METHOD FOR CONTROLLING OPENING AND CLOSING OF PLATFORM SCREEN DOOR

Disclosed is a method for controlling a screen door using a train detection sensor array that is arranged along the longitudinal direction of a platform. The method for controlling the screen door includes a first step for allowing the screen door to be opened in a case where a train is not detected by a head portion train detection sensor of the sensor array and the train is detected by at least some of the remaining successive train detection sensors except for the head portion train detection sensor.
Description

TECHNICAL FIELD

[0001] The present invention relates to a technology of controlling opening and closing of a platform screen door including a vertically openable door.

BACKGROUND ART

[0002] Passengers located on a platform for a train may fall to a railway or collide with a moving car. To prevent such accidents, a laterally openable platform screen door including laterally openable doors may be installed between a platform and a railway (a platform screen door may be referred to as a platform safety device or platform safety door in the present specification). A laterally openable door may be in one-to-one correspondence to a gate of a train, and be provided in plurality along a platform. A lock device may be installed on a laterally openable door to allow manual opening and closing thereof in an emergency. A person located on a rail side may release the lock device to manually open the laterally openable door in the emergency. A location of a gate of a stopping train should be the same as that of a screen door of a laterally openable platform screen door. Thus, laterally openable platform screen doors cannot be used for a platform at which various trains stop.

[0003] Korean Patent Registration No. 10-0601112 discloses a technology relating to a vertically openable platform screen door. A vertically openable platform screen door according to the technology includes a main body installed between both ends of a platform, a vertically openable door vertically moving along the main body, and a driver vertically moving the vertically openable door. When the vertically openable door has a laterally elongated shape, the vertically openable door may not be in one-to-one correspondence to a gate of a train stopping at the platform. Thus, various types of trains can stop at the platform on which the vertically openable platform screen door is installed.

[0004] Since the vertically openable platform screen door is vertically moved, the head of a passenger may be damaged while the vertically openable platform screen door is closed. In addition, when the vertically openable door has a great lateral length, the weight thereof may be increased so as to need increased energy for driving the vertically openable door. To address these limitations, technologies of vertically openable platform screen doors in the art provide a rope type vertically openable door.

[0005] However, such rope type vertically openable doors cause another limitation. Since laterally openable platform screen doors include a plate type door, when a lock device as described above is installed on a rail side of the plate type door, a person located on a platform side of the plate type door cannot manipulate the lock device. However, when vertically openable platform screen doors include a rope type door, a lock device installed on the rope type door can be manipulated by both persons located at a rail side and a platform side of the rope type door. Such a limitation may be caused by other types of vertically openable doors such as a mesh type door.

[0006] In addition, vertically openable platform screen doors may cause unpredictable safety issues that are not caused by laterally openable platform screen doors. In particular, a method of setting a time point when a screen door is opened or closed may be an issue. Thus, vertically openable platform screen doors need an opening and closing control technology that is different from that of laterally openable platform screen doors.

DISCLOSURE OF THE INVENTION

TECHNICAL PROBLEM

[0007] The present invention provides a novel door opening and closing control technology for preventing a negligent accident from occurring during an operation of a vertically openable platform screen door. An aspect of the present invention provides a technology of controlling a time point when opening or closing of a platform screen door is allowed. Another aspect of the present invention provides a technology of controlling manual opening and closing of a vertically openable platform screen door.

TECHNICAL SOLUTION

[0008] An aspect of the present invention may provide a method for controlling a screen door using a train detection sensor array that is arranged in the longitudinal direction of a platform. The method includes a first step of allowing the screen door to be opened in a case where a train is not detected by a head portion train detection sensor of the sensor array and the train is detected by successive train detection sensors as at least one part of the remaining train detection sensors except for the head portion train detection sensor.

[0009] The screen door may be allowed to be opened only when a velocity of the train is a preset velocity or lower. That is, whether to allow the opening of the screen door may be controlled the velocity of the train. The velocity may be obtained using both a distance between two train detection sensors of the train detection sensor array and information about a time when the train is detected by each of the two train detection sensors. As such, a method of controlling opening of a screen door according to a velocity of a train may be useful when stopping the train at a regular position is difficult. In addition, the method may be useful in cases where various types of trains stop at a platform. In these cases, stop positions may be different according to the types of the trains. When setting of a favorable section according to adjustment of angles of a head portion train detection sensor and a tail portion train detection sensor in a train...
traveling direction is difficult, a velocity of a train may be used as described above to determine whether the train passes by the platform without stopping at the platform or adjusts a location thereof to enter the favorable section. For example, although a train tries to stop at the regular position, the train may stop beyond the head portion train detection sensor. In this case, the train may be moved rearward to be located in the favorable section. At this point, a moving velocity of the train is significantly low, and detection of the train by the head portion train detection sensor is insufficient to determine that the train passes by the platform without stopping at the platform. As such, when a velocity of a train is sufficiently low, it may be correctly determined that the train does not pass by a platform without stopping at the platform and adjusts a location thereof to stop in the favorable section.

[0010] The closing of the screen door may start after the train starts to depart from the platform. Whether the train started to depart or not may be determined using information collected at the train detection sensor array. The closing of the screen door may start after the train completely leaves the platform. Whether the train completely leaves the platform may be determined using information collected at the sensor array.

[0011] The screen door may be allowed to be opened only when the train is not detected by a tail portion train detection sensor of the train detection sensor array.

[0012] In the first step, the screen door that is vertically openable may be allowed to be opened in a case where the train is not detected by the head portion train detection sensor and the tail portion train detection sensor of the train detection sensor array and the train is detected by all of successive train detection sensors as at least one part of the remaining train detection sensors except for the head portion train detection sensor and the tail portion train detection sensor.

[0013] When the train is detected by the head portion train detection sensor, the opening of the screen door that is vertically openable may not be allowed.

[0014] A distance between the head portion train detection sensor and the tail portion train detection sensor may be greater than the length of the train.

[0015] The head portion train detection sensor and a tail portion train detection sensor may perform a detecting operation in a direction having a predetermined angle from a direction perpendicular to an extension direction of the platform.

[0016] A platform screen door system including the screen door may include: a pair of elevating members comprising a driving part that controls vertical movements of the screen door; and a sensor that detects an object in a front space or a rear space of the screen door. And the platform screen door system may determine whether to allow manual opening and closing of the screen door according to whether the object is detected in the front space or the rear space when detecting external force applied to the screen door.

[0017] When the screen door may be a stop mode, a) the driving part is basically in a lock state, and b) when the external force applied to the screen door is detected, and the object is detected in the rear space, the driving part may be changed from the lock state to a release state, thereby providing a mode of allowing the manual opening and closing.

[0018] Alternatively, when the screen door is a stop mode,

a) the driving part may be basically in a release state, and
b) when the external force applied to the screen door is detected, and the object is not detected in the rear space, the driving part may be changed from the release state to a lock state, thereby providing a mode of preventing the manual opening and closing.

[0019] The driving part may include: a closed-circuit type connector fixed and coupled to the screen door to adjust the vertical movements of the screen door; a rotation member rotating the closed-circuit type connector; and a motor rotating the rotation member.

[0020] The detecting of the external force applied to the screen door may be performed by detecting induced voltage of the driving part generated by the external force.

[0021] The detecting of the external force applied to the screen door may be performed by detecting a movement of a lever installed on the screen door.

[0022] Another aspect of the present invention may provide a vertically openable platform screen door to which the method for controlling the screen door can be applied.

[0023] Another aspect of the present invention may provide a method for controlling a screen door using a train detection train detection sensor array that is arranged in the longitudinal direction of a platform. The screen door is not allowed to be opened in a case where a train is detected by at least one of a head portion train detection sensor and a tail portion train detection sensor of the train detection sensor array and a velocity of the train is a predetermined velocity or higher. The screen door may not be allowed to be opened only when a condition that the train is detected by one or more sensors except for the head portion train detection sensor and the tail portion train detection sensor is additionally satisfied.

ADVANTAGEOUS EFFECTS

[0024] The present invention can provide a novel door opening and closing control technology for preventing a negligent accident from occurring during an operation of a vertically openable platform screen door. An aspect of the present invention can provide a technology of controlling a time point when opening or closing of a platform screen door is allowed. Another aspect of the present invention can provide a technology of controlling manual opening and closing of a vertically openable platform.
<Vertically openable platform screen door>

[0027] Figs. 1(a), 1(b), and 1(c) are a perspective view, a front view, and a bottom view illustrating a vertically openable platform screen door according to an embodiment of the present invention, respectively, and Fig. 1(d) is a view illustrating an application of the vertically openable platform screen door.

[0028] Referring to Figs. 1(a) to 1(d), a platform screen door according to the current embodiment may include a left rope-elevating member 100L and a right rope-elevating member 100R, which are uprightly installed. An upper screen door 11 and a lower screen door 12 may be installed between the left rope-elevating member 100L and the right rope-elevating member 100R. Each of the upper screen door 11 and the lower screen door 12 may include one or more ropes. The upper screen door 11 and the lower screen door 12 may be individually and vertically moved by the left rope-elevating member 100L and the right rope-elevating member 100R.

[0029] Ropes, which are installed between the left rope-elevating member 100L and the right rope-elevating member 100R, may be laterally elongated. In this case, an auxiliary rope-elevating member 100M may be disposed between the left rope-elevating member 100L and the right rope-elevating member 100R to prevent sagging of the ropes.

[0030] In addition, according to embodiments, a horizontal frame 100U may be disposed on the upper parts of the left rope-elevating member 100L and the right rope-elevating member 100R. The horizontal frame 100U may improve structural stability of the platform screen door. A hollow space may be provided in the horizontal frame 100U and accommodate various cables or belts for connecting mechanical or electrical elements installed in the left rope-elevating member 100L, the right rope-elevating member 100R, and/or the auxiliary rope-elevating member 100M. In addition, according to embodiments, a driving motor may be provided to vertically move the upper screen door 11 and the lower screen door 12. Although Fig. 1(a) illustrates that the auxiliary rope-elevating member 100M is uprightly installed on a platform, the auxiliary rope-elevating member 100M may be suspended from the horizontal frame 100U according to another embodiment.

[0031] Referring to Fig. 1(b), the upper screen door 11 and the lower screen door 12 prevent a movement of a person. Referring to Fig. 1(d), the upper screen door 11 and the lower screen door 12 are moved upward to allow a movement of a person. Hereinafter, Fig. 1(b) is considered as a view illustrating a “closed” state of the platform screen door, and Fig. 1(d) is considered as a view illustrating an “open” state of the platform screen door. Referring to Fig. 1(d), when a car 701 arrives at a platform 500, the upper screen door 11 and the lower screen door 12 are moved upward to allow a passenger to freely move between the train 701 and the platform 500.

[0032] In the open state of Fig. 1(d), the upper screen
door 11 and the lower screen door 12 may overlap each other in the upper part of the platform screen door. To this end, the left rope-elevating member 100L and the right rope-elevating member 100R may perform a control process such that a vertical movement distance (or a vertical movement velocity) of the upper screen door 11 is smaller than a vertical movement distance (or a vertical movement velocity) of the lower screen door 12. In addition, referring to Fig. 1(c), the upper screen door 11 may be horizontally spaced apart from the lower screen door 12 such that the upper screen door 11 overlap the lower screen door 12.

[0033] As illustrated in Figs. 1(a) to 1(d), screen doors are classified into the upper screen door 11 and the lower screen door 12, and the upper screen door 11 overlaps the lower screen door 12 in the open state of the platform screen door, thereby decreasing the whole height of the platform screen door. However, the present invention is not limited to the forgoing embodiments. That is, the screen doors may not be classified into two or more upper and lower screen doors as described above. This case increases the whole height of the platform screen door, but does not require individual control of the upper screen door 11 and the lower screen door 12 as illustrated in Figs. 1(a) to 1(d), thereby providing a simpler inner configuration. Alternatively, a vertically openable platform screen door may be formed using vertically movable three or more doors.

<First embodiment of inner driving assembly of vertically openable platform screen door>

[0034] Fig. 2(a) is a view illustrating an example of an inner structure of the left rope-elevating member 100L of Fig. 1(a). Fig. 2(b) is a right side view illustrating the inner structure of Fig. 2(a). Fig. 2(c) is a view illustrating an example of an inner structure of the right rope-elevating member 100R of Fig. 1(a). Fig. 2(d) is a view illustrating an example of an inner structure of the auxiliary rope-elevating member 100M of Fig. 1(a).

[0035] Referring to Fig. 2(a), the left rope-elevating member 100L includes an upper sprocket 14 and a lower sprocket 15, which are connected by a chain 20. The lower sprocket 15 is connected to a driving device 120 such as a rotary motor. The driving device 120 may rotate the upper sprocket 14 and the lower sprocket 15 together.

[0036] The left rope-elevating member 100L includes two rails 111 and 112 which guide a left upper block 140L and a left lower block 130L, respectively. The left upper block 140L and the left lower block 130L may be connected to a rotation shaft of the upper sprocket 14 by second connectors 152, respectively. The upper screen door 11 of Fig. 1(a) may be connected to the left upper block 140L, and the lower screen door 12 of Fig. 1(b) may be connected to the left lower block 130L.

[0037] A balance weight 121 having a weight corresponding to those of the left upper block 140L and the left lower block 130L may be connected to the rotation shaft of the upper sprocket 14. The balance weight 121 may decrease a driving load applied to the driving device 120.

[0038] Referring to Fig. 3(a) (to be described later), the left upper block 140L may include two outer rotation pulleys 43 for installing an outer wire rope 200H of the upper screen door 11, and seven inner rotation pulleys 42 for installing an inner wire rope 201H. In the same manner, the left lower block 130L may include two outer rotation pulleys 33 for installing an outer wire rope 200L of the lower screen door 12, and seven inner rotation pulleys 32 for installing an inner wire rope 201L. The number of rotation pulleys may be changed according to embodiments.

[0039] Referring to Fig. 2(b), a first pulley 150 and a second pulley 151 having a diameter smaller than that of the first pulley 150 rotate about the same axis as that of the upper sprocket 14. The first pulley 150 is connected to the left lower block 130L by one of the second connectors 152, and the second pulley 151 is connected to the left upper block 140L by another of the second connectors 152. The balance weight 121 is connected to the upper sprocket 14 by a first connector 122 and moves in a direction opposite to a moving direction of the left upper block 140L and the left lower block 130L. The upper sprocket 14 is connected to the lower sprocket 15 by the chain 20, and the lower sprocket 15 is rotated by the driving device 120. The chain 20 forms a closed loop. When the lower sprocket 15 rotates, the chain 20 rotates, thereby rotating the upper sprocket 14. The driving device 120 may be controlled by a control part 59.

[0040] Referring to Fig. 2(c), the right rope-elevating member 100R has an inner structure corresponding to that of the left rope-elevating member 100L. However, since the left upper block 140L is connected to a right upper block 140R by the wire ropes 200H, 200L, 201H, and 201L, the right upper block 140R has a structure formed by modifying the left upper block 140L. That is, the right upper block 140R may include two outer rotation pulleys 43 for installing the outer wire rope 200H, and six inner rotation pulleys 42 for installing the inner wire rope 201H. A right lower block 130R has the same configuration as that of the right upper block 140R.

[0041] Referring to Fig. 2(d), the auxiliary rope-elevating member 100M includes the first pulley 150, the second pulley 151, the first connector 122, the second connector 152, and the balance weight 121, as illustrated in Fig. 2(b). Further, the auxiliary rope-elevating member 100M may include an auxiliary upper block 140M corresponding to the left upper block 140L and the right upper block 140R. Further, the auxiliary rope-elevating member 100M may include an auxiliary lower block 130M corresponding to the left lower block 130L and a right lower block 130R.

[0042] The screen doors 11 and 12 and the blocks 140L, 140R, 130L, 130R are separately described in the present specification, but would be re-defined as “a screen door” as a whole.
Fig. 3(a) is a view illustrating the outer wire ropes 200H and 200L and the inner wire ropes 201H and 201L installed between a pair of the rope-elevating members 100R and 100L of Fig. 1(a). Referring to Fig. 3a, the upper blocks 140L and 140R and the lower blocks 130L and 130R are moved downward to prevent a movement of a person.

The outer wire rope 200H and the inner wire rope 201H, as two types of wire ropes, may be installed between the left upper block 140L and the right upper block 140R. The outer wire rope 200H may be supported by the four outer rotation pulleys 43, and both ends thereof may be fixed by a first coupler 61 and be coupled thereto. The inner wire rope 201H may be supported by the thirteen inner rotation pulleys 42, and both ends thereof may be fixed by a second coupler 62 and be coupled thereto. The outer wire rope 200H and the inner wire rope 201H may form “the upper screen door 11”.

In the same manner, the outer wire rope 200L and the inner wire rope 201L, as two types of wire ropes, are installed between the left lower block 130L and the right lower block 130R. The outer wire rope 200L and the inner wire rope 201L may form “the lower screen door 12”.

The outer wire ropes 200H and 200L are disposed outside of the inner wire ropes 201H and 201L and may have a lower flexibility or higher elasticity than the inner wire ropes 201H and 201L. In this case, the outer wire ropes 200H and 200L may be formed of the same material as that of the inner wire ropes 201H and 201L, and include a thicker wire than that of the inner wire ropes 201H and 201L. Alternatively, the outer wire ropes 200H and 200L may be formed of a material having a coefficient of elasticity different from that of a material for the inner wire ropes 201H and 201L. That is, the outer wire ropes 200H and 200L and the inner wire ropes 201H and 201L may be different types of wire ropes.

Fig. 3b illustrates a state in which the upper blocks 140L and 140R and the lower blocks 130L and 130R of the platform screen door of Fig. 3a are moved upward to allow a movement of a person. Referring to Fig. 3b, the auxiliary rope-elevating member 100M is disposed between the left rope-elevating member 100L and the right rope-elevating member 100R. According to another embodiment, the auxiliary rope-elevating member 100M may be removed.

Six platform screen doors 1001 to 1006 (in which the auxiliary rope-elevating member 100M is omitted) as illustrated in Fig. 1(a) are continuously arrayed in the platform screen door system illustrated in Fig. 4(a). For example, the platform screen door system may be used as a safety device of a platform for a train of six cars 701 to 706 as illustrated in Fig. 4(b). Referring to Fig. 4(b), the lateral length of one platform screen door may correspond to that of one car.

Alternatively, unlike Fig. 4(b), a train having a car of which has a lateral length smaller or greater than that of the lateral length of one platform screen door, may stop at the platform. In this case, a stop location of the train can be appropriately adjusted, and thus, the platform screen door system illustrated in Fig. 4(a) can completely control a safety of a passenger located at the platform and a movement of a passenger through a gate installed on the train.

Figs. 5(a) and 5(b) are a front view (for example, at a platform side) and a rear view (for example, at a rail side), respectively, illustrating a platform screen door including an object detection sensor according to another embodiment of the present invention. Figs. 5(c) and 5(d) are left and right views, respectively, from line A-A’ of the platform screen door of Fig. 5(a). Fig. 5(e) is a view illustrating a state in which a train arrives at a platform. Referring to Figs. 5(a) and 5(b), the platform screen door 1001 is formed by providing a transmission front sensor TX_FS, a reception front sensor RX_FS, a transmission rear sensor TX_BS, and a reception rear sensor RX_BS on the platform screen door of Fig. 1(a). The term “front” means the platform side, and the term “rear” means the rail side. For convenience in description in Figs. 5(a) and 5(b), the auxiliary rope-elevating member 100M of Fig. 1(a) is omitted, and the upper screen door 11 and the lower screen door 12 are opened upward.

The transmission front sensor TX_FS and the reception front sensor RX_FS may be installed on a front surface of the left rope-elevating member 100L and a front surface of the right rope-elevating member 100R, respectively. The transmission rear sensor TX_BS and the reception rear sensor RX_BS may be installed on a rear surface of the left rope-elevating member 100L and a rear surface of the right rope-elevating member 100R, respectively. For example, the transmission front sensor TX_FS transmits an object detection signal df1 such as an infrared ray, the reception front sensor RX_FS may receive the object detection signal df1. When the reception front sensor RX_FS fails to receive the object detection signal df1, it may be determined that an object such as a person is located between the transmission front sensor TX_FS and the reception front sensor RX_FS, that is, at the front side of the platform screen door 1001.

In the same manner, the transmission rear sensor TX_BS and the reception rear sensor RX_BS may
use an object detection signal db1 to determine whether an object such as a person is located at the rear side of the platform screen door 1001.

[0055] While the transmission front sensor TX_FS and the reception front sensor RX_FS are used to detect whether an object is located at the front side of the platform screen door 1001 according to the foregoing embodiment, an infrared image sensor may be used to detect whether an object is located at the front side of a platform screen door according to another embodiment. In this case, a person having body heat is detected without using a transmission sensor and a reception sensor. This case may be applied to a configuration of a sensor for detecting whether an object is located at the platform side. To sum up, the present invention is not limited to a specific shape of a sensor for detecting whether an object is located at the front and rear sides of a screen door.

[0056] For example, the platform screen door 1001 of Figs. 5(a) and 5(b) may be used as an element of the platform screen door system of Fig. 4(a).

<Example of control scenario of manual opening and closing of vertically openable platform screen door>

[0057] The platform screen doors described with reference to Figs. 1(a) to 5(e) may have a lateral length of several or greater meters (for example, 10 m or 20 m). Thus, the upper and lower screen doors 11 and 12 may have a lateral length of several meters. Hence, a decrease of the weight of the upper and lower screen doors 11 and 12, and a structure for improving durability thereof are needed. To this end, the upper and lower screen door 11 and 12 may be provided in the form of a rope, as described above. Alternatively, according to another embodiment, at least one of the upper and lower screen door 11 and 12 may be provided in the form of a plate.

[0058] When the upper and/or lower screen door 11 and/or 12 is provided in the form of a rope and is closed, a person located on a platform may try to manually open the upper and/or lower screen door 11 and/or 12 upward, holding a rope thereof. That is, the person may try to manually open or close a platform screen door at a platform side. At this point, it is not allowed to manually open or close the platform screen door, the trying is prevented, thereby preventing a negligent accident at the platform. Cases in which manual opening and closing of a platform screen door are allowed may be variously provided according to scenarios. For example, a scenario may be provided as illustrated in Figs. 6(a) or 6(b).

[0059] Figs. 6(a) or 6(b) are tables illustrating examples of a scenario of manual opening and closing of a platform screen door according to an embodiment of the present invention.

[0060] Referring to Figs. 6(a) and 6(b), first and second scenarios have a combination of four cases according to whether an object is located at each of a platform side and a rail side. An object located at the platform side may be detected by the transmission front sensor TX_FS and the reception front sensor RX_FS, and an object located at the rail side may be detected by the transmission rear sensor TX_BS and the reception rear sensor RX_BS.

When an object such as a person is detected by the sensors TX_FS, RX_FS, TX_BS, and RX_BS, wordings “detected” are displayed in Figs. 6(a) and 6(b). When an object such as a person is not detected by the sensors TX_FS, RX_FS, TX_BS, and RX_BS, wordings “not detected” are displayed in Figs. 6(a) and 6(b).

[0061] "Cases 2" and "cases 4" in Figs. 6(a) and 6(b) are cases in which an object is detected at the rail side. Cases, in which passengers attempt an emergency escape from a train stopping at the rail side, or a fallen person attempts an escape from a railway to the platform side, may correspond to "cases 2" and "cases 4". Thus, in these cases, manual opening and closing of a platform screen door should be allowed, regardless of whether an object is located at the platform side. Thus, when "cases 2" and "cases 4" are detected, the platform screen door may be in a release or unlock state. The release state may mean, for example, a state in which a rotation shaft of the driving device 120 of Fig. 3b is not controlled by electric power and is freely rotated by external force. The release state of the platform screen door may mean that the driving device 120 as a driving part for driving the platform screen door is in a release state.

[0062] In "cases 1", an object is not detected at the rail side, and an object is detected at the platform side. If the manual opening and closing of the platform screen door are allowed in these cases, and the platform screen door is manually opened, a person located at the platform side may fall to the rail side and have an accident. Thus, the manual opening and closing of the platform screen door may not be allowed in "cases 1". Accordingly, the platform screen door may be in a lock state.

[0063] "Case 3" of the first scenario of Fig. 6(a), and "case 3" of the second scenario of Fig. 6(b) are cases in which an object is not detected at the platform side and the rail side. It may be determined in these cases that a person trying to manually open and close the platform screen door is not located at the platform screen door. Thus, the platform screen door may set to any one of the lock state and the release (unlock) state in "cases 3".

[0064] The first and second scenarios are just examples, and another scenario or a more specific scenario formed by adding another condition to the conditions of the first and second scenarios may be provided.

[0065] In addition, a first structure for setting the platform screen door to the lock state or the unlock state according to a specific scenario may be provided as described above, and simultaneously, a second structure for setting the platform screen door to the lock state or the release state may be provided. The first and second structures may be prioritized.
<First embodiment>

[0066] A platform screen door according to an embodiment of the present invention will now be described with reference to Figs. 1(a) to 6(b).

[0067] The platform screen door may include: one or more of screen doors 11 and 12 which are vertically openable; a pair of elevating members 100L and 100R for controlling vertical movements of the screen doors 11 and 12; and one or more sensors for detecting an object in front and rear spaces of the screen doors 11 and 12. The elevating members 100L and 100R allow manual opening and closing of the screen doors 11 and 12, and the platform screen door determines whether to allow the manual opening and closing of the screen doors 11 and 12 according to a combination of cases according to whether an object is detected in the front space and whether an object is detected in the rear space.

[0068] The sensor may include front sensors TX_FS and RX_FS and rear sensors TX_BS and RX_BS of the elevating members 100L and 100R. However, the present invention is not limited thereto. For example, referring to Figs. 7(a) and 7(b), the sensor may be constituted by a front sensor FS and a rear sensor BS. Alternatively, referring to Figs. 7(c) and 7(d), the sensor may be constituted by a sensor IS that detects the front and rear sides thereof.

[0069] Figs. 7(a) and 7(b) illustrate a modified example of the sensor configuration of Figs. 5(a) to 5(e). The front sensor FS and the rear sensor BS may be installed on front and rear surfaces of an upper frame 100U of a platform screen door 1001, respectively. The front sensor FS may detect an object at a platform side of the platform screen door 1001 (within a range corresponding to an angle θ), and the rear sensor BS may detect an object at a rail side of the platform screen door 1001 (within a range corresponding to the angle θ). The front sensor FS as illustrated in Figs. 7(a) and 7(b) is not divided into a transmission sensor and a reception sensor. However, for example, when the front sensor FS is constituted by a photo sensor such as an infrared sensor, whether a person is present is determined using a color temperature output from the front sensor FS. Thus, the rear sensor BS can be realized. The rear sensor BS can be realized in this manner.

[0070] Figs. 7(c) and 7(d) illustrate another modified example of the sensor configuration of Figs. 5(a) to 5(e). The sensor IS may be installed under the upper frame 100U of the platform screen door 1001. The sensor IS may detect an object at the platform side and the rail side of the platform screen door 1001 (within a range corresponding to an angle 2θ). The sensor IS as illustrated in Figs. 7(c) and 7(d) is not only not divided into a transmission sensor and a reception sensor, but also not divided into a front sensor and a rear sensor. However, for example, when the sensor IS is constituted by a photo sensor such as an infrared sensor, whether a person is present at the front and rear sides of the sensor IS is determined using a color temperature output from the sensor IS. Thus, the sensor IS can be realized.

[0071] Furthermore, any sensor can be applied to the present invention, provided that an object located at the platform side of a surface of a platform screen door and an object located at the rail side thereof are distinguished from each other and are detected by the sensor.

[0072] In this case, the platform screen door may allow manual opening and closing when detecting that an object is located in the rear space as described above. Alternatively, the platform screen door may prevent the manual opening and closing when detecting that an object is located in the front space, and an object is not located in the rear space. Such operations may be controlled by a control part 59. The control part 59 may communicate with a central control device provided separately from the platform screen door. For example, the central control device may be a main control device 43 illustrated in Fig. 13. When the control part 59 detects external force applied to a driving device 120 in a stop state, the control part 59 may control the driving device 120 to resist the external force.

[0073] In this case, when the driving device 120 is maintained in the stop state, vertical locations of the screen doors 11 and 12 may not be changed. For example, such a result may be obtained from a structure of the rope-elevating member 100L according to the embodiment as illustrated in Figs. 2(a) to 2(d). In this case, the driving device 120 may be a rotary motor, and the external force may be external torque applied a rotation shaft of the rotary motor. Alternatively, the driving device 120 may be a linear motor, and the external force may be force applied a movable part of the linear motor.

[0074] In this case, the control part 59 may detect induced voltage of the driving device 120 generated by the external force. For example, when the driving device 120 is a rotary motor, voltage is applied to a winding of the rotary motor to rotate a rotator of the rotary motor. On the contrary, when the rotator of the rotary motor is forcibly rotated, induced voltage is generated at the winding. That is, the rotary motor may be used as a generator. This manner may be applied to the linear motor. Thus, when external force is applied to a movable part (or a rotator) of the driving device 120 as described above, induced voltage is generated at a winding of the driving device 120. This is well known in the field of electrical technologies and can be applied to the present invention.

[0075] The control part 59 may drive the driving device 120 in a mode of vertically moving the screen doors 11 and 12; release the driving of the driving device 120 when the external force is not applied in a mode of maintaining the screen doors 11 and 12 in a stop state; and control the driving device 120 to resist the external force when the external force is applied in the mode of maintaining the screen doors 11 and 12 in the stop state. The term "release" may mean that electric power for operating the movable part (or the rotator) of the driving device 120 is not consumed.
<Second embodiment>

A platform screen door according to another embodiment of the present invention will now be described with reference to Figs. 1(a) to 3(b).

The platform screen door includes: one or more of screen doors 11 and 12 which are vertically openable; and a pair of elevating members 100L and 100R installed at the left and right sides of the screen doors 11 and 12 to control vertical movements of the screen doors 11 and 12. Each of the elevating members 100L and 100R includes: closed-circuit type connectors 20L and 20S fixed and coupled to the screen doors 11 and 12 to adjust the vertical movements of the screen doors 11 and 12; rotation members 14L, 14S, 15L, and 15S rotating the closed-circuit type connectors 20L and 20S; a driving device 120 rotating the rotation members 14L, 14S, 15L, and 15S; and a control part 59 controlling an operation of the driving device 120. When the control part 59 detects external force applied to the driving device 120 in a stop state, the control part 59 may control the driving device 120 to resist the external force.

Furthermore, the first embodiment and the other elements set forth in the detailed description of the present invention may be combined with the platform screen door of the second embodiment.

<Third embodiment>

A platform screen door according to another embodiment of the present invention will now be described.

The platform screen door includes: one or more of screen doors 11 and 12 which are vertically openable; a pair of elevating members 100L and 100R including driving parts 59, 120, 20L, 20S, 14L, 14S, 15L, and 15S for controlling vertical movements of the screen doors 11 and 12; and sensors RX_FS, RX_BS, TX_F8, TX_BS, FS, BS, and IS for detecting an object in a front or rear space of the screen doors 11 and 12. When external force applied to the screen doors 11 and 12 is detected, whether to allow manual opening and closing of the screen doors 11 and 12 is determined according to whether an object is detected in the front or rear space. At this point, states of the screen doors 11 and 12 may be divided into a stop mode and a motion mode. The motion mode may be an upward or downward motion for changing an open or closed state of a screen door, and the stop mode may be a state in which the screen door has been moved upward or downward.

When the screen doors 11 and 12 are in the stop mode, a) the driving parts 59, 120, 20L, 20S, 14L, 14S, 15L, and 15S may be basically in a lock state. b) When external force applied to the screen doors 11 and 12 is detected, and an object is detected in the rear space, the driving parts 59, 120, 20L, 20S, 14L, 14S, 15L, and 15S may be changed from the lock state to a release state, thereby providing a mode of allowing the manual opening and closing of the screen doors 11 and 12. The stop mode may mean a state in which the screen doors 11 and 12 have been moved downward.

The lock state may mean a state in which, for example, when the driving parts 59, 120, 20L, 20S, 14L, 14S, 15L, and 15S includes a rotary motor, the rotary motor is actively controlled to prevent a rotation shaft of the rotary motor from rotating even though external force is applied to the rotation shaft. Alternatively, when the driving parts 59, 120, 20L, 20S, 14L, 14S, 15L, and 15S includes a linear motor, the lock state may mean a state in which the linear motor is actively controlled to prevent a movable part of the linear motor from moving relative to a stationary part even though external force is applied to the movable part.

The release state is opposite to the lock state. For example, the release state means a state in which when external force is applied to the rotation shaft of the rotary motor, the rotation shaft is freely rotated by the external force, or a state in which when external force is applied to the movable part of the linear motor, the movable part is freely moved relative to the stationary part by the external force.

Alternatively, according to the current embodiment, when the screen doors 11 and 12 are in the stop mode, a) the driving parts 59, 120, 20L, 20S, 14L, 14S, 15L, and 15S may be basically in the release state. b) When external force applied to the screen doors 11 and 12 is detected, and an object is not detected in the rear space, the driving parts 59, 120, 20L, 20S, 14L, 14S, 15L, and 15S may be changed from the release state to the lock state, thereby providing a mode of preventing the manual opening and closing of the screen doors 11 and 12.

When the external force applied to the screen doors 11 and 12 is detected, the driving parts 59, 120, 20L, 20S, 14L, 14S, 15L, and 15S may control the screen doors 11 and 12 at least not to move downward.

The detecting of the external force applied to the screen doors 11 and 12 may be performed by detecting induced voltage generated according to a movement of a driving part (a rotation shaft) of a driving device as described above by the external force.

Alternatively, the detecting of the external force applied to the screen doors 11 and 12 may be performed by detecting a movement of a lever installed on the screen doors 11 and 12.

Such an example using a lever is included in a platform screen door as illustrated in Fig. 8. An upper screen door 11 and a lower screen door 12 as illustrated in Fig. 8 may be rope type screen doors as illustrated in Fig. 3(a). A lever 310 may be installed on the lower screen door 12. Movable parts 320 including sensors may be formed at both ends of the lever 310. When a person pulls the lever 310 upward, the movable parts 320 may be moved, and the sensors included in the movable parts 320 may generate a detecting signal denoting that external force is applied to a screen door. The detecting signal
may be transmitted to a driving part as described above. The sensors may be switches having an electrical contact point, or be formed using a piezoelectric device that generates an electric signal according to deformation there- 

[0090] As described above, various methods of detect- 

[0091] A lateral openable screen door according to the 

[0092] However, a rope type screen door according to an 

[0093] A platform screen door according to an embed- 

[0094] Fig. 9 is a plan view illustrating a state in which a 

[0095] Fig. 10(a) is a table illustrating output results of the train detection sensors 1 to 7 according to positions of the cars 71 to 76 according to an embodiment of the present invention. Numbers 1 to 7 in a first row of Fig. 10(a) denote the train detection sensors 1 to 7, respectively. A mark “O” of Fig. 10(a) means that a car is detected at a corresponding train detection sensor, and a mark “X” means that a car is not detected at a corresponding train detection sensor.

[0096] Figs. 10(b), 10(c), 10(d), and 10(e) illustrate, respectively, positions of the train corresponding to an entry state, a shortfall state, a favorable state, and an extra state, which are shown in Fig. 10(a).

[0097] Referring to Fig. 10(b), when the cars 71 to 76 start to enter the platform 50, only the tail portion train detection sensor 7 outputs a signal denoting that the train is detected. At this point, a screen door opening and closing control device according to an embodiment of the present invention may determine that the train enters the platform 50.

[0098] Referring to Fig. 10(c), the cars 71 to 76 enter the platform 50, and the train detection sensors 2 to 7, except for the head portion train detection sensor 1, output signals denoting that the train is detected. When the head portion train detection sensor 1 does not output a signal denoting that the train is detected, and successive train detection sensors including the tail portion train detection sensor 7 output signals denoting that the train is detected, the screen door opening and closing control device may determine that opening of screen doors is not allowed yet.

[0099] Referring to Fig. 10(d), the cars 71 to 76 enter the platform 50, and the train stops at the regular stop position 88. At this point, the head portion train detection sensor 1 and the tail portion train detection sensor 7 do not output signals denoting that the train is detected, and the train detection sensors 2 to 6 output signals denoting that the train is detected. When the head portion train detection sensor 1 and the tail portion train detection sensor 7 do not output signals denoting that the train is detected, and successive sensors as at least one part of the train detection sensors 2 to 6 output signals denoting that the train is detected, the screen door opening and closing control device may determine that opening of screen doors is not allowed yet.

[0100] Referring to Fig. 10(e), the cars 71 to 76 enter the platform 50, and the train stops beyond the regular stop position 88. At this point, the tail portion train detection sensor 7 does not output a signal denoting that the train is detected, and the train detection sensors 1 to 6 output signals denoting that the train is detected. When the head portion train detection sensor 1 outputs a signal denoting that the train is detected, the screen door opening and closing control device may determine that the
opening of the screen doors is not allowed.

Fig. 11(a) is a table illustrating output results of the train detection sensors 1 to 7 according to positions of cars 171 to 174, a train of which is different from the train of Fig. 10(a), according to an embodiment of the present invention. Figs. 11(b), 11(c), 11(d), 11(e), and 11(f) illustrate, respectively, positions of the train corresponding to an entry state, a shortfall state, a first favorable state, a second favorable state, and an excess state, which are shown in Fig. 11(a).

Since the train of the cars 171 to 174 to which an algorithm of Fig. 11(a) is applied is shorter than the train of the cars 71 to 76 as illustrated in Fig. 10(a), the output results of the train detection sensors 1 to 7 of Fig. 11(a) are different from those of Fig. 10(a).

Referring to Fig. 11(b), when the cars 171 to 174 start to enter the platform 50, only the tail portion train detection sensor 7 outputs a signal denoting that the train is detected. When the train is detected, the head portion train detection sensor 1 and the tail portion train detection sensor 7 operate a detecting operation in the head portion train detection sensor 1 and the tail portion train detection sensor 7 do not output signals denoting that the train is detected, and the train detection sensors 2 to 5 that are successive sensors as at least one part of the train detection sensors 2 to 6 output signals denoting that the train is detected, the screen door opening and closing control device may determine that the opening of the screen doors is allowed.

Referring to Fig. 11(f), the cars 171 to 174 enter the platform 50, and the train stops beyond the regular stop position 88. At this point, the tail portion train detection sensor 7 does not output a signal denoting that the train is detected, and the train detection sensors 1 to 5 output signals denoting that the train is detected. When the head portion train detection sensor 1 outputs a signal denoting that the train is detected, the screen door opening and closing control device may determine that opening of the screen doors is not allowed. When the screen doors are opened, and the head portion train detection sensor 1 outputs a signal denoting that the train is detected, the screen door opening and closing control device may be ready to close the screen doors. That is, the closing of the screen doors may be allowed.

As in the embodiments described with reference to Figs. 10(a) and 11(a), when the head portion train detection sensor 1 and the tail portion train detection sensor 7 do not output signals denoting that the train is detected, and successive sensors as at least one part of the train detection sensors 2 to 6 output signals denoting that the train is detected, the screen door opening and closing control device may determine that the opening of the screen doors is not allowed yet.

Referring to Fig. 11(d), the cars 171 to 174 completely enter the platform 50. At this point, the head portion train detection sensor 1 and the tail portion train detection sensor 7 do not output signals denoting that the train is detected, and the train detection sensors 3 to 6 output signals denoting that the train is detected. When the head portion train detection sensor 1 and the tail portion train detection sensor 7 do not output signals denoting that the train is detected, and the train detection sensors 2 to 6 output signals denoting that the train is detected, the screen door opening and closing control device may determine that the opening of the screen doors is allowed. At this point, the train of the cars 171 to 174 does not stop at the regular stop position 88 yet, but the cars 171 to 174 have entered the platform 50. Thus, the screen door opening and closing control device may determine that the opening of the screen doors is allowed.

Referring to Fig. 11(e), the cars 171 to 174 enter the platform 50, and the train stops at the regular stop position 88. At this point, the head portion train detection sensor 1 and the tail portion train detection sensor 7 do not output signals denoting that the train is detected, and the train detection sensors 2 to 5 output signals denoting that the train is detected. When the head portion train detection sensor 1 and the tail portion train detection sensor 7 do not output signals denoting that the train is detected, and the train detection sensors 2 to 5 that are successive sensors as at least one part of the train detection sensors 2 to 6 output signals denoting that the train is detected, the screen door opening and closing control device may determine that the opening of the screen doors is allowed.

Referring to Fig. 11(f), the cars 171 to 174 enter the platform 50, and the train stops beyond the regular stop position 88. At this point, the tail portion train detection sensor 7 does not output a signal denoting that the train is detected, and the train detection sensors 1 to 5 output signals denoting that the train is detected. When the head portion train detection sensor 1 outputs a signal denoting that the train is detected, the screen door opening and closing control device may determine that opening of the screen doors is not allowed. When the screen doors are opened, and the head portion train detection sensor 1 outputs a signal denoting that the train is detected, the screen door opening and closing control device may be ready to close the screen doors. That is, the closing of the screen doors may be allowed.

The embodiments described with reference to Figs. 10(a) to 11(f) may use a configuration as illustrated in Fig. 12(a) or 12(b) such that when a train stops at a regular stop position, the head portion train detection sensor 1 and the tail portion train detection sensor 7 do not output signals denoting that the train is detected.

Referring to Fig. 12(a), a distance L2 between a head portion train detection sensor 1 and a tail portion train detection sensor 7 is greater than a length L1 of a train stopping at a platform 50. This configuration may be used to realize the embodiments described with reference to Figs. 10(a) to 11(f).

Referring to Fig. 12(b), a distance L2 between a head portion train detection sensor 1 and a tail portion train detection sensor 7 is substantially the same as a length L1 of a train stopping at a platform 50. When the head portion train detection sensor 1 and the tail portion train detection sensor 7 perform a detecting operation in a direction perpendicular to a railway 80, and the train stops at a regular position, all train detection sensors may detect the train. Thus, it may be difficult to realize the embodiments described with reference to Figs. 10(a) to 11(f). Thus, when the configuration as illustrated in Fig. 12(b) is used, the head portion train detection sensor 1 and the tail portion train detection sensor 7 may be in-
clined outward at a predetermined angle from the direction perpendicular to the railway 80, as illustrated in Figs. 12(c) and 12(d). Alternatively, the head portion train detection sensor 1 and the tail portion train detection sensor 7 may be configured to detect the outsides thereof as illustrated in Figs. 12(c) and 12(d), without being physically inclined at the predetermined angle.

According to the embodiments described with reference to Figs. 10(a) to 11(f) and other embodiments, opening of screen doors may be allowed under a first condition in which: a head portion train detection sensor 1 does not output a signal denoting that a train is detected; and at least one part of train detection sensors 2 to 7, as successive sensors except for the head portion train detection sensor 1, output signals denoting that the train is detected. That is, the first condition may include a case in which the tail portion train detection sensor 7 outputs a signal denoting that the train is detected. Thus, it may be determined under the first condition that the train arrives at a platform 50. Since a velocity of the train arriving at the platform 50 is decreased, even when the opening of the screen doors is allowed before the train stops at a regular position, the possibility of a negligent accident is low.

The train may pass by the platform 50, without stopping at the platform 50. In this case, when the opening of the screen doors is allowed under the first condition, since the train may pass by the platform 50 at a high velocity, the possibility of a negligent accident is high. Thus, the first condition may be used together with a second condition below, thereby determining whether to allow the opening of the screen doors. That is, the second condition relates to whether a velocity of a train is a preset first velocity or lower. When the first and second conditions are simultaneously satisfied, since it may be determined that a velocity of the train entering the platform 50 is decreased, it may be predicted that the train will stop at the platform 50, and the opening of the screen doors may be allowed.

At this point, the velocity of the train may be measured using the train detection sensors 1 to 7. That is, for example, a distance between the train detection sensors 6 and 7 is a previously determined value, and a difference value between times when the train is detected at the train detection sensors 6 and 7 is determined, thereby calculating the velocity of the train. The calculating of the velocity of the train may be performed by a processing device such as the main control device 43 to be described later with reference to Fig. 13.

A part performing an algorithm of controlling opening and closing of screen doors by using conditions as shown in Figs. 10(a) and 11(a) may be included in, for example, the main control device 43 of Fig. 13. A part performing an algorithm of controlling manual opening and closing of screen doors by using two scenarios as shown in Figs. 6(a) and 6(b) may be included in, for example, the main control device 43, individual control panels 31 to 36 of Fig. 13, or the control part 59 of Fig. 2(b).

According to the embodiments described with reference to Figs. 10(a) to 11(f) and other embodiments, opening of screen doors may be allowed under a first condition in which: a head portion train detection sensor 1 does not output a signal denoting that a train is detected; and at least one part of train detection sensors 2 to 7, as successive sensors except for the head portion train detection sensor 1, output signals denoting that the train is detected. That is, the first condition may include a case in which the tail portion train detection sensor 7 outputs a signal denoting that the train is detected. Thus, it may be determined under the first condition that the train arrives at a platform 50. Since a velocity of the train arriving at the platform 50 is decreased, even when the opening of the screen doors is allowed before the train stops at a regular position, the possibility of a negligent accident is low.

The train may pass by the platform 50, without stopping at the platform 50. In this case, when the opening of the screen doors is allowed under the first condition, since the train may pass by the platform 50 at a high velocity, the possibility of a negligent accident is high. Thus, the first condition may be used together with a second condition below, thereby determining whether to allow the opening of the screen doors. That is, the second condition relates to whether a velocity of a train is a preset first velocity or lower. When the first and second conditions are simultaneously satisfied, since it may be determined that a velocity of the train entering the platform 50 is decreased, it may be predicted that the train will stop at the platform 50, and the opening of the screen doors may be allowed.

At this point, the velocity of the train may be measured using the train detection sensors 1 to 7. That is, for example, a distance between the train detection sensors 6 and 7 is a previously determined value, and a difference value between times when the train is detected at the train detection sensors 6 and 7 is determined, thereby calculating the velocity of the train. The calculating of the velocity of the train may be performed by a processing device such as the main control device 43 to be described later with reference to Fig. 13.

A part performing an algorithm of controlling opening and closing of screen doors by using conditions as shown in Figs. 10(a) and 11(a) may be included in, for example, the main control device 43 of Fig. 13. A part performing an algorithm of controlling manual opening and closing of screen doors by using two scenarios as shown in Figs. 6(a) and 6(b) may be included in, for example, the main control device 43, individual control panels 31 to 36 of Fig. 13, or the control part 59 of Fig. 2(b).
door may be useful for a rope type screen door as well as a plate type screen door as described above. [0123] When the vertically openable screen door is a rope type door, the vertically openable screen door may be moved downward between a first time point when all gates of the train are closed and a second time point when the train completely leaves the platform. At this point, a part of the body of a person may be fitted between ropes and be seriously damaged by a protrusion part of the train. To prevent such a negligent accident, a descent start time point of the vertically openable screen door may be set to a time point after the train completely leaves the platform, according to an embodiment of the present invention. Such setting may be useful for a hard and heavy plate type door as well as the rope type door. This is because when a part of the body of a person is fitted in a space between a descending plate type screen door and a running train, the person may end up dead.

[0124] When a vertically openable platform screen door is installed on a platform at which various trains can stop, a time point when a screen door starts to move downward may be set to a time point after a train starts to depart, not to a time point after all gates of the train are closed. This is because none of all types of trains stopping at the platform can transmit information about whether gates are opened or closed, to a screen door opening and closing control part of the vertically openable platform screen door. It may be determined using the train detection sensors 1 to 7 as described above whether a train departs from the platform. That is, when a train stopping at the platform starts to depart, the train detection sensors 1 to 7 may measure a velocity of the train according to a method as described above. Thus, whether the train stops to depart from the platform, and whether the train completely leaves the platform may be determined. A velocity of the train may be determined using various other techniques [0125] A passenger detection sensor may be installed on a screen door. The passenger detection sensor provides a material for determining a case in which a passenger may be damaged by the screen door. When the case occurs, a control part of the screen door may perform an operation for preventing the passenger from being damaged by the screen door.

[0126] A sensor may be installed on a screen door to prevent wrongful opening and closing of the screen door. That is, a screen door may detect a case in which the screen door is forcibly opened although the screen door should be closed for a safety of a passenger. When the case occurs, a control part of the screen door may maintain the closing of the screen door.

[0127] According to an embodiment of the present invention, although the passenger detection sensor is used, a screen door may be opened simultaneously with the arrival of a train, regardless of an output from the passenger detection sensor.

[0128] Also, technologies as described above can be applied to a vertical openable platform screen door including plate type doors. Thus, the present invention is not limited by specific materials for vertical openable doors, and shapes and forms thereof.


Claims

1. A method for controlling a screen door using a train detection sensor array that is arranged in the longitudinal direction of a platform, the method comprising allowing the screen door to be opened in a case where a train is not detected by a head portion train detection sensor of the sensor array and the train is detected by all of successive train detection sensors as at least one part of the remaining train detection sensors except for the head portion train detection sensor.

2. The method of claim 1, wherein the screen door is allowed to be opened only when the train is not detected by a tail portion train detection sensor of the sensor array.

3. The method of claim 1 or 2, wherein the screen door is allowed to be opened only when a velocity of the train is a preset velocity or lower.

4. The method of claim 3, wherein the velocity is obtained using both a distance between at least two train detection sensors of the train detection sensor...
array and information about a time when the train is detected by each of the at least two train detection sensors.

5. The method of claim 1, wherein when the train is detected by only one of a tail portion train detection sensor and the head portion train detection sensor, and a velocity of the train is a predetermined velocity or higher, the screen door is prevented from being opened.

6. The method of claim 1 or 2, wherein the closing of the screen door starts after the train starts to depart from the platform.

7. The method of claim 6, wherein whether the train started to depart or not is determined using information collected at the train detection sensor array.

8. The method of claim 6, wherein the closing of the screen door starts after the train completely leaves the platform.

9. The method of claim 1, wherein when the train is detected by the head portion train detection sensor or a tail portion train detection sensor, the opening of the screen door that is vertically openable is not allowed.

10. The method of claim 1, wherein the head portion train detection sensor and a tail portion train detection sensor perform a detecting operation in a direction having a predetermined angle from a direction perpendicular to an extension direction of the platform.

11. The method of claim 1, wherein a platform screen door system comprising the screen door comprises: a pair of elevating members comprising a driving part that controls vertical movements of the screen door; and a sensor that detects an object in a front space or a rear space of the screen door, and the platform screen door system determines whether to allow manual opening and closing of the screen door according to whether the object is detected in the front space or the rear space when detecting external force applied to the screen door.

12. The method of claim 11, wherein when the screen door is a stop mode, a) the driving part is basically in a lock state, and b) when the external force applied to the screen door is detected, and the object is not detected in the rear space, the driving part is changed from the release state to a lock state, thereby providing a mode of preventing the manual opening and closing.

13. The method of claim 11, wherein when the screen door is a stop mode, a) the driving part is basically in a release state, and b) when the external force applied to the screen door is detected, and the object is not detected in the rear space, the driving part is changed from the release state to a lock state, thereby providing a mode of preventing the manual opening and closing.

14. The method of claim 11, wherein the driving part comprises: a closed-circuit type connector fixed and coupled to the screen door to adjust the vertical movements of the screen door; a rotation member rotating the closed-circuit type connector; and a motor rotating the rotation member.

15. The method of claim 11, wherein the detecting of the external force applied to the screen door is performed by detecting induced voltage of the driving part generated by the external force.

16. A screen door device comprising: a train detection sensor array that is arranged in the longitudinal direction of a platform; a screen door that is arranged in the longitudinal direction of the platform; and a control device that receives an output signal from the train detection sensor array and generates a signal for controlling opening and closing of the screen door, wherein the control device allows the screen door to be opened in a case where a train is not detected by a head portion train detection sensor of the sensor array and the train is detected by all of successive train detection sensors as at least one part of the remaining train detection sensors except for the head portion train detection sensor.

17. The screen door device of claim 16, wherein when the train is detected by at least one of a tail portion train detection sensor of the sensor array and the head portion train detection sensor, and a velocity of the train is a predetermined velocity or higher, the control device does not allow the screen door to be opened.
### Scenario 1

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<th>Object on Platform Side</th>
<th>Object on Rail Side</th>
<th>State of Lock Device</th>
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<tbody>
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</tr>
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(a)

### Scenario 2

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(b)
[FIG. 10]

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(b)

c

d

e
### (a) Table

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### (b) Diagram

![Diagram](image)

### (c) Diagram

![Diagram](image)

### (d) Diagram

![Diagram](image)

### (e) Diagram

![Diagram](image)

### (f) Diagram

![Diagram](image)
[FIG. 12]
**INTERNATIONAL SEARCH REPORT**

### A. CLASSIFICATION OF SUBJECT MATTER

**B61B 1/02(2006.01)i, E04H 17/08(2006.01)i, E01F 1/00(2006.01)i, E005 15/16(2006.01)i, E005 15/20(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols):

B61B 1/02; B61L 23/00; E005F 15/16; E006B 9/02; B61B 1/00; E04H 17/08; E01F 1/00; E005F 15/20

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models: IPC as above

Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and where practicable, search terms used):

eKOMPASS (KIPO internal) & Keywords: screen, door, sensor, train

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
  - "A" document defining the general state of the art which is not considered to be of particular relevance
  - "D" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  - "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  - "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  - "Q" document of the same patent family

Date of the actual completion of the international search: 28 MARCH 2014 (28.03.2014)

Date of mailing of the international search report: 31 MARCH 2014 (31.03.2014)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office

Government Complex-Daejeon, 159 Seocho-ro, Daejeon 305-761, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

• KR 100601112 [0003]