TITLE OF THE INVENTION:
HANDRAIL BELT DISINFECTION APPARATUS AND HANDRAIL BELT DISINFECTION METHOD OF PASSENGER CONVEYOR

TECHNICAL FIELD

Embodiments of the present invention relate to a handrail belt disinfection apparatus and a handrail belt disinfection method of a passenger conveyor.

BACKGROUND

A passenger conveyor such as an escalator is used as means for moving people.

An escalator has an endless handrail belt. An endless handrail belt is provided on both sides of a step on which a user stands, and moves in conjunction with the running of the step. In order to use an escalator safely, it is desired that the user gets on a step while grasping a handrail belt with a hand.

However, if a handrail belt is not properly disinfected during a viral outbreak, there is a risk that a user may become infected.

Conventionally, there is a method of spraying disinfectant on a handrail belt or a method of disinfecting a handrail belt by irradiating the handrail belt with ultraviolet light.

SUMMARY

However, if the method of spraying disinfectant on the handrail belt is adopted, the user is hesitant to grasp the handrail belt in a wet state.

Further, if the method of always irradiating the handrail belt with ultraviolet light is adopted, deterioration of the handrail belt due to irradiation of the handrail belt with ultraviolet light is accelerated.

The problem to be solved by the present invention is to provide a handrail belt disinfection apparatus and a handrail belt disinfection method of a passenger conveyor which can efficiently disinfect a handrail belt while suppressing deterioration of the handrail belt.

A handrail belt disinfection apparatus of embodiments has a first light source that is provided in a landing platform plate which is positioned near an inlet portion serving as an entry or exit point of a handrail belt which circulates and moves in conjunction with the running of a passenger conveyor, the first light source emitting ultraviolet light toward the handrail belt.

Further, a handrail belt disinfection method of another embodiment includes emitting ultraviolet light toward a handrail belt from a first light source when a user is detected by a user detection sensor provided at a landing platform plate, the first light source being provided in a landing platform plate positioned near an inlet portion serving as an entry or exit point of the handrail belt; emitting ultraviolet light from a second light source toward a back side jaw portion, the second light source being provided in a deck which supports the handrail belt and is positioned near the inlet portion, the back side jaw portion being formed by folding back a part of the handrail belt toward the deck; and stopping emission of the ultraviolet light from the first light source and the second light source after elapse of a time from when the user detection sensor detects the user to when the user grasps the handrail belt.

According to the handrail belt disinfection apparatus and handrail belt disinfection method having the above configuration, the handrail belt of a passenger conveyor can be disinfected efficiently while suppressing deterioration of the handrail belt.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an explanatory diagram showing the overall configuration of an escalator according to an embodiment;

FIG. 2 is a side view showing the installation positions of a first light source and a second light source in an escalator according to an embodiment;

FIG. 3 is a cross sectional view showing an installation position of a second light source in an escalator according to an embodiment;

FIG. 4 is a block diagram showing a control configuration of an escalator according to an embodiment; and

FIG. 5 is a flowchart showing a processing procedure of an escalator according to an embodiment.

DETAILED DESCRIPTION

Hereinafter, an apparatus and method of embodiments will be described with reference to the drawings.

FIG. 1 is an explanatory diagram showing the overall configuration of an escalator according to an embodiment.

An escalator 1 has a plurality of steps 4 that circulate and move between a landing platform 2 on an upper floor and a landing platform 3 on an upper floor. A handrail belt 5 to be grasped by a user is installed on the escalator. The handrail belt 5 circulates and moves between the landing platform 2 and the landing platform 3 by moving in conjunction with the steps 4.

The handrail belt 5 is supported by handrail panels 6 and moves along the handrail panels 6. The handrail panels 6 are provided in an upright manner to the right and left with the steps 4 therebetween. In the embodiment, the handrail panels 6 are assumed to be stainless steel panels but may be glass panels.

Infrared user detection sensors 7 are installed near landing platform plates F of the landing platforms 2 and 3. The user detection sensors 7 detect a user who is to get on the escalator 1 from the landing platforms 2 and 3. Thereafter, the escalator 1 starts running and the steps 4 move.

In the embodiment, first light sources 10 are embedded in the right and left sides of each landing platform plate F with the steps 4 therebetween. Each landing platform plate F is provided below inlet portions 8 serving as an entry or exit point of the handrail belt 5. The surfaces of the first light sources 10 and the surface of each landing platform plate F are flush with each other. Therefore, no interference is caused when a user gets on/off the escalator. Ultraviolet light is emitted in the direction of the handrail belt 5 from positions below the inlet portions 8. Therefore, the user is not irradiated with ultraviolet light.

Skirt portions 9 are provided at positions below the left and right handrail panels

6, respectively. The skirt portions 9 are connected to inlet portions 8 on the lower floor and inlet portions (not shown) on the upper floor, and contain a part of the handrail belt 5 which circulates and moves. In the skirt portions 9, second light sources 11 are arranged on the right and left sides of each handrail panel 6 in a parallel manner. The handrail belt 5 has a front surface and back side jaw portions (return portions 14). The return portions 14 are formed by folding back, toward the handrail panel 6, portions of the handrail belt in the width direction (lateral direction in FIG. 3). The second light sources 11 are arranged immediately above the back side return portions 14 of the handrail belt 5. The second light sources 11 irradiate the back side return portions 14 of the handrail belt 5 with ultraviolet light.

More specifically, as shown in FIG. 3, the second light sources 11 include an inner (left side in FIG. 3) second light source 11a on the steps 4 side and an outer second light source 11b. The inner second light source 11a is arranged in a space S which is positioned inside a handrail support (deck) that supports the handrail belt 5. Further, a light transmission hole 13 is provided in a panel mounting plate 12a which forms the handrail support. Through the light transmission hole 13, the light emitted from the inner second light source 11a reaches a back side return portion 14 of the handrail belt 5 which is formed by folding back the handrail belt toward the handrail support side.

The outer second light source 11b irradiates, with the light, the return portion 14 of the handrail belt 5 which is positioned on the side opposite to the inner second light source 11a. The outer second light source 11b is mounted on the outside of the handrail support (the panel mounting plate 12b) which supports the handrail belt 5.

The first light sources 10 and the second light sources 11a and 11b are light sources that emit ultraviolet light having a wavelength of about 222 nm. Ultraviolet light having a wavelength of about 222 nm enable disinfection (virus killing, sterilization) without causing abnormalities in the human body.

Therefore, the handrail belt 5 can be disinfected by irradiating the front surface and the return portions 14 of the handrail belt 5 with ultraviolet light emitted from the first light sources 10 and the second light sources 11a and 11b.

Further, the first light sources 10 and the second light sources 11a and 11b start

emitting ultraviolet light when the user detection sensors 7 provided for starting the operation of the escalator 1 detect a user.

The movement distance of the handrail belt 5 from the inlet portions 8 to a position at which a passenger grasps the handrail belt 5 is about 1000 mm to 1200 mm. Further, the time from when a user is detected to when the user grasps the handrail belt 5 is about two seconds if the walking speed of the user is taken into consideration. If the operating speed of the escalator 1 is 30 m/min, the handrail belt 5 moves at 500 mm/sec. Therefore, the handrail belt 5 moves by 1000 mm during about 2 seconds. Under the condition that the escalator 1 is operated at 30 m/min, if ultraviolet light is emitted from the first light sources 10 and the second light sources 11a and 11b for one second, the range of the handrail belt 5 which can be irradiated with ultraviolet light is a value obtained by adding the length of the light sources to 500 mm. According to such a calculation result, if the irradiation is started when the user detection sensors 7 detect a user, and if the handrail belt 5 is irradiated for one second, a position at which the user grasps the handrail belt 5 can be disinfected.

As described above, according to the present embodiment, it is possible to appropriately emit ultraviolet light toward a position at which a user will grasp the handrail belt 5 when the user gets on the escalator 1. That is, according to the present embodiment, the handrail belt is irradiated with ultraviolet light for a predetermined time from the time when the user detection sensors 7 detect a user instead of always irradiating the handrail belt with ultraviolet light. By means of such a configuration, a position at which the user grasps the handrail belt 5 can be disinfected. Further, the handrail belt can be disinfected efficiently while suppressing deterioration of the handrail belt.

Next, a handrail belt disinfection apparatus and a disinfection method according to an embodiment will be described with reference to FIGS. 4 and 5.

As shown in FIG. 4, the handrail belt disinfection apparatus of the present embodiment includes an escalator control device 20.

The escalator control device 20 includes a control unit 21, a drive command output unit 22, and a timer 23.

The control unit 21 is composed of a computer that integrally controls the

escalator 1. When the user detection sensors 7 detect a user, the drive command output unit 22 outputs a run command to a drive device 30 to start the running of the escalator 1. Further an ultraviolet irradiation command is output to a light source control circuit 40. Accordingly, ultraviolet light is emitted from the first light sources 10 and the second light sources 11 toward the handrail belt 5. The timer 23 sets the irradiation time of ultraviolet light in advance based on the aforementioned calculation result. The irradiation time set in the timer 23 can be changed depending on the use state of the escalator 1.

In the flowchart of FIG. 5, after the user detection sensors 7 detect a user (step S1, YES), the escalator 1 starts running, and the steps 4 and the handrail belt 5 circulate and move between the landing platform 2 and the landing platform 3 (step S2).

In accordance with the detection of a user by the user detection sensors 7, an ultraviolet irradiation command is output from the drive command output unit 22 to the light source control circuit 40. This emits ultraviolet light toward the handrail belt 5 from the first light sources 10 and the second light sources 11 (step S3).

The irradiation of the handrail belt with ultraviolet light is continued for the time until the user grasps the handrail belt 5 based on the time measured by the timer 23 (step S4). After the time until the user grasps the handrail belt 5 has elapsed based on the time measured by the timer 23, the emission of ultraviolet light from the first light sources 10 and the second light sources 11 is stopped (step S5).

Further, suppose that users are continuously detected by the user detection sensors 7. In the above case, the emission of ultraviolet light is continued until a user is no longer detected.

<Modified example>

A sign saying “This escalator is already disinfected. You can use this escalator safely.” or the like may be displayed near the entrance. In this case, a sign saying “The escalator is already disinfected.” or “The escalator is being disinfected.” may be displayed at a place which is visible to a user when the user is detected by the user detection sensors 7. This enables the user to grasp the handrail belt 5 without anxiety and to use the escalator 1 without anxiety.

Further, the first light sources and second light sources 11a and 11b may always

emit ultraviolet light by changing the setting of the timer 23 depending on the use state of the escalator 1 such as when the escalator 1 is crowded.

Although the above embodiments have been described with the escalator 1 as an example, it is needless to say that the present invention is widely applicable to passenger conveyors such as moving sidewalks.

Although several embodiments of the present invention have been described above, these embodiments have been presented as examples and are not intended to limit the scope of the invention. These new embodiments may be implemented in a variety of other ways, and various omissions, substitutions, and modifications may be made without departing from the spirit of the invention. These embodiments and modification thereof are included in the scope and gist of the invention, and are also included in the invention recited in claims and the equivalent scope thereof.

CLAIMS

1. A handrail belt disinfection apparatus comprising:

a first light source (10) that is provided in a landing platform plate (F) which is positioned near an inlet portion (8) serving as an entry or exit point of a handrail belt (5) which circulates and moves in conjunction with running of a passenger conveyor, the first light source (10) emitting ultraviolet light toward the handrail belt (5).

2. The handrail belt disinfection apparatus according to claim 1, wherein

an irradiation time of the first light source (10) is a time from when a user is detected at a landing platform (2) to when the user grasps the handrail belt (5).

3. The handrail belt disinfection apparatus according to claim 1 or 2, comprising:

a deck which supports the handrail belt (5); and

a second light source (11) that is provided in the deck which is positioned near the inlet portion (8), the second light source (11) irradiating a back side jaw portion (14) with ultraviolet light, the back side jaw portion (14) being formed by folding back a part of the handrail belt (5) toward the deck.

4. The handrail belt disinfection apparatus according to claim 3, wherein

the second light source (11) is provided in plurality, and the second light sources (11a, 11b) are provided at two locations of a location inside the deck and a position outside the deck.

5. The handrail belt disinfection apparatus according to claim 3 or 4, wherein

an irradiation time of the second light source (11) is a time from when a user is detected at a landing platform (2) to when the user grasps the handrail belt (5).

6. A handrail belt disinfection method comprising:

emitting ultraviolet light toward a handrail belt (5) from a first light source (10)

when a user is detected by a user detection sensor (7) provided at a landing platform (2), the first light source (10) being provided in a landing platform plate (F) positioned near an inlet portion (8) serving as an entry or exit point of the handrail belt (5);

emitting ultraviolet light from a second light source (11) toward a back side jaw portion (14), the second light source (11) being provided in a deck which supports the handrail belt (5) and is positioned near the inlet portion (8), the back side jaw portion (14) being formed by folding back a part of the handrail belt (5) toward the deck; and

stopping emission of the ultraviolet light from the first light source (10) and the second light source (11) after elapse of a time from when the user detection sensor (7) detects the user to when the user grasps the handrail belt (5).