

MOVING HANDRAIL DETERIORATION DIAGNOSING DEVICE AND MOVING HANDRAIL
DETERIORATION DIAGNOSING METHOD

[Technical Field]

[0001]

The present invention relates to a moving handrail deterioration diagnosing device and a moving handrail deterioration diagnosing method for diagnosing damage inside a moving handrail provided in a passenger conveyor such as an escalator or a moving walkway by irradiation with radioactive rays.

[Background Art]

[0002]

In the background art, there has been known a technique in which a moving handrail of a passenger conveyor is removed and a radiation device is supported on a guide so that the moving handrail is placed between a radiation generating portion and a radiation receiving portion in order to display the condition of wires buried in the moving handrail. In addition, in the background art, Patent Literature 1 has given disclosure about a technique in which a radiation generating portion and a fluorescent portion for displaying a radiographic image are attached through an attachment portion so as to be disposed above and below a moving handrail respectively. The radiographic image is displayed while the moving handrail is moved. Thus, the condition of wires buried in the moving handrail can be observed.

[Citation List]

[Patent Literature]

[0003]

[Patent Literature 1] JP-A-2003-48683

[Summary of Invention]

[Technical Problem]

[0004]

In the aforementioned background-art technique in which a moving handrail of a passenger conveyor is removed and placed between a radiation generating portion and a radiation receiving portion of a radiation device, it takes time to remove and place the moving handrail. On the other hand, in the background-art technique disclosed in Patent Literature 1, that is, in the technique in which a radiation generating portion and a fluorescent portion are attached above and below a moving handrail respectively, a guide or a support portion for the moving handrail comes out in a radiographic image. It is therefore impossible to observe only the wires buried in the moving handrail in a portion to be observed.

[0005]

The invention has been accomplished in consideration of the aforementioned actual circumstances in the background art. An object of the invention is to provide a moving handrail deterioration diagnosing device and a moving handrail deterioration diagnosing method in which it is not

necessary to remove a moving handrail during the diagnosis of deterioration in the moving handrail, but it is possible to take an image in which other constituent members of a passenger conveyor than the moving handrail are prevented from coming out and being superimposed on a portion to be observed in the moving handrail and a steel cord buried in the moving handrail.

[Solution to Problem]

[0006]

In order to achieve the foregoing object, a moving handrail deterioration diagnosing device according to the invention includes: a radiation emitting portion which emits radioactive rays to a moving handrail of a passenger conveyor, the moving handrail moving in sync with steps moving with passengers standing thereon, a steel cord being buried inside the moving handrail; and a radiation receiving portion which receives the radioactive rays transmitted through the moving handrail; characterized in that: the radiation emitting portion and the radiation receiving portion are disposed on one and the same surface side of the moving handrail so that deterioration in the moving handrail can be diagnosed while a curved part of the moving handrail is put between the radiation emitting portion and the radiation receiving portion.

[0007]

In addition, in order to achieve the foregoing object, a moving handrail deterioration diagnosing method according to the invention includes

the step of diagnosing deterioration in a moving handrail of a passenger conveyor, the moving handrail moving in sync with steps moving with passengers standing thereon, a steel cord being buried inside the moving handrail; characterized in that: a moving handrail deterioration diagnosing device including a radiation emitting portion which emits radioactive rays to the moving handrail and a radiation receiving portion which receives the radioactive rays transmitted through the moving handrail is used for diagnosing deterioration in the moving handrail; and deterioration in the moving handrail is diagnosed in a state where the radiation emitting portion is disposed on one side of a curved part of the moving handrail and the radiation receiving portion is disposed on the other side of the curved part on one and the same surface side of the moving handrail as the radiation emitting portion is disposed so as to put the curved part between the radiation emitting portion and the radiation receiving portion.

[Advantageous Effects of Invention]

[0008]

According to the invention, it is possible to provide a moving handrail deterioration diagnosing device and a moving handrail deterioration diagnosing method in which it is not necessary to remove a moving handrail during the diagnosis of deterioration in the moving handrail, but it is possible to take an image in which other constituent members of a passenger conveyor than the moving handrail are prevented from coming out and being

superimposed on a portion to be observed in the moving handrail and a steel cord buried in the moving handrail.

[0009]

The other objects, configurations and effects than the aforementioned ones will be made clear in the description of the following embodiment.

[Brief Description of Drawings]

[0010]

[Fig. 1] A side view of a moving handrail deterioration diagnosing device according to an embodiment of the invention.

[Fig. 2] A back view of the moving handrail deterioration diagnosing device according to the embodiment of the invention.

[Fig. 3] A view showing a radiographic image of a moving handrail taken by the moving handrail deterioration diagnosing device according to the embodiment of the invention.

[Fig. 4] A side view showing the schematic configuration of a passenger conveyor to be diagnosed by the moving handrail deterioration diagnosing device according to the embodiment of the invention.

[Description of Embodiments]

[0011]

An embodiment of a moving handrail deterioration diagnosing device and a moving handrail deterioration diagnosing method according to the

invention will be described below with reference to the drawings.

[0012]

Fig. 4 is a side view showing the schematic configuration of a passenger conveyor to be diagnosed by a moving handrail deterioration diagnosing device according to an embodiment of the invention.

[0013]

In Fig. 4, an escalator, for example, a down escalator is depicted as an example of a passenger conveyor. The passenger conveyor 22 consisting of an escalator has a frame 23 which is buried under an upper floor and under a lower floor and built between the upper floor and the lower floor. In addition, the passenger conveyor 22 has a sprocket 24 which is provided under the upper floor and rotated by a not-shown drive unit, a driven sprocket 25 which is provided under the lower floor, a not-shown endless chain which is wound around the sprockets 24 and 25, and a plurality of steps 26 which are provided on the chain and move with passengers standing thereon.

[0014]

In addition, endless moving handrails 15 disposed in parallel with the traveling direction of the steps 26 are provided on the opposite sides of the steps 26. Passengers standing on the steps 26 can hold the moving handrails 15. The moving handrails 15 are driven by a terminal gear 27. The terminal gear 27 is arranged so that the terminal gear 27 can be rotated by the chain 28 in sync with the aforementioned sprocket 24 which is rotated

by the not-shown drive unit. Thus, the moving handrails 15 and the steps 26 are driven at the same velocity. That is, the moving handrails 15 and the steps 26 move in sync. A steel cord 16 which will be described later is buried inside each moving handrail 15 to be diagnosed in the invention.

[0015]

Figs. 1 and 2 are explanatory views of a moving handrail deterioration diagnosing device according to an embodiment of the invention. Fig. 1 is a side view, and Fig. 2 is a back view.

[0016]

The moving handrail deterioration diagnosing device A according to the embodiment shown in Fig. 1 has an X-ray source 1 which is a radiation emitting portion for emitting radioactive rays, that is, X-rays to the moving handrail 15, and a radiation receiving portion 29 which receives the X-rays transmitted through the moving handrail 15. The radiation receiving portion 29 is, for example, constituted by a scintillator 2 and a camera 3. In this configuration, the scintillator 2 producing light in response to the X-rays is imaged by the camera 3 using a mirror.

[0017]

In addition, in the moving handrail deterioration diagnosing device A according to the embodiment, the X-ray source 1 is connected to a slide rail-including post 5 through a distance changing portion 10 and a height changing portion 6. A support base 30 is connected to the base of the slide

rail-including post 5, and a plurality of stopper-including casters 12 are provided on the bottom side of the support base 30. In addition, an X-ray control unit 11 for controlling the generation of X-rays emitted from the X-ray source 1 is mounted on the top side of the support base 30.

[0018]

The aforementioned distance changing portion 10 includes a support part 10a which supports the X-ray source 1, a support post 10b which is connected to the radiation receiving portion 29 and inserted into an insertion hole provided in the support part 10a, and a fixing screw 10c which fixes the support part 10a and the support post 10b to each other. Thus, when the fixing screw 10c is loosened, the support post 10b moves relatively to the insertion hole of the support part 10a so that the distance between the X-ray source 1 and the radiation receiving portion 29 can be set at a desired distance.

[0019]

In addition, the aforementioned height changing portion 6 can slide on a slide rail of the slide rail-including post 5 when a handle 6a is operated. When the height of the height changing portion 6 is changed, the height positions of the X-ray source 1 and the radiation receiving portion 29 can be changed.

[0020]

Further, the height changing portion 6 and the distance changing

portion 10 are connected through an angle changing portion 31. The angle changing portion 31 has a vertical rotation shaft 7 which changes the vertical direction of the X-ray source 1 and the radiation receiving portion 29, that is, changes the elevation angle as indicated by the arrows in Fig. 1, and a vertical rotation shaft fixing screw 8 which fixes the rotation of the vertical rotation shaft 7 so as to fix the rotation angle thereof. In addition, the angle changing portion 31 has a horizontal rotation shaft 17 which rotates the X-ray source 1 and the radiation receiving portion 29 horizontally, that is, in the directions of the arrows indicated in Fig. 2, and a horizontal rotation shaft fixing screw 9 (shown in Fig. 1) which fixes the rotation of the horizontal rotation shaft 17 so as to fix the rotation angle thereof.

[0021]

In order to carry out the diagnosis of deterioration in the moving handrail 15 using the deterioration diagnosing device A according to the embodiment, a personal computer 14 for accumulating, analyzing and processing video data is disposed, and the camera 3 and the personal computer 14 are connected through a video cable 13 for transmitting video images.

[0022]

When the moving handrail 15 and the steel cord 16 buried in the moving handrail 15 are observed by the moving handrail deterioration diagnosing device A configured thus, the moving handrail deterioration

diagnosing device A according to the embodiment is placed near a curved part 15a, 15b or 15c shown in Fig. 4. Description will be made upon the procedure in the case in which the moving handrail deterioration diagnosing device A according to the embodiment is, for example, placed near the curved part 15a to carry out the diagnosis of deterioration.

[0023]

The moving handrail 15 to be diagnosed in the embodiment moves in the same direction as the moving direction of the steps 26, on the upper surface side with the curved parts 15a and 15b as the boundaries. In addition, the moving handrail 15 is pulled into a not-shown deck base on the lower surface side with the curved parts 15a and 15b as the boundaries, and moves in the opposite direction to the moving direction of the steps 26.

[0024]

To work on the preparation for installation of the moving handrail deterioration diagnosing device A according to the embodiment, first, the height changing portion 6 and the distance changing portion 10 are operated to adjust the distance between the X-ray source 1 and the radiation receiving portion 29 and the heights of the X-ray source 1 and the radiation receiving portion 29 in advance so that the curved part 15a of the moving handrail 15 can be put between the X-ray source 1 and the scintillator 2 of the radiation receiving portion 29.

[0025]

In order to diagnose deterioration in the moving handrail 15, the stoppers of the casters 12 of the moving handrail deterioration diagnosing device A according to the embodiment are unlocked, and the position of the deterioration diagnosing device A is determined so that a portion to be observed of the curved part 15a of the moving handrail 15 can be observed. When the position of the deterioration diagnosing device A is determined, the position of the deterioration diagnosing device A is fixed by the stoppers of the casters 12. Further, the height changing portion 6, the distance changing portion 10, the angle changing portion 31 and so on are operated to perform fine adjustment such that the X-ray source 1 and the scintillator 2 of the radiation receiving portion 29 can be set in proper positions in concert with the portion to be observed. As a result of the fine adjustment, X-rays can be emitted from the X-ray source 1 toward the scintillator 2 as indicated by an X-ray direction 4 for radiography illustrated in Fig. 1.

[0026]

In the state where the X-ray source 1 and the radiation receiving portion 29 are set as described above, the X-ray source 1 is disposed on one side of the curved part 15a of the moving handrail 15 while the radiation receiving portion 29 is disposed on the other side of the curved part 15a on one and the same surface side of the moving handrail 15 where the X-ray source 1 is disposed. Thus, the X-ray source 1 and the radiation receiving

portion 29 are disposed to put the curved part 15a therebetween. In addition, the moving handrail deterioration diagnosing device A according to the embodiment diagnoses deterioration in the state where the curved part 15a is put between the X-ray source 1 and the radiation receiving portion 29 as described above. Incidentally, during the operation of the moving handrail deterioration diagnosing device A according to the embodiment, main portions including the X-ray source 1 and the radiation receiving portion 29 as a whole are covered with a leakage X-ray shielding portion 18 made of lead or lead rubber, as shown in Fig. 2.

[0027]

Fig. 3 is a view showing a radiographic image of a moving handrail taken by the moving handrail deterioration diagnosing device A according to the embodiment.

[0028]

As shown in Fig. 3, the radiographic image taken by the moving handrail deterioration diagnosing device A according to the embodiment, that is, the radiographic image of a steel cord 19 or wires 21 produced by the deterioration of the steel cord 19 is displayed on the personal computer 14.

[0029]

A worker who is checking the radiographic image displayed on the personal computer 14 adjusts the distance changing portion 10 for changing

the distance between the X-ray source 1 and the radiation receiving portion 29 in the position where the X-ray direction 4 for radiography overlaps the steel cord 16 buried in the moving handrail. At this time, the distance between the X-ray source 1 and the radiation receiving portion 29 is made as small as possible.

[0030]

The steel cord 16 buried in the moving handrail is arranged as follows. That is, several thin wires are twisted into a slightly thick wire called a strand. Several strands prepared thus are further twisted into the steel cord 16. The radiographic image of the thus configured steel cord 16 taken by the moving handrail deterioration diagnosing device A according to the embodiment is the form of a steel cord 19 shown in Fig. 3. In the embodiment, the moving handrail 15 of the passenger conveyor 22 is radiographically imaged in the state where the steel cord 16 buried in the moving handrail 15 is curved like a mountain in a front end portion where the moving handrail 15 is folded back in a landing zone. When the steel cord 19 on the radiographic image deteriorates, untwisted wires are displayed as wires 21 in Fig. 3. Thus, the condition of the wires 21 can be observed easily at a determination place 20.

[0031]

According to the embodiment, it is possible to image the moving handrail 15 without touching the moving handrail 15. It is therefore

possible to take X-ray moving images while operating the passenger conveyor 22. Further, when untwisted wires are observed at the determination place 20 in the form of the wires 21 in Fig. 3, the X-ray source 1 and the radiation receiving portion 29 as a whole may be rotated vertically around the vertical rotation shaft 7 or rotated horizontally around the horizontal rotation shaft 17 so that an image can be taken to inspect only the portion of the wires in detail. That is, a still image can be taken in a desired position so as to observe the deterioration condition further in detail.

[0032]

In the embodiment, the X-ray source 1 and the radiation receiving portion 29 are disposed so that the summit part of the steel cord 16 in the curved part 15a can be irradiated, as described previously. In the summit part of the curved part 15a, the steel cord 16 is located in the outermost layer. Therefore, when this position is observed, the steel cord 16 can be prevented from being superimposed and radiographically imaged on another member. Thus, the diagnostic accuracy can be improved.

[0033]

In addition, from such a point of view, it is preferable that the X-ray source 1 and the radiation receiving portion 29 are set in the moving handrail 15 in such a manner that the summit part of the steel cord 16 in the curved part 15a can be observed.

[0034]

In addition, the moving handrail deterioration diagnosing device A according to the invention has the distance changing portion 10 for changing the distance between the X-ray source 1 and the radiation receiving portion 29, so that the distance between the X-ray source 1 and the radiation receiving portion 29 can be adjusted in accordance with the shape of the curved part 15a by the distance changing portion 10. Therefore, when the distance between the X-ray source 1 and the radiation receiving portion 29 is made as small as possible as described previously, a radiographic image can be obtained with a small X-ray output. Thus, the risk of leakage of X-rays to the outside during diagnosis can be reduced. Even if the X-rays leak, the influence of the X-rays on the outside can be reduced on a large scale. In addition, the safety of a worker can be secured easily. Further, due to such a configuration, the moving handrail deterioration diagnosing device A can be applied easily to various forms of passenger conveyors.

[0035]

As described above, the moving handrail deterioration diagnosing device A according to the embodiment irradiates the curved part 15a of the moving handrail 15 of the passenger conveyor 22 with X-rays. Accordingly, it is possible to take a radiographic image of the moving handrail 15, that is, diagnose deterioration in the moving handrail 15 without removing the moving handrail 15. Thus, the deterioration diagnosing device A including the X-ray source 1 and the radiation receiving portion 29 can be installed

easily. Further, the layout can be adjusted so that the distance between the X-ray source 1 and the radiation receiving portion 29 can be minimized in an installation state in which the diagnosis of deterioration can be performed. Thus, the X-ray output can be reduced, and the leakage amount of X-rays can be suppressed.

[0036]

In addition, the moving handrail deterioration diagnosing device A according to the embodiment takes a radiographic image in the state where the steel cord 16 buried in the moving handrail 15 is curved during the imaging with X-rays. Thus, untwisted wires produced by the deterioration of the steel cord 16 can be observed accurately.

[0037]

Although an escalator has been described as a passenger conveyor by way of example in the embodiment, the invention is not limited thereto, but can be applied to a general passenger conveyor such as a moving walkway.

[0038]

Although the moving handrail deterioration diagnosing device A according to the embodiment is installed near the curved part 15a by way of example so as to diagnose deterioration in the moving handrail 15, the moving handrail deterioration diagnosing device A may be installed near the curved part 15b shown in Fig. 4. Also in this configuration, accurate deterioration diagnosis can be performed without removing the moving

handrail 15 from the passenger conveyor 22. That is, operations and effects similar to those in the aforementioned embodiment can be obtained. In addition, the procedure of installation and so on can be made the same.

[0039]

Further, the moving handrail deterioration diagnosing device A according to the embodiment may be installed near the curved part 15c shown in Fig. 4, so as to perform the diagnosis of deterioration. In this case, the form of the deterioration diagnosing device A has to be changed. However, when the deterioration diagnosing device A can be attached to such a curved part 15c, the X-ray source 1 can be received within the deck base of the moving handrail 15. As a result, X-rays can be prevented from leaking, and deterioration in the moving handrail 15 can be diagnosed in accordance with necessity without stopping service for passengers.

[0040]

The invention is not limited to the aforementioned embodiment, but may include various modifications. For example, the aforementioned embodiment has been described in detail merely in order to make it easy to understand the invention. The invention is not always limited to one which has all the aforementioned constituents.

[Reference Signs List]

[0041]

1 X-ray source

- 2 scintillator
- 3 camera
- 4 X-ray direction for radiography
- 5 slide rail-including post
- 6 height changing portion
- 7 vertical rotation shaft
- 8 vertical rotation shaft fixing screw
- 9 horizontal rotation shaft fixing screw
- 10 distance changing portion
- 11 x-ray control unit
- 12 stopper-including caster
- 13 video cable
- 14 personal computer
- 15 moving handrail
- 15a curved part
- 15b curved part
- 15c curved part
- 16 steel cord buried in moving handrail
- 17 horizontal rotation shaft
- 18 leakage X-ray shielding portion
- 19 radiographic image of steel cord
- 20 determination place

21 steel cord wire

[CLAIMS]

[Claim 1]

A moving handrail deterioration diagnosing device comprising:
a radiation emitting portion which emits radioactive rays to a moving handrail of a passenger conveyor, the moving handrail moving in sync with steps moving with passengers standing thereon, a steel cord being buried inside the moving handrail; and

a radiation receiving portion which receives the radioactive rays transmitted through the moving handrail; characterized in that:

the radiation emitting portion and the radiation receiving portion are disposed on one and the same surface side of the moving handrail so that deterioration in the moving handrail can be diagnosed while a curved part of the moving handrail is put between the radiation emitting portion and the radiation receiving portion.

[Claim 2]

A moving handrail deterioration diagnosing device according to Claim 1, characterized in that:

the radiation emitting portion and the radiation receiving portion are disposed so that a summit part of the steel cord in the curved part can be irradiated.

[Claim 3]

A moving handrail deterioration diagnosing device according to Claim

1 or 2, further comprising:

a distance changing portion which changes a distance between the radiation emitting portion and the radiation receiving portion;

characterized in that:

the distance between the radiation emitting portion and the radiation receiving portion can be adjusted by the distance changing portion in accordance with a shape of the curved part.

[Claim 4]

A moving handrail deterioration diagnosing method comprising the step of:

diagnosing deterioration in a moving handrail of a passenger conveyor, the moving handrail moving in sync with steps moving with passengers standing thereon, a steel cord being buried inside the moving handrail; characterized in that:

a moving handrail deterioration diagnosing device including a radiation emitting portion which emits radioactive rays to the moving handrail and a radiation receiving portion which receives the radioactive rays transmitted through the moving handrail is used for diagnosing deterioration in the moving handrail; and

deterioration in the moving handrail is diagnosed in a state where the radiation emitting portion is disposed on one side of a curved part of the moving handrail and the radiation receiving portion is disposed on

the other side of the curved part on one and the same surface side of the moving handrail as the radiation emitting portion is disposed so as to put the curved part between the radiation emitting portion and the radiation receiving portion.

[Claim 5]

A moving handrail deterioration diagnosing method according to Claim 4, characterized in that:

the radiation emitting portion and the radiation receiving portion are disposed so that a summit part of the steel cord in the curved part can be irradiated.