing a device for measuring a step braking distance of a passenger conveyor and a method therefor, the device and the method capable of accurately and easily measuring the step braking distance.

An embodiment of the invention is a device for measuring a step braking distance of a passenger conveyor, and has: an instructing section that outputs a stop signal to instruct the passenger conveyor having endlessly coupled steps to stop moving the steps; a measuring section that is disposed at a base point located at a higher position than the steps, measures a first angle defined by a first line

and a perpendicular line from the base point, and measures a second angle defined by a second line and the perpendicular line, the first line connecting the base point and a first position of a particular portion of a reference step as one of the plural steps at the time when the stop signal is output, and the second line connecting the base point and a second position of the particular portion of the stopped reference step; and a calculating section that calculates a braking distance of the reference step from the first angle, the second angle, and a length of the perpendicular line from the base point to a height at which the reference step exists.

According to the embodiment of the invention, it is possible to accurately and easily measure the step braking distance.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side explanatory view in which an escalator in a first embodiment of the invention is seen from a left side and in which members on the left side are not illustrated;

FIG. 2 is a simplified explanatory view of a vertical cross section in which a portion on an upper floor side of the escalator installed with a measuring device is seen from the left;

FIG. 3 is a simplified explanatory view of a vertical cross section in which the portion on the upper floor side of the escalator is seen from the left in a state of measuring a first angle of a reflector of a step;

FIG. 4 is a simplified explanatory view of a vertical cross section in which the portion on the upper floor side of the escalator is seen from the left in a state of measuring a second angle of the reflector of the stopped step;

FIG. 5 is a plan view of a state where the measuring device measures the reflector of the step;

FIG. 6 is a block diagram of the escalator;

FIG. 7 is a flowchart of a method for measuring a step braking distance;

FIG. 8 is a simplified explanatory view of a vertical cross section in which a portion on an upper floor side of an escalator in a second embodiment is seen from the left in a state of measuring a step braking distance; and

FIG. 9 is a flowchart of a method for measuring the step braking distance of the escalator in the second embodiment.

DESCRIPTION OF EMBODIMENTS

A description will be made on a step braking distance measuring device (hereinafter simply be referred to as a

"measuring device") 100 for an escalator 10 as one of passenger conveyors in an embodiment of the invention with reference to the drawings.

[First Embodiment]

A description will be made on the measuring device 100 for the escalator 10 in a first embodiment with reference to FIGS. 1 to 7. In a description of a front-rear direction of the escalator 10, an upper floor is set as a rear side, and a lower floor is set as a front side when the lower floor is looked down from the upper floor. FIG. 1 is a simplified explanatory view of a vertical cross section illustrating a left surface of the escalator 10. FIGS. 2 to 4 are simplified explanatory views of the vertical cross sections in each of which a portion on the upper floor side of the escalator 10 is seen from the left and members on the left side thereof are not illustrated in order to facilitate understanding of an internal structure of the escalator 10.

(1) Escalator 10

A description will be made on an overall structure of the escalator 10 with reference to FIGS. 1 and 2.

As illustrated in FIG. 1, a truss 12 as a framework of the escalator 10 is supported along the front-rear direction by using support angles 2, 3 across an upper floor and a lower floor of a building 1. The truss 12 includes:

an upper horizontal section 12a that is located on the upper floor side and is horizontal; a lower horizontal section 12b that is located on the lower floor side and is horizontal; and an inclined section 12c that couples the upper horizontal section 12a and the lower horizontal section 12b and is inclined with respect to a horizontal direction. Steps 30 are coupled endlessly and run on the escalator 10. Each of the steps 30 runs horizontally in a horizontal segment of the upper horizontal section 12a, runs obliquely in an inclined segment of the inclined section 12c, and thereafter runs horizontally in a horizontal segment of the lower horizontal section 12b.

A drive unit 18, a right and left pair of step sprockets 24, 24, and a right and left pair of belt sprockets 27, 27 for running the step 30 are provided in a machine room 14 on the upper floor side that is located in the upper horizontal section 12a of the truss 12. This drive unit 18 has: a motor 20; a decelerator 21; a small drive sprocket 19 that is attached to an output shaft of this decelerator 21; and an electromagnetic brake 23 of a disc type or a drum type that stops rotation of the motor 20 and keeps a stopped state thereof. A large drive sprocket 17 is coaxially attached to the right and left pair of the step sprockets 24, 24, and an endless drive chain 22 is hung between the large drive sprocket 17 and the small drive sprocket 19.

The right and left pair of the step sprockets 24, 24 and the right and left pair of the belt sprockets 27, 27 are respectively coupled by coupling belts, which are not illustrated, and rotate synchronously. In addition, a controller 50 that controls the motor 20, the electromagnetic brake 23, and the like is provided in the machine room 14 on the upper floor side (see FIG. 6).

A right and left pair of driven sprockets 26, 26 is provided in a machine room 16 on the lower floor side that is located in the lower horizontal section 12b of the truss 12. A right and left pair of endless step chains 28, 28 is respectively hung between the right and left pair of the step sprockets 24, 24 on the upper floor side and the right and left pair of the driven sprockets 26, 26 on the lower floor side. A right and left pair of first wheels 301, 301 in each of the plural steps 30 is respectively coupled to the right and left pair of the step chains 28, 28 at equally-spaced intervals. When the motor 20 rotates, the first wheel 301 of the step 30 runs on a guide rail 31 (see FIG. 2) that is fixed to the truss 12 and is dedicated to the first wheel, and a second wheel 302 of the step 30 runs on a guide rail 25 that is fixed to the truss 12 and is dedicated to the second wheel.

A right and left pair of balustrades 36, 36 is vertically provided on both right and left sides of an upper

portion of the truss 12. A handrail 39 is provided on top of this balustrade 36, and an endless handrail belt 38 moves along this handrail 39.

A front skirt guard 40 on the upper floor side is provided to a lower front portion on the upper floor side of each of the right and left pair of the balustrades 36. A front skirt guard 42 on the lower floor side is provided to a lower front portion on the lower floor side thereof. Inlets 46, 48 as entry/exit points of the handrail belt 38 are projected from the front skirt guards 40, 42, respectively. A skirt guard 44 is provided to a lower side portion of each of the right and left pair of the balustrades 36, and the step 30 runs between the right and left pair of the skirt guards 44, 44.

The handrail belt 38 synchronously moves with the step 30 due to co-rotation of the belt sprocket 27 and the step sprocket 24. For example, as illustrated in FIG. 1, when the step 30 is descending, the handrail belt 38 runs toward the lower floor side along the handrail 39 at an upper end of the balustrade 36, enters the front skirt guard 42 from the inlet 48 on the lower floor side, moves upward in the skirt guard 44 in the lower side portion of the balustrade 36, is wound around the belt sprocket 27 through plural guide rollers 66 to be applied with drive power, and thereafter appears from the inlet 46 on the upper floor side

to the outside of the front skirt guard 40 through plural guide rollers 64. In addition, a pressing member 68 that presses the running handrail belt 38 against the rotating belt sprocket 27 is provided below the belt sprocket 27.

A landing board 32 on the upper floor side is horizontally provided on a ceiling surface of the machine room 14. The ceiling surface of the machine room 14 serves as a landing between the right and left pair of the skirt guards 44, 44 on the upper floor side. A landing board 34 on the lower floor side is horizontally provided on a ceiling surface of the machine room 16. The ceiling surface of the machine room 16 serves a landing between the right and left pair of the skirt guards 44, 44 on the lower floor side. A comb 60 with teeth is provided at a tip of the landing board 32 on the upper floor side, and the step 30 advances or enters from this comb 60. In addition, a comb 62 with teeth is provided at a tip of the landing board 34 on the lower floor side.

(2) Measuring Device 100

Next, a description will be made on the measuring device 100 with reference to FIGS. 2, 5, and 6.

The measuring device 100 is a device for measuring a braking distance L until the step 30 comes to a complete stop after receiving a stop signal.

As illustrated in FIG. 2, the measuring device 100 has

a rectangular-parallelepiped body 102. As illustrated in FIGS. 2 and 5, wheels 104 are provided in a freely rotatable manner in a front portion and a rear portion of each of right and left surfaces of this body 102, so as to horizontally support the body 102 in a freely movable manner. As illustrated in FIG. 2, a support column 106 is provided perpendicularly on an upper surface of the body 102. In addition, in order to support this support column 106 in the perpendicular direction, an auxiliary column 108 is obliquely provided on the upper surface of the body 102, so as to support the support column 106 from behind.

A sensor is provided at an upper end of the support column 106. In the following embodiment, a camera 110 is provided as the sensor. This camera 110 is provided to be freely rotatable about a rotational shaft 116 that is provided horizontally and in a right-left direction at an upper end of the support column 106. A cylindrical imaging section 112 including a lens is projected from a front portion of this camera 110. As illustrated in FIG. 6, the camera 110 is integrated with a posture control motor 114. Accordingly, the camera 110 can rotate in an up-down direction about the rotational shaft 116, and thus the imaging section 112 can be positioned toward a predetermined target. A rotation angle of the imaging section 112 corresponds to a rotation control angle of the posture

control motor 114, and the rotation angle of the imaging section 112 of the camera 110 can be measured by the posture control motor 114. The camera 110 having the imaging section 112 and the posture control motor 114 constitute a measuring section 120.

An arithmetic section 118 is provided in the body 102. As illustrated in FIG. 6, this arithmetic section 118 is connected to the camera 110 and the posture control motor 114, and receives an image captured by the camera 110 and the rotation angle of the imaging section 112 of the camera 110. The arithmetic section 118 has: a function as an instructing section that outputs the stop signal to instruct the controller 50 to stop the step 30; and a function as a calculating section that calculates the braking distance L of the step 30 from a moving image captured by the camera 110 and the rotation angle of the imaging section 112 of the camera 110. The arithmetic section 118 can communicate data between the controller 50 in the escalator 10 and a tablet terminal 200 in short-range wireless communication.

(3) Method for Measuring Braking Distance L of Step 30

Next, a description will be made on a method for measuring the braking distance L of the step 30 by using the measuring device 100. It is assumed that the step 30 as a measurement target descends and is stopped in the horizontal segment of the upper horizontal section 12a. A

case where the step 30 is stopped after reaching the inclined segment of the inclined section 12c will be described in a second embodiment.

First, as illustrated in FIG. 5, a circular reflector 304 that reflects light is attached to a center of a front end of an upper surface (a cleat surface) 303 of the single step 30 of the plural steps 30. The step (a hatched step in FIGS. 3 and 4) 30, to which this reflector 304 is attached, will hereinafter be described as a "reference step" 30.

Next, as illustrated in FIG. 3, the body 102 of the measuring device 100 is installed on the landing board 32 on the upper floor side. The landing board 32 is horizontal, and the support column 106 extends perpendicularly. Then, a length h of a perpendicular line R from the rotational shaft 116 at a base point O of the upper end of the support column 106 to a lower surface of the landing board 32 is set, and a point P_0 is set at a position where the perpendicular line R intersects the lower surface of the landing board 32. A reason why the point P_0 is located on the lower surface of the landing board 32 is because it is at the same height as a position where the step 30 advances and is level with the upper surface of the step 30. Furthermore, the imaging section 112 of the camera 110 is positioned such that the imaging section 112 can capture an image of vicinity of a front end of the comb 60 on the upper

floor side.

A description will now be made on the method for measuring the braking distance L, which is executed after the above preparation is made, with reference to FIG. 7.

In step S1, the controller 50 operates the step 30 normally at a normal speed, and the camera 110 starts capturing the moving image. The arithmetic section 118 analyzes the moving image captured by the camera 110 to constantly monitor presence or absence of the reflector 304. Then, the processing proceeds to step S2. A reason why the reflector 304 is monitored is because the reflector 304 shines in a still image in a single frame of the moving image and thus a position thereof can easily be analyzed.

In step S2, as illustrated in FIG. 3, the reference step 30, to which the reflector 304 is attached, advances from the comb 60 on the upper floor side. Then, when the arithmetic section 118 detects the reflector 304, the processing proceeds to step S3.

In step S3, the arithmetic section 118 outputs the stop signal to the controller 50 so as to stop movement of the step 30, and then the processing proceeds to step S4. When receiving the stop signal, the controller 50 causes a drive circuit 70 to stop supplying a drive current to the motor 20 and causes the electromagnetic brake 23 to forcibly stop the rotation of the motor 20. From such a position,

braking of the reference step 30 is started. Thereafter, the reference step 30 moves a predetermined braking distance from the position where braking thereof has been started, and is then stopped.

In step S4, a first angle θ_1 is calculated from a control rotation angle of the posture control motor 114. The first angle θ_1 is defined by the perpendicular line R and a first line S1 that connects the base point O of the rotational shaft 116 and a point P1 at which the reflector 304 at the front end of the reference step 30 is located at the time when the reference step 30 advances from a tip of the comb 60. Then, the processing proceeds to step S5.

The first angle θ_1 and the length h of the perpendicular line R define a relationship expressed by the following equation (1). Thus, in step S5, the arithmetic section 118 calculates a first distance L1 from the point P0 to the point P1 by using the following equation (2), which is obtained by modifying the equation (1). Then, the processing proceeds to step S6. Hereinafter, "*" means multiplication.

$$\tan\theta_1 = L1/h \quad \dots(1)$$

$$L1 = h*\tan\theta_1 \quad \dots(2)$$

In step S6, in a period from the time at which the rotation of the motor 20 is forcibly stopped by using the electromagnetic brake 23 to the time at which the reference

step 30 is stopped after moving the predetermined braking distance, the arithmetic section 118 causes the imaging section 112 to rotate about the rotational shaft 116 by the posture control motor 114 in a manner to follow the reflector 304 of the moving reference step 30. This following occurs when the arithmetic section 118 analyzes the moving reflector 304 from the moving image, controls the rotation of the posture control motor 114 such that the reflector 304 exists at the same position in the still images in the single frame of the moving image, and then causes the camera 110 to rotate. Then, when determining from the moving image that the reflector 304 of the step 30 has been stopped, as illustrated in FIG. 4, the arithmetic section 118 detects a point P2 at the position, and the processing proceeds to step S7.

In step S7, the arithmetic section 118 calculates a second angle θ_2 that is defined by the perpendicular line R and a second line S2 connecting the point P2 and the base point O of the rotational shaft 116, and the processing proceeds to step S8.

A distance L2 from the point P0 to the point P2 defines a relationship expressed by the following equation (3). Thus, in step S8, the arithmetic section 118 calculates the second distance L2 by using the following equation (4), which is obtained by modifying the equation (3). Then, the

processing proceeds to step S9.

$$\tan\theta_2 = L_2/h \quad \dots(3)$$

$$L_2 = h*\tan\theta_2 \quad \dots(4)$$

In step S9, the arithmetic section 118 calculates the braking distance L of the step 30 from the first distance L1 and the second distance L2 by using the following equation (5), and then the processing proceeds to step S10.

$$L = L_2 - L_1 \dots(5)$$

In step S10, the arithmetic section 118 outputs the braking distance L to the tablet terminal 200 in the short-range wireless communication, and terminates the processing. The worker compares the braking distance L displayed on the tablet terminal 200 with a reference braking distance. In the case where the braking distance L is equal to or longer than the reference braking distance, the worker can determine that a brake pad of the electromagnetic brake 23 is worn.

(4) Effects

According to this embodiment, the braking distance L can be calculated only by installing the measuring device 100 on the landing board 32 on the upper floor side of the escalator 10 to capture the moving image of the movement of the reference step 30. The worker can determine from this braking distance L whether the brake pad of the electromagnetic brake 23 is worn.

In addition, since the braking distance L can be calculated without attaching a pulse generator to the motor 20 of the escalator 10 or adding a position detector of the step 30, the invention can also be applied to the existing escalator 10.

(5) Modified Examples

A robotic inspection system may be introduced for inspection of the escalator 10, and the measuring device 100 may be integrated into the robot. In this case, modification of the escalator 10 only requires addition of a device for receiving the stop signal from the arithmetic section 118 and modification of the drive circuit, which can keep cost low.

[Second Embodiment]

Next, a description will be made on a measuring device 100 for an escalator 10 in the second embodiment with reference to FIGS. 8 and 9.

In the first embodiment, the description has been made on the case where the reference step 30, which advances from the comb 60 on the upper floor side, is stopped in the horizontal segment of the upper horizontal section 12a of the truss 12.

However, as illustrated in FIG. 8, in the case where a position (a point P4) at which the reflector 304 of the reference step 30 is stopped is in the inclined segment of

the inclined section 12c of the truss 12, an inclination angle thereof has to be taken into consideration, and the braking distance L cannot accurately be calculated from the first angle θ_1 and the second angle θ_2 .

Accordingly, in this embodiment, a description will be made on a method for measuring the braking distance L in the case where the position (the point P4) at which the reference step 30 having the reflector 304 is stopped is in the inclined segment of the inclined section 12c of the truss 12 with reference to FIG. 8 and a flowchart in FIG. 9.

Since steps S1 to S8 as a first half of processing in the measuring method in this embodiment are the same as those in the measuring method in the first embodiment, a description thereon will not be made. A description will herein be made from a latter half of the processing after the second distance L2 is calculated in step S8 and the processing proceeds to step S11.

In step S11, it is determined whether the reference step (a hatched step in FIG. 8) 30 having the reflector 304 is stopped in the horizontal segment of the upper horizontal section 12a or the inclined segment of the inclined section 12c. As a determination method, if the second distance L2 calculated in step S8 is equal to or longer than a threshold value (a distance from the point P0 to a position of a

boundary between the upper horizontal section 12a and the inclined section 12c) L_{max} , it is determined that the reference step 30 moves beyond the upper horizontal section 12a and is stopped in the inclined segment of the inclined section 12c, and the processing proceeds to step S12 (in case of y). If the second distance $L2$ is shorter than the threshold value L_{max} , it is determined that the reference step 30 is in the horizontal segment of the upper horizontal section 12a, and the processing proceeds to step S18. Then, similar to the measuring method in the first embodiment, the braking distance L is calculated by using the equation (5), and the processing is terminated.

In step S12, $N = 1$ is set, and the processing proceeds to step S13. That is, the step 30 that follows the reference step 30 and advances next from the comb 60 on the upper floor side (hereinafter referred to as a "measurement step", a double-hatched step in FIG. 8) will be referred to as the measurement step 30 of $N = 1$. The step 30 that advances next by following the measurement step 30 of $N = 1$ is the measurement step 30 of $N = 2$.

In step S13, since the reference step 30 is stopped in the inclined segment of the inclined section 12c, a point P3 at a front end of the measurement step 30 of $N = 1$, which advances by following the reference step 30, is detected. Then, the processing proceeds to step S14. In regard to

the point P3 at the front end of the measurement step 30 of $N = 1$, since the reflector 304 is not attached, a yellow demarcation line 305 (see FIG. 5) that is provided to a front portion and both right and left portions of the step 30 is detected as the point P3.

In step S14, the arithmetic section 118 calculates a third angle θ_3 that is defined by the perpendicular line R and a third line S3 connecting the point P3 of the measurement step 30 of $N = 1$ and the base point O of the rotational shaft 116, and the processing proceeds to step S15.

In step S15, a third distance L3 from the point P0 to the point P3 is calculated from the following equation (7), and the processing proceeds to step S16.

$$L3 = h \cdot \tan \theta_3 \quad \dots(7)$$

In step S16, if the third distance L3 of the measurement step 30 of $N = 1$ is equal to or longer than the threshold value Lmax, the measurement step 30 of $N = 1$ also exists in the inclined segment of the inclined section 12c, and thus the processing proceeds to step S17 (in case of y). If the third distance L3 is shorter than the threshold value Lmax, the measurement step 30 of $N = 1$ exists in the horizontal segment of the upper horizontal section 12a, and thus the processing proceeds to step S18 (in case of n).

In step S17, $N = N + 1$ is set. In other words, since

the measurement step 30 of $N = 1$ also exists in the inclined segment of the inclined section 12c, the next step 30 of $N = 2$ (the second step S30 from the reference step 30 being zero) is set as the measurement step 30. Then, the processing returns to step S13. In this way, until the measurement step 30 that is stopped in the horizontal segment of the upper horizontal section 12a appears, the number of N is increased by 1, and the point $P(N + 2)$ is detected. Next, an $(N + 2)$ th angle $\theta(N + 2)$ of the $(N + 2)$ th measurement step 30 is calculated, and an $(N + 2)$ th distance $L(N + 2)$ is calculated. Such processing continues until the $(N + 2)$ th distance $L(N + 2)$ becomes shorter than the threshold value L_{max} .

In step S18, since the N th (for example, $N = 1$) measurement step 30 exists in the horizontal segment of the upper horizontal section 12a, the arithmetic section 118 calculates a provisional braking distance L' of the N th measurement step 30 by using the following equation (8) from the first distance $L1$ and the third distance $L3$.

$$\begin{aligned} L' &= L3 - L1 \\ &= h(\tan\theta3 - \tan\theta1) \quad \dots(8) \end{aligned}$$

Since the provisional braking distance L' of this N th measurement step 30 is shorter than the braking distance L of the reference step 30 by $N \cdot M$, the true braking distance L is calculated by using the following equation (9), and

the processing proceeds to step S19. Here, M denotes a dimension in the front-rear direction of the step 30 and is 400 mm, for example.

$$L = L' + N * M \quad \dots(9)$$

In step S19, the arithmetic section 118 outputs the braking distance L to the tablet terminal 200 in the short-range wireless communication, and terminates the processing.

As it has been described so far, even in the case where the position (the point P4) at which the reference step 30 having the reflector 304 is stopped is in the inclined segment of the inclined section 12c of the truss 12, the braking distance L can be measured.

[Modified Examples]

In the above embodiment, the reflector 304 is attached to the front end of the upper surface (the cleat surface) of the step 30. However, the invention is not limited thereto, and the reflector 304 may be provided to a central portion in the front-rear direction of the step 30.

In the above embodiment, the reflector 304 is attached to the step 30. However, a mark other than the reflector 304 may be attached, or the yellow demarcation line 305 may be used as the mark for the determination.

In the above embodiment, the posture control motor 114 causes the camera 110 to rotate and thereby automatically follow the reflector 304. However, instead thereof, the

worker may cause the camera 110 to rotate while looking at the reflector 304 of the step 30, and may measure the first angle θ_1 and the second angle θ_2 .

In the above embodiment, the first distance L_1 is calculated from the first angle θ_1 at the time point at which the reflector 304 advances from the comb 60. However, after the reference step 30 is stopped, the first angle θ_1 and the second angle θ_2 may be calculated from the moving image, and the braking distance L may be calculated by using the following equation (6) obtained from the equation (2) and the equation (4).

$$\begin{aligned} L &= h \cdot \tan \theta_2 - h \cdot \tan \theta_1 \\ &= h(\tan \theta_2 - \tan \theta_1) \quad \dots(6) \end{aligned}$$

In the above embodiment, the communication among the measuring device 100, the tablet terminal 200, and the controller 50 is assumed to be the short-range wireless communication. However, wired communication may be adopted in which the measuring device 100, the tablet terminal 200, and the controller 50 are connected by cords.

In the above embodiment, the description has been made on the case where the step 30 is stopped immediately after the arithmetic section 118 of the measuring device 100 outputs the stop signal. However, in the case where there is a delay time between the time at which the arithmetic section 118 outputs the stop signal and the time at which

the controller 50 performs the stop operation, the further accurate measurement can be made by executing processing to correct the delay time.

In the above embodiment, it is configured that the measuring device 100 emits the stop signal. However, instead thereof, the worker may perform a drive stop operation of the escalator 10, the controller 50 may notify the measuring device 100 of the output of the stop signal, and the braking distance L may thereby be measured.

In the above embodiment, the measuring device 100 is installed on the landing board 32 on the upper floor side. However, instead thereof, the measuring device 100 may be installed on the landing board 34 on the lower floor side. At this time, the step 30 ascends, and the braking distance L is measured.

In the above embodiment, the description has been made on the case where the invention is applied to the escalator 10. However, instead thereof, the invention may be applied to the moving walkway.

The above description has been made on the embodiments of the invention. However, each of these embodiments is merely provided as the example and thus is not intended to limit the scope of the invention. These novel embodiments can be implemented in any of various other aspects, and various types of elimination, replacement, and changes can

be made thereto within the scope that does not depart from the gist of the invention. These embodiments and the modifications thereof are included in the scope and the gist of the invention and are also included in the invention described in the claims and the equivalent scope thereof.

CLAIMS

1. A step braking distance measuring device for a passenger conveyor, the step braking distance measuring device comprising:

an instructing section that outputs a stop signal to instruct the passenger conveyor having endlessly coupled steps to stop moving the steps;

a measuring section that is disposed at a base point located at a higher position than the steps, measures a first angle defined by a first line and a perpendicular line from the base point, and measures a second angle defined by a second line and the perpendicular line, the first line connecting the base point and a first position of a particular portion of a reference step as one of the plural steps at the time when the stop signal is output, and the second line connecting the base point and a second position of the particular portion of the stopped reference step; and

a calculating section that calculates a braking distance of the reference step from the first angle, the second angle, and a length of the perpendicular line from the base point to a height at which the reference step exists.

2. The step braking distance measuring device for a passenger conveyor according to claim 1, wherein

the measuring section has a sensor that rotates about the base point in accordance with movement of the particular portion of the reference step.

3. The step braking distance measuring device for a passenger conveyor according to claim 2, wherein

a mark is provided to the particular portion of the step,

the sensor is a camera, and

the measuring section analyzes the mark from a moving image that is captured by the camera, and causes the camera to rotate about the base point along with movement of the mark, so as to follow the mark and captures the moving image.

4. The step braking distance measuring device for a passenger conveyor according to claim 1, wherein

the first position and the second position are horizontal.

5. The step braking distance measuring device for a passenger conveyor according to claim 1, wherein

in the case where the reference step moves through a horizontal segment from the first position, descends or

ascends, and is stopped in an inclined segment, and the Nth ($N \geq 1$) step from the reference step is stopped in the horizontal segment,

the measuring section measures a third angle that is defined by the perpendicular line and a third line connecting the base point and a third position of the particular portion of the step that is stopped in the horizontal segment, and

the calculating section calculates a provisional braking distance of the stopped step from the first angle, the third angle, and a length of the perpendicular line, sets a dimension in a front-rear direction of the step as M, and calculates the braking distance of the reference step by adding a value obtained by multiplying N by M to the provisional braking distance.

6. A method for measuring a step braking distance for a passenger conveyor having:

a motor that moves plural endlessly coupled steps; and
a brake device that stops the motor,

the method for measuring a step braking distance for a passenger conveyor comprising:

outputting a stop signal to instruct the motor to stop;

measuring a first angle defined by a first line and a

perpendicular line from a base point located at a higher position than the step, and measuring a second angle defined by a second line and the perpendicular line, the first line connecting the base point and a first position of a particular portion of a reference step as one of the plural steps at the time when the stop signal is output, and the second line connecting the base point and a second position of the particular portion of the stopped reference step; and

calculating a braking distance of the reference step from the first angle, the second angle, and a length of the perpendicular line from the base point to a height at which the reference step exists.