

Specification

ELEVATOR DOOR DEVICE

Technical field

5 The present invention relates to an elevator door device for opening and closing the entrance/exit to the passenger cage and the entrance/exit to an elevator landing stage when the passenger cage of an elevator arrives at a floor.

Background art

10 An entrance/exit is provided for entering/alighting from the passenger cage of an elevator at the landing stage of each floor of a building. An entrance/exit frame is provided surrounding this entrance/exit, a landing stage door of the
15 sliding door type being provided in this entrance/exit frame, this entrance/exit being open/closed by this landing stage door.

 This landing stage door is normally closed and performs opening/closing operation by receiving driving force from the
20 cage door of the passenger cage when the passenger cage that ascends and descends within the elevator shaft stops at the elevator landing stage on reaching a floor.

 An engagement mechanism is provided in the cage door of the passenger cage for engaging with the landing stage door
25 and transmitting drive originating from the cage door to the landing stage door. On door opening, the cage door that has

the drive force first of all moves in the door opening direction and, after it is moved by a fixed amount or more, the action thereof actuates the engagement mechanism, producing engagement of the cage door and the landing stage door; by this engagement, the drive force of the cage door is transmitted to the landing stage door, causing the landing stage door to move in the door opening direction integrally with the cage door, until it reaches the shutter box.

On door closure (on door-closing or on closing the door), the landing stage door is moved in the door closing direction together with the cage door driven by the cage door, while the engagement of the landing stage door and cage door is still maintained. The engagement between the cage door and the landing stage door produced by this engagement mechanism is released just before the landing stage door reaches the prescribed door closed position.

After this release of their engagement, the cage door moves under its own drive force to the door closed position, achieving door closure, while door closure of the landing stage door is achieved by movement of the landing stage door to the door closed position under drive force provided by a door closer. This closer is constituted by a spring or weight that biases the landing stage door in the door closing direction.

When the cage door and the landing stage door are closed, the engagement of this cage door and landing stage door is

released so that they are mutually separated: consequently, after door closure, the passenger cage can ascend/descend without interference from the landing stage door.

However, in particular in high-rise buildings, when there is a temperature difference between indoors and outdoors, such as for example in winter, there is a strong ascending air current in the elevator shaft and a large air pressure difference is produced between the interior of the elevator shaft, that is shut off by the landing stage doors, and the elevator landing stages.

Consequently, during door closure operation of the landing stage door, although the air pressure difference was eliminated when the landing stage door was open, there is an abrupt increase in air pressure difference immediately prior to the landing stage door being fully closed: thus strong wind pressure acts on the doorway abutment face of the landing stage door and this may even prevent full closure of the landing stage door.

In particular, recently, smoke barrier doors (or smoke partition doors) for improving sealing off in the event of a fire are commonly being adopted and the problem described above of increase in air pressure difference inside and outside the landing stage doors during door closure may even more easily occur.

An effective means of preventing this problem is to increase the self-closing force provided by the closer, as

mentioned above. However, increasing the self-closing force of the closer necessitates a larger spring or weight, giving rise to problems concerning installation space of the elevator.

5 The closer is normally biased in the door closing direction of the landing stage door, so, if the self-closing force of this closer is increased, during door opening of the landing stage door, the landing stage door must always be moved, through the cage door, with a large drive force in the
10 door opening direction, against this self-closing force. This therefore leads to the problem of the drive mechanism tending to become of increased size.

Disclosure of the invention

15 The present invention was made in view of the above, its object being to provide a door device for an elevator whereby complete closure can be achieved by reliably moving the landing stage door to a prescribed door closed position in the event of closure of the landing stage door, without
20 needing to increase the force of the closer.

In order to achieve the above object, a door device for an elevator according to the present invention is constructed as follows. Specifically,

25 a door device for an elevator comprising a landing stage door that opens and closes the entrance/exit of an elevator landing stage and a passenger cage door that opens and closes

the entrance/exit of a passenger cage, in which the cage door is driven by a drive device and, on door opening, when the cage door is moved by a fixed distance from the door closed position in the door opening direction, the cage door is

5 engaged with the landing stage door by this operation by means of an engagement mechanism and by this engagement the landing stage door is moved in the door opening direction integrally with the cage door and, on door closure, when the mutually engaging cage door and landing stage door are
10 integrally moved in the door closing direction until the cage door and landing stage door have approached a position at a fixed distance with respect to the door closed position, transmission of drive force from the cage door to the landing stage door is interrupted by release of the engagement of the
15 engagement mechanism by this operation is characterized in that a toggle spring mechanism is provided whereby, during door closure, the cage door and the landing stage door approach the door closure position, but leaving a fixed distance with respect to this position and, immediately prior
20 to release of the engagement of the cage door and the landing stage door, the landing stage door is engaged with the toggle spring mechanism and the landing stage door is thus resiliently pressed in the door closure direction.

Furthermore, a door device for an elevator according to
25 the present invention may be constructed as follows.
Specifically,

the toggle spring mechanism comprises: a bracket that is freely rotatably mounted on the entrance/exit frame provided so as to surround the entrance/exit of the elevator; a spring member that is linked with this bracket and that resiliently biases this bracket in one direction of rotation when this bracket rotates in this one direction past a neutral position and that, when this bracket rotates in the other direction, resiliently biases this bracket in the other direction of rotation; and an engagement member capable of engagement with the bracket is provided on the landing stage door, characterized in that, when the cage door and the landing stage door move in the door closure direction to approach the door closed position, the landing stage door engages with the bracket through said engagement member and, in addition, the bracket is rotated past the neutral position by the operation of movement of the cage door and the landing stage door in the door closure direction, and, in response to this rotation, the landing stage door is resiliently pressed in the door closure direction by said spring member.

Furthermore, a door device for an elevator according to the present invention may be constructed as follows. Specifically,

the toggle spring mechanism comprises: a bracket that is freely rotatably mounted on the landing stage door; a spring member that is linked with this bracket and that resiliently biases this bracket in one direction of rotation when this

bracket rotates in this one direction past a neutral position and that, when this bracket rotates in the other direction, resiliently biases this bracket in the other direction of rotation; and an engagement member capable of engagement with
5 the bracket is provided on the entrance/exit frame provided so as to surround the entrance/exit of the elevator; characterized in that, when the cage door and the landing stage door move in the door closure direction to approach the door closed position, said bracket of the landing stage door
10 engages with the engagement member and, in addition, the bracket is rotated past the neutral position by the operation of movement of the cage door and the landing stage door in the door closure direction, and, in response to this rotation, said landing stage door is resiliently pressed in the door
15 closure direction by said spring member.

Furthermore, a door device for an elevator according to the present invention may be constructed as follows.
Specifically,

it is characterized in that a buffer member that buffers
20 impact during rotational operation of the bracket is provided in the toggle spring mechanism.

Brief description of the drawings

Figure 1 is a front view showing the condition during
25 door opening of the door device according to a first embodiment of the present invention.

Figure 2 is a front face view showing the condition of a first stage during the door closure operation of the door device.

Figure 3 is a front view showing the condition of a
5 second stage during the door closure operation of the door device.

Figure 4 is a front view showing the condition on completion of door closure of the door device.

Figure 5 is a front view showing a modified example of
10 mounting of a buffer member on a stop of the toggle spring mechanism in the door device.

Figure 6 is a front view showing the condition of a first stage during door closure operation of the door device according to a second embodiment of the present invention.

Figure 7 is a front view showing the condition of a
15 second stage during door closure operation of the door device.

Figure 8 is a front view showing the condition on completion of door closure of the door device.

Figure 9 is a front view showing a modified example of
20 mounting of a buffer member on a stop of the toggle spring mechanism in the door device.

Best mode for carrying out the invention

An embodiment of the present invention is described below
25 with reference to the drawings.

Figure 1 to Figure 4 show a first embodiment. These Figures are front views showing the side of an elevator landing stage from the interior of an elevator shaft provided in the building.

5 An entrance/exit 1 is formed in the wall of the elevator landing stage and an entrance/exit frame 2 is installed in this wall so as to surround this entrance/exit 1. This entrance/exit frame 2 comprises a pair of vertical beams 3a, 3b and a transverse beam 4 spanning the tops of these two
10 vertical beams 3a, 3b; a guide rail 5 is horizontally mounted on the transverse beam 4.

 Numeral 10 is a landing stage door that opens and closes an entrance/exit 1. A hanger 11 is provided at the top of this landing stage door 10. This hanger 11 is freely movably
15 suspended on the guide rail 5 and the entrance/exit 1 is opened/closed by movement of this landing stage door 10 along the guide rail 5.

 A toggle spring mechanism 14 is provided on the transverse beam 4 of the entrance/exit frame 2. This toggle
20 spring mechanism 14 comprises a bracket 15; one end of this bracket 15 is freely rotatably mounted on the transverse beam 4 by means of an axis 16. A U-shaped engagement groove 17 is formed extending from the end on the side of the other end of this bracket 15 towards the intermediate section thereof. The
25 edge on the open-side of this engagement groove 17

constitutes a guide section 18 that opens out in a tapered fashion towards the outside at the end of the bracket 15.

First and second stops 20a, 20b are mounted on the transverse beam 4 positioned on both sides, to the left and right, of the bracket 15 and a spring member 22 comprising for example a coil spring is arranged between practically the middle of the bracket 15 and the transverse beam 4.

The bracket 15 rotates in the clockwise direction and anti-clockwise direction in the Figure about the axis 16, respectively on either side of a neutral position extending practically in the vertical direction. The spring member 22 extends practically vertically so as to run along the center line of this bracket 15 when the bracket 15 is at the neutral position; when the bracket 15 is rotated thence in the clockwise direction, the spring member 22 is tilted downwards in a leftwardly inclined fashion, causing the bracket 15 to be resiliently biased in the clockwise direction; when the bracket 15 is rotated in the anti-clockwise direction, the direction of the spring member 22 is inverted together with the bracket 15, causing the spring member 22 to be tilted downwards in a rightwardly inclined fashion, causing the bracket 15 to be resiliently biased in the anti-clockwise direction.

By the resilient biasing by means of the spring member 22, the bracket 15 can be maintained in bistable condition (in two stable conditions), namely, a condition rotated in the

clockwise direction in abutment with the first stop 20a, or a condition rotated in the anti-clockwise direction, in abutment with the second stop 20b.

5 An engagement pin 25 constituting an engagement member capable of engagement with the engagement groove 17 of the bracket 15 in response to movement of this landing stage door 10 is mounted on the hanger 11 of the landing stage door 10.

Numeral 27 indicated by the chain line in the Figure is a sliding door type cage door that opens and closes the
10 entrance/exit of the passenger cage that ascends and descends in the elevator shaft; an engagement mechanism 28 capable of engagement with the landing stage door 10 is provided on this cage door 27. A drive device (not shown) that drives the cage door 27 is provided on the passenger cage.

15 Normally, as shown in Figure 4, the entrance/exit 1 of the elevator landing stage is closed by the landing stage door 10. In this condition, when the passenger cage that ascends and descends within the elevator shaft reaches the floor of the elevator landing stage, this cage door 27 faces
20 the landing stage door 10. After this, the cage door 27 is driven by the drive device and moves in the door opening direction.

When the cage door 27 has been moved by a very small fixed distance in the door opening direction, the engagement
25 mechanism 28 is actuated by this operation, producing engagement of the cage door 27 and the landing stage door 10;

drive force is transmitted by this engagement from the cage door 27 to the landing stage door 10 and the landing stage door 10 is thereby moved in the door opening direction integrally with the cage door 27 until it reaches the shutter box 30 as shown in Figure 1: the entrance/exit 1 of the elevator landing stage and the entrance/exit of the passenger cage are thereby opened, allowing passengers to board or to alight.

When door closure is performed from this condition, the landing stage door 10 is moved in the door closure direction integrally with the cage door 27, driven by a drive device. The bracket 15 is then held in a stable condition inclined downwards towards the shutter box 30 by abutment with the first stop 20a, as shown in Figure 1.

When the landing stage door 10 reaches the prescribed position by movement in the door closing direction together with the cage door 27, as shown in Figure 2, the engagement pin 25 of the landing stage door 10 enters the engagement groove 17 of the bracket 15. By further movement of the landing stage door 10 in the door closing direction driven by the cage door 27, the engagement pin 25 then moves relatively along the engagement groove 17 and, accompanying this process, the bracket 15 rotates in the anti-clockwise direction about the axis 16 against the resilient force of the spring member 22.

As the rotation proceeds, as shown in Figure 3, when the bracket 15 has rotated to a position very slightly beyond the neutral position i.e. when the landing stage door 10 has reached a position a certain distance in front of the door closure position **S**, the engagement mechanism 28 is actuated by this operation, causing the engagement between the landing stage door 10 and the cage door 27 to be released.

By release of this engagement, transmission of drive force from the cage door 27 to the landing stage door 10 is interrupted, but, at this point, as shown in Figure 4, the bracket 15 has passed the neutral position, so the direction of action of the resilient force of the spring member 22 is inverted, with the result that this now acts as a force causing rotation of the bracket 15 in the anti-clockwise direction i.e. as a force tending to move the landing stage door 10 in the door closure direction. Thus, the landing stage door 10 is precisely pushed in so as to move to the door closure position **S** by this resilient force produced by the spring member 22 and reliable closure is achieved.

Thus, when the landing stage door 10 approaches a position immediately prior to the door closure position **S**, and engagement of the landing stage door 10 and the cage door 27 is thus released, the resilient force of the spring member 22 is applied to the landing stage door 10, so the landing stage door 10 can achieve complete closure by precise movement to the door closure position **S** without needing to

increase the force of the closer that is used to move the landing stage door 10 in the door closure direction.

When the landing stage door 10 has reached the door closure position S, the bracket 15 abuts the second stop 20b and is held in a stable condition inclined downwards towards the right. Also, now that the engagement with the landing stage door 10 has been released, the cage door 27 is moved to the prescribed door closure position by the drive force provided by the drive device, and the entrance/exit of the passenger cage is closed. When respective door closure is achieved by the landing stage door 10 and the cage door 27, the engagement of the landing stage door 10 and the door 27 is released, so ascent/descent of the passenger cage becomes possible.

When the landing stage door 10 moves in the door opening direction from the door closed condition shown in Figure 4, in response to this movement, first of all, the bracket 15 rotates in the clockwise direction against the resilient force of the spring member 22. Then, when the landing stage door 10 has moved a certain distance, the bracket 15 passes the neutral position and the direction of action of the resilient force of the spring member 22 is thereby inverted, and thus acts as a force tending to rotate the bracket 15 in the clockwise direction.

When the landing stage door 10 moves further in the door opening direction, the engagement pin 25 is disengaged from

the engagement groove 17 of the bracket 15 and the bracket 15 is thus stably held by the resilient force of the spring member 22 in a condition inclined towards the left abutting the first stop 20a; the landing stage door 10 stops when it reaches the shutter box 30.

Incidentally, as shown as a modified example in Figure 5, it is possible to mount buffer members 33 made of resilient material such as rubber at the peripheries of the stops 20a, 20b that are abutted by the bracket 15.

With such a construction, impact and noise occurring when the bracket 15 abuts the stops 20a, 20b can be absorbed and buffered by the buffer members 33.

Also, as a further different modified example, it is possible to adopt for example a construction wherein for example sheet-shaped buffer members made of resilient material such as rubber are mounted at both side edges of the bracket 15 so that the bracket 15 abuts the stops 20a, 20b through the intermediary of these buffer members. In this case also, impact and noise occurring when the bracket 15 abuts the stops 20a, 20b can be absorbed and buffered by these buffer members.

Figure 6 to Figure 8 show a second embodiment. In this embodiment, the bracket 15 of the toggle spring mechanism 14 is freely rotatably mounted on a hanger 11 of the landing stage door 10 by means of an axis 16. A spring member 22 is arranged between practically an intermediate section of this

bracket 15 and a transverse beam 4 of the entrance/exit frame 2 and an engagement pin 25 capable of engagement with an engagement groove 17 of the bracket 15 is mounted on the transverse beam 4.

5 In this embodiment, when the landing stage door 10 is moved in the door closure direction, as shown in Figure 6, the bracket 15 abuts the first stop 20a due to the resilient force of the spring member 22 and is thus held in a stable condition inclined upwards.

10 When the landing stage door 10 reaches a prescribed position by movement in the door closure direction together with the cage door 27, the engagement pin 25 of the transverse beam 4 is fitted into the engagement groove 17 of the bracket 15 provided on the landing stage door 10.

15 By further movement of the landing stage door 10 in the door closing direction, the engagement pin 25 is relatively moved along the engagement groove 17 and, accompanying this process, as shown in Figure 7, the bracket 15 is rotated in the anti-clockwise direction about the axis 16 against the
20 resilient force of the spring member 22.

 Then, when the bracket 15 has rotated to a position very slightly past the neutral position, which extends practically in the vertical direction i.e. when the landing stage door 10 has reached a position a certain distance in front of the
25 door closure position **S**, the engagement mechanism 28 is

actuated by this operation and the engagement of the landing stage door 10 and cage door 27 is thereby released.

By the release of this engagement, transmission of drive force from the cage door 27 to the landing stage door 10 is interrupted, but, since at this point the bracket 15 has passed the neutral position, the direction of action of the resilient force of the spring member 22 is inverted, with the result that this force acts as a force tending to rotate the bracket 15 in the anti-clockwise direction i.e. a force tending to move the landing stage door 10 in the door closure direction. The landing stage door 10 is thereby moved precisely to the door closure position **S** and closure is reliably achieved.

In this way, in this embodiment also, when the landing stage door 10 approaches a position immediately prior to the door closure position **S**, and engagement of the landing stage door 10 and the cage door 27 is thus released, the resilient force of the spring member 22 is applied to the landing stage door 10, so the landing stage door 10 can achieve complete closure by precise movement to the door closure position **S** without needing to increase the force of the closer that is used to move the landing stage door 10 in the door closure direction.

When the landing stage door 10 has reached the door closure position **S**, the bracket 15 abuts the second stop 20bb

and is held in a stable condition inclined downwards towards the left.

When the landing stage door 10 moves in the door opening direction from the door closed condition, in response to this movement, first of all, the bracket 15 rotates about the axis 16 in the clockwise direction against the resilient force of the spring member 22. Then, when the landing stage door 10 has moved a certain distance, the bracket 15 passes the neutral position and the direction of action of the resilient force of the spring member 22 is thereby inverted, and thus acts as a force tending to rotate the bracket 15 in the clockwise direction.

When the landing stage door 10 moves further in the door opening direction, the engagement pin 25 is disengaged from the engagement groove 17 of the bracket 15 and the bracket 15 is thus held in a stable condition by the resilient force of the spring member 22 in a condition inclined upwards towards the right abutting the first stop 22a.

In this second embodiment also, as shown as a modified example in Figure 9, it is possible to mount buffer members 33 made of resilient material such as rubber at the peripheries of the stops 20a, 20b that are abutted by the bracket 15.

With such a construction, impact and noise occurring when the bracket 15 abuts the stops 20a, 20b can be absorbed and buffered by the buffer members 33.

Also, as a further different modified example, it is possible to adopt for example a construction wherein for example sheet-shaped buffer members made of resilient material such as rubber are mounted at both side edges of the bracket 15 so that the bracket 15 abuts the stops 20a, 20b through the intermediary of these buffer members. In this case also, impact and noise occurring when the bracket 15 abuts the stops 20a, 20b can be absorbed and buffered by these buffer members.

10 It should be noted that, although, in the embodiments described above, a door device was described of the type opening on one side to open or close an entrance/exit of an elevator landing stage when a single landing stage door was moved in the left or right direction, the present invention
15 could likewise be applied to a door device of the type opening on both sides to open and close an entrance/exit by movement of two landing stage doors mutually symmetrically to left and right, or to a door device of a multi-speed type, in which a plurality of landing stage doors are arranged in
20 different stages to front and rear and an entrance/exit is opened/closed by movement of these landing stage doors with different speeds in the same left/right direction.

However, in a door device of the type opening on both sides or a door device of a multi-speed type as described
25 above, since the construction is such that the remaining landing stage doors move in a linked manner with a single

landing stage door, the toggle spring mechanism of the present invention may be arranged to be incorporated with this single landing stage door.

5 **Industrial applicability**

With the present invention complete closure can be achieved by reliably moving the landing stage door to a prescribed door closed position in the event of closure of the landing stage door, without needing to increase the force
10 of the closer.

Claims

1. A door device for an elevator comprising:
 - a landing stage door that opens and closes an
 - 5 entrance/exit of an elevator landing stage;
 - a cage door that opens and closes an entrance/exit of a passenger cage,
 - wherein said cage door is driven by a drive device and,
 - on door opening, when said cage door is moved by a fixed
 - 10 distance from a door closed position in a door opening direction, said cage door is engaged with said landing stage door by an operation by means of an engagement mechanism and by an engagement said landing stage door is moved in said door opening direction integrally with said cage door and,
 - 15 on door closure, when said mutually engaging cage door and landing stage door are integrally moved in a door closing direction until said cage door and landing stage door have approached a position at a fixed distance with respect to said door closed position, transmission of drive force from
 - 20 said cage door to said landing stage door is interrupted by release of the engagement of said engagement mechanism by an operation, and
 - a toggle spring mechanism whereby, during door closure, said cage door and said landing stage door approach said door
 - 25 closure position, but leaving a fixed distance with respect to said door closure position and, immediately prior to

release of said engagement of said cage door and said landing stage door, said landing stage door is engaged with said toggle spring mechanism and said landing stage door is thus resiliently pressed in said door closure direction.

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2. The door device for an elevator according to claim 1, said toggle spring mechanism comprising:

a bracket that is freely rotatably mounted on an entrance/exit frame provided so as to surround an

10 entrance/exit of said elevator; and

a spring member that is linked with said bracket and that resiliently biases said bracket in one direction of rotation when said bracket rotates in said one direction past a neutral position and that, when said bracket rotates in
15 another direction, resiliently biases said bracket in another other direction of rotation;

wherein an engagement member capable of engagement with said bracket is provided on said landing stage door, and wherein, when said cage door and said landing stage door move
20 in said door closure direction to approach said door closed position, said landing stage door engages with said bracket through said engagement member and, in addition, said bracket is rotated past said neutral position by said operation of movement of said cage door and said landing stage door in
25 said door closure direction, and, in response to a rotation,

said landing stage door is resiliently pressed in said door closure direction by said spring member.

3. The door device for an elevator according to claim 1,
5 said toggle spring mechanism comprising:

a bracket that is freely rotatably mounted on said landing stage door; and

a spring member that is linked with said bracket and that resiliently biases said bracket in one direction of rotation
10 when said bracket rotates in said one direction past a neutral position and that, when said bracket rotates in another direction, resiliently biases said bracket in another direction of rotation;

wherein an engagement member capable of engagement with
15 said bracket is provided on said entrance/exit frame provided so as to surround said entrance/exit of said elevator; and also wherein, when said cage door and said landing stage door move in said door closure direction to approach said door closed position, said bracket of said landing stage door
20 engages with said engagement member and, in addition, said bracket is rotated past said neutral position by said operation of movement of said cage door and said landing stage door in said door closure direction, and, in response to a rotation, said landing stage door is resiliently pressed
25 in said door closure direction by said spring member.

4. The door device for an elevator according to claim 2
or 3,

wherein a buffer member that buffers impact during
rotational operation of said bracket is provided in said

5 toggle spring mechanism.