

TITLE OF THE INVENTION

ELEVATOR DOOR APPARATUS AND INSTALLATION METHOD THEREOF

BACKGROUND OF THE INVENTION

5 Present invention relates an elevator door apparatus and an installation method thereof, especially relates to the elevator door apparatus and the installation method thereof driven by a link mechanism.

A conventional elevator door apparatus driven by the
10 link mechanism is disclosed in Japanese Patent Laid-open No. 57-19272, for example.

In the conventional elevator door apparatus, if the position of combining point of the link is deviated a little, total closed position and total opening position
15 of the door changes sensitively, because a great number of the links are combined.

Accordingly, the connecting points of the every links, in other word, relative angles of every links should be positioned precisely, and in order to make opening and
20 closing movement of the door smoothly, the connecting points of the every links respectively needs to be adjusted.

Moreover in order to make such adjustment more precisely, It should be repeated in total opening and
25 closing condition of the door, there arises a problem to spend great labor and time on installation of the door.

Furthermore, many links are used, when the passenger

opens the door by a manual operation from the inside of the car in order to be rescued in an emergency, a big power of the passenger is needed and there arises a problem that an immediate rescue becomes impossible.

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SUMMARY OF THE INVENTION

The first object of the present invention is to provide an elevator door apparatus which may be installed easily.

10 The second object of the present invention is to provide the elevator door apparatus which may be opened in an elevator car by a small manual operation power in the emergency.

In order to achieve the above object of the present
15 invention, in an elevator car door apparatus having a door provided on the elevator car to be able to move to a horizontal direction, a pair of first links, an end thereof being connected to be rotatable to a part of the elevator car, a pair of second links, an end thereof being
20 connected to be rotatable to other end of said first links, other end of said second links being connected to said door of the elevator car, a third link being connected to a portion between said pair of the first links, and restraining said pair of the first links to rotate in
25 symmetry to a vertical central axis of an entrance of the elevator car, and a driving means to add a rotational power to said pair of first links, said elevator door

apparatus comprising first removable temporary fixing means holding department for restraining a relative angle of said first links and said second links to keep an constant value, second removable temporary fixing means
5 holding department for restraining a relative angle of said second links and said door to keep an constant value, first adjusting means for adjusting position of at least one of two junction points provided between said third link and said first links, and second adjusting means for
10 adjusting a position of a junction point between said driving means and said first links.

As stated above, said first and said second removable temporary fixing means holding departments, and said first and said second adjusting means are provided in the
15 present invention, the installation work to make the relative angle of the respective links reasonable becomes easy, the adjusting work for opening and closing the door is performed in a short time, and the door may be opened by the manual operation easily because the relative angle
20 of every links becomes reasonable.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a front elevation view of the elevator door apparatus as one embodiment of the present
25 invention.

Figure 2 shows a perspective view of a removable temporary fixing means holding department for temporarily

fixing a relative angle between said an auxiliary link and a door of an elevator car.

Figure 3 is a perspective view for showing an example of the construction of a temporary fixing means for the
5 door of the elevator car.

Figure 4 is a perspective view for showing an example used as the temporary fixing means.

Figure 5 is a perspective view for showing an example of the construction of a link fulcrum position adjusting
10 means.

Figures 6A, 6B, 6C, 6D show views for explaining installing order of the elevator door apparatus in an embodiment of the present invention.

Figure 7 shows a front elevation view of an another
15 embodiment of the present invention.

Figure 8 shows a front elevation view of a variation example of the Figure 7.

Figure 9 shows a perspective view of the variation example of the Figure 7.

20 Figure 10 shows a front elevation view of the variation example of the Figure 7.

Figure 11 shows a front elevation view of the variation example of the Figure 10.

25 Figure 12 shows a front elevation view of the variation example of the Figure 11.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of the present invention will be explained relating to a elevator car shown in Figures 1 to 6A, 6B, 6C, 6D.

The numerals 1a, 1b are respective second removable
5 temporary fixing means holding departments for restraining relative angles between doors 6a, 6b and auxiliary links 8a, 8b as second links to be a constant value, 2a, 2b upright frames, 3 car-side sill, 4 door hanger rail, 5 door roller, 7a, 7b fulcrums for supporting said auxiliary
10 links 8a, 8b on said doors 6a, 6b, 9a, 9 b fulcrums for jointing to support main links 10a, 10b on said auxiliary links 8a, 8b, 11a, 11 b fulcrums for supporting main links 10a, 10b on said auxiliary links 8a, 8b, on door machine base, 12a, 12 b fulcrums for supporting link 14 as a third
15 link between the main links 10a, 10b, 15 fulcrum for supporting a power transmitting link 16 for transmitting power to the main links 10a, 17 fulcrum for supporting a power transmitting link 16 to pulley 18, 19 chain, 20, 22 pulleys, 21 a belt, 23 a motor, 28 stopper rubber, and 29
20 stopper.

On said upright frames 2a, 2b constructing frames for the car, the sill 3, the door hanger rail 4 and the door machine base 13 are directly or indirectly installed to be fixed. A center mark 56 showing a center of the door width
25 is provided on the sill 3. Moreover, the door 6a, 6b is supported on the door hanger rail 4 by the door roller 5 on the upper side, and the lower part of the door is

installed to the sill 3 to be movable to a horizontal direction. During the car door 6a, 6b and the driving mechanism, a link mechanism for driving to open and shut the car door 6a, 6b is installed.

5 This link mechanism consists of the auxiliary links 8a, 8b which are installed on the car door 6a, 6b so as to be rotatable around the fulcrum, the main link 10a, 10b connected to the auxiliary links 8a, 8b so as to be rotatable around the fulcrums 9a, 9b, and connected to the
10 door machine base 13 so as to be rotatable around the fulcrums 11a, 11b, the link 14 connected to the main links 10a, 10b so as to be rotatable around the fulcrums 12a, 12b, so as to rotate the main links 10a, 10b almost in symmetry to a vertical central axis of the entrance, and
15 the power transmitting link 16 for connecting the main link 10b with pulley 18 as the drive means through the fulcrums 15, 17.

Thereby, the door 6a, 6b are mutually driven almost symmetrically to right and left directions.

20 The driving means is constituted with a deceleration mechanism which consists of the power transmitting link 16, the pulley 18, the motor 23, the chain 19, the pulley 20, the belt 21, and the pulley 22. The stopper rubber 28 is installed to a head department on pulley 18, rotation
25 range of the pulley 18 is regulated by the stopper 29 that is fixed in the door machine base 13.

As the door for the elevator is constructed as above,

the car doors 6a, 6b respectively open to the right and the left by rotating the motor 23 to anti-clock winding direction.

Numerals 24a, 24b are first temporary fixing means
5 holding departments for restraining a relative angle between the main links 10a, 10b and the auxiliary link 8a, 8b to be a constant value, numeral 26 is first adjustment means for adjusting position of at least one of two
10 junction points 12a, 12b provided between said link 14 and said main links 10a, 10b, numeral 27 is second adjustment means for adjusting position of junction point 15 provided between said driving means and said main links 10b, numerals 25a, 25b removable temporary fixing means,
15 30 plate, 31 to 33, 44, 45, 51 bolts, 34, 35, 37, 38 holes, 36, 39 temporary fixing pin, 40, 41, 49, 53 nuts, 42 body, 42' contacting part, 43 groove, 46, 47 long holes, 54 bearing, 55 means to adjust stopper position, and 57 plate for fixing.

As shown in Fig. 1, the embodiment of the elevator
20 door in accordance with the present invention comprises the removable temporary fixing means 1a, 1b for restraining and temporarily fixing auxiliary links 8a, 8b to an angle with respect to the vertical axis or the horizontal axis of the doors 6a, 6b and the removable
25 temporary fixing means 24a, 24b for restraining main links 10a, 10b to an angle and temporarily fixing the main links to the auxiliary links 8a, 8b, which are provided in the

auxiliary links 8a, 8b; the adjusting means 26, 27 for adjusting junction points between the main link 10b and links 14, 16; and the removable temporary door fixing means 25a, 25b for restraining the car-side doors in a closed state. The embodiment of the elevator door in accordance with the present invention is different in having the above-mentioned construction from the elevator door of the conventional technology explained by Fig. 7.

In the above description, although the adjusting means 26 is provided in the fulcrum 12b side of the link 14, the adjusting means may be provided in the fulcrum 12a side. Further, although the adjusting means 27 is provided in the fulcrum 15 side of the link 16, the adjusting means may be provided in the fulcrum 17 side, or may be replaced a stopper position adjusting means 55 for changing the position of the stopper 29 to be in contact with the stopper rubber 28. Furthermore, although the door temporary fixing means 25a, 25b are attached to the car-side door hanger rail 4, the door temporary fixing means may be attached to the car-side sill side.

An example of the detailed constructions of the removable temporary fixing means 1a and 24a will be described below, referring to Fig. 2. The removable temporary fixing means 1b and 24b can be constructed by changing symmetrically between left-hand side and right-hand side.

As shown in Fig. 2, a plate 30 is fixed using bolts

32 to a fixing plate 57 which is a part of the car-side door 6a. The auxiliary link 8a is rotatably attached in the plate 30 using a bolt 31, a ring 58, a washer 59 and a nut 40. That is, the fulcrum 7a shown in Fig. 1 is
5 composed of the bolt 31, the ring 58, the washer 59 and the nut 40. Further, the main link 10a is rotatably attached to the auxiliary link 8a using a bolt 33, a ring 60, a washer 61 and a nut 41. That is, the fulcrum 9a shown in Fig. 1 is composed of the bolt 33, the ring 60,
10 the washer 61 and the nut 41. However, constructions of the fulcrums 7a, 7b, 9a, 9b need not to be limited to the above-mentioned structure.

The auxiliary link 8a and the plate 30 have holes 35, 34 of the same shape, respectively. By inserting a
15 temporary fixing pin 36 through the holes 35, 34, the auxiliary link 8a can be temporarily fixed in an appropriate angle to the car-side door 6a. That is, the temporary fixing means 1a shown in Fig. 1 is composed of the holes 35, 34 and the temporary fixing pin 36. The
20 auxiliary link 8a and the main link 10a have holes 37, 38 of the same shape, respectively. By inserting a temporary fixing pin 39 through the holes 37, 38, the main link 10a can be temporarily fixed in an appropriate angle to the auxiliary link 8a. That is, the temporary fixing means 24a
25 shown in Fig. 1 is composed of the holes 37, 38 and the temporary fixing pin 39.

An example of the detailed construction of the door

temporary fixing means 25a will be described below, referring to Fig. 3 and Fig. 4. The door temporary fixing means 25b can be constructed by changing symmetrically between left-hand side and right-hand side.

5 As shown in Fig. 3, the door temporary fixing means 25a is composed of a body 42 having an engaging groove 43, a fixing bolt 44 to be inserted into a screw hole provided in the body 42 and a contact portion 42'. The door temporary fixing means 25a is used under the car-side
10 doors 6a, 6b being in the full-closed state in such a manner that, as shown in Fig. 4, the engaging groove 43 is inserted to the car-side door hanger rail 4, the contact portion 42' is brought in contact with the car-side door roller 5 by sliding the temporary fixing means 25a, and
15 the door temporary fixing means 25a is fixed to the car-side door rail 4 by the fixing bolts 44. By fixing the door temporary fixing means 25a, 25b in left-hand side and right-hand side to the car-side door hanger rail 4 as described above, the car-side doors 6a, 6b can be
20 temporarily fixed in the full-closed state.

 An example of the detailed construction of the adjusting means 26 will be described below, referring to Fig. 5.

 A bearing 54 is fixed to the link 14, and a flange
25 50 is rotatably connected to the bearing 54 using a bolt 51, a washer 52 and a nut 53. The flange 50 has a plurality of long holes 47. On the other hand, the main

link 10b has long holes 46 which have a direction of the longitudinal axis different from the of the longitudinal axis of the hole 47, for example, in a direction crossing at nearly right angle to each other. The main link 10b and
5 the flange 50 are connected by a bolt 45, a washer 48 and a nut 49. Since the direction of the longitudinal axis of the long hole 47 different from the of the longitudinal axis of the hole 47, the main link 10b and the flange 50 are connected so that the connecting portion position can
10 be adjusted in the two directions. The construction of the adjusting means 26 shown in Fig. 5 can be similarly applied to the adjusting means 27 provided in the connecting portion of the main link 10b and the link 16.

An embodiment of procedure of installing the
15 elevator door in accordance with the present invention will be described below, referring to Figs. 6A, 6B, 6C, 6D.

Initially, the car-side doors 6a, 6b are temporarily fixed in the full-closed state using the removable door temporary fixing means 25a, 25b, as shown
20 in Fig. 6A. At that time, the car-side doors 6a, 6b are set in such that the center of end portions of the car-side doors 6a, 6b in left-hand side and right-hand side agrees with a center mark 56 provided in the car-side sill 3. Next, the auxiliary links 8a, 8b are connected to the
25 car-side doors 6a, 6b through the fulcrums 7a, 7b. Then, the temporary fixing pins of the removable temporary fixing means 1a, 1b described above are attached to the

auxiliary fixing means 8a, 8b, and the auxiliary links 8a, 8b are fixed by the temporary fixing means 1a, 1b in such that the angle between the auxiliary links 8a, 8b and the vertical axis or the horizontal axis of the car-side doors
5 6a, 6b becomes an appropriate relative angle.

Next, as shown in Fig. 6B, the main links 10a, 10b are attached to the door machine base 13 through the fulcrums 11a, 11b. Further, the main links 10a, 10b are connected with the auxiliary links 8a, 8b through the
10 fulcrums 9a, 9b. Furthermore, the temporary fixing pins of the removable temporary fixing means 24a, 24b described above are attached to the auxiliary links 8a, 8b, and the main links 10a, 10b are temporarily fixed by the temporary fixing means 24a, 24b in such that the angle between the
15 main links 10a, 10b and the auxiliary links 8a, 8b becomes an appropriate relative angle while the positions of the fulcrums 11a, 11b are being adjusted.

Then, as shown in Fig. 6C, the link 14 is attached to the main links 10a, 10b through the fulcrums 12a, 12b.
20 At that time, the above-mentioned adjusting means 26 for adjusting the fulcrum 12a or 12b is kept setting to any one of the both ends of the link 14, but the adjusting means 26 is set to an appropriate value. Further, the link 16 is attached through the fulcrums 15, 17. At that time,
25 since the end portions of the link 16 do not agree completely with the positions of the fulcrums 15, 17 due to accumulation of manufacturing error and installing

error, the adjusting means 27 is provided in any one of the both ends of the link 16 in order to adjust the error. The link 16 is attached by changing the position of the fulcrum 15 or the fulcrum 17 using the adjusting means 27.

- 5 The adjusting means 27 may be replaced by the stopper position adjusting means 55 for changing the position of the stopper 29 to be in contact with the stopper rubber 28 to change the rotating angle of the pulley 18.

Finally, as shown in Fig. 6D, the pins of the door
10 temporary fixing means 25a, 25b and the temporary fixing means 1a, 1b, 24a, 24b are removed, and the car-side doors 6a, 6b are brought in the full-opened state, and the above-mentioned adjusting means 26 is adjusted so that the traveling distances of the car-side doors 6a, 6b in left-
15 hand side and right-hand side in the full-opened state the car-side doors 6a, 6b become appropriate values equal to each other. Therein, by adjusting the position of the fulcrum 12b toward a slanting right upper direction using the adjusting means 26, the car-side door 6a in left-hand
20 side can be moved larger than movement of the car-side door in right-hand side, and on the contrary, by adjusting the position of the fulcrum 12b toward a slanting right lower direction using the adjusting means 26, the car-side door 6a in left-hand side can be moved smaller than
25 movement of the car-side door in right-hand side. The ratio of the adjusting quantity to the change of movement quantity can be known in advance.

Therefore, the adjusting work can be performed by once bringing the car-side doors 6a, 6b in the full-opened state, measuring a difference between the moving distances of the car-side doors 6a, 6b in left-hand side and right-hand side, bringing the car-side doors 6a, 6b in the full-closed state again, and moving the fulcrum 12b by a distance corresponding to the difference between the moving distances. That is, there is no need to perform repeating adjustment.

10 In the next, in the elevator door apparatus which has finished the above adjustment, a construction which is capable to easily open the door from inside of the elevator car in an emergency without big manual force will be explained using Fig. 7.

15 In this embodiment shown in Fig. 7, a car-side door 6a is constructed so as to be opened by being moved in a direction shown by an arrow, and an engaging unit 62a transmitting a drive force of the car-side door 6a to a hoist-way door (not shown) is fixed to the car-side door.

20 One end of the auxiliary link 8a is connected to the car-side door 6a at a fulcrum 7a so as to be rotatable with respect to a rotating axis (a third rotating axis) of a straight line perpendicular to a traveling plane of the car-side door 6a (a plane parallel to the plane of the

25 Figure), and the other end is connected to one end of the main link 10a at a fulcrum 9a so as to be rotatable with respect to a rotating axis (a second rotating axis) of a

straight line parallel to the third rotating axis. In the
embodiments including the present embodiment to be
described below, depiction and explanation of the door
machine base 13, the drive link 16 and the drive means 18
5 will be omitted.

A relative angle, which is smaller one of relative
angles between a straight line 63a connecting between the
fulcrum 7a and the fulcrum 9a of the auxiliary link 8a and
a straight line 65a connecting between the fulcrum 11a and
10 the fulcrum 9a of the main link 10a, is let be α . The
relative angle α , is set nearly 0° or within the range of
 0° to 10° in the closed state of the door. This angle is
good in controllability, but is an angle which may
generate a mode to increase a force required to open the
15 car-side door 6a (a manual door-opening force) when the
car-side door 6a is to be manually opened.

A relative angle, which is smaller one of relative
angles between a straight line 63a connecting between the
fulcrum 7a and the fulcrum 9a of the auxiliary link 8a and
20 a vertical straight line 64a of the car-side door 6a is
let be β when the car-side door 6a is not in the full-
closed state. The relative angle β under the full-closed
state of the car-side door 6a is let be β_0 . In order to
prevent the relative angle β from becoming smaller than
25 the relative angle β_0 , that is, to prevent the auxiliary
link 8a from rotating relatively clockwise around the
fulcrum 7a as a center to the car-side door 6a under the

full-closed state of said car-side door 6a, a second protective is fixed to an engaging unit 62a so as to be in contact with the auxiliary link 8a in the full-closed state of the car-side door 6a. The second protective means
5 is constructed by including the stopper 60a and an elastic body 61a covering a contact surface of the stopper 60a with the auxiliary link 8a. The stopper 60a is screwed to a female screw in the engaging unit 62a and fixed by a nut 60b so that the gap between the stopper and the member
10 opposite to the stopper 60a, that is, the auxiliary link 8a is adjustable.

Since the stopper 60a is mounted in such a state described above, when a horizontal force is applied to the car-side door 6a in the opening direction of the car-side
15 door 6a under condition that the car-side door 6a is in the complete closed state, the relative angle β between the auxiliary link 8a (the straight line 63a) and the vertical straight line 64a of the car-side door 6a never becomes smaller than the relative angle β_0 between the
20 straight line 63a and the straight line 64a under the full-closed state of the car-side door 6a.

At that time, A relative angle α , which is smaller one of relative angles between a straight line 63a and an extension line 65a connecting between the fulcrum 11a and
25 the fulcrum 9a, never becomes smaller than the relative angle α_0 between the straight line 63a and the straight line 65a under the full-closed state of the car-side door

6a. Accordingly, even though the relative angle α , is nearly 0° or within the range of 0° to 10° in the closed state of the door, the force required to manually open the car-side door 6a does not increase.

5 The same effect can be attained without the elastic body 61a. However, by providing the elastic body 61a in the contact surface of the stopper 60a with the auxiliary link 8a, a shock of collision between the stopper 60a and the auxiliary link 8a at closing of the car-side door 6a
10 is buffered. The same effect can be attained by providing the elastic body 61a on the surface of the auxiliary link 8a colliding with the stopper 60a.

 Further, the same effect can be obtained by attaching the stopper 60a composing the second preventive
15 means to the auxiliary link 8a so as to be in contact with the engaging unit 62a under the complete closed state of the car-side door 6a, as a second embodiment shown by Fig. 8. In this case, it is preferable to attach the stopper 60a to the auxiliary link 8a also by screwing so that the
20 gap between the stopper 60a and the engaging unit 62a may be adjusted.

 Further, the same effect can be obtained by attaching the car-side door 6a so as to be in contact with the auxiliary link 8a under the complete closed state of
25 the car-side door 6a, as a second embodiment shown by Fig. 9. In this case, the stopper 60a is also screwed to a supporter 60c fixed to the car-side door 6a so that the

gap between the stopper 60a and the engaging unit 62a may be adjusted.

This embodiment shown in Fig. 10 is constructed in such that a first protective means is composed of a projecting portion 66 formed in the main link 10a side of the auxiliary link 8a; a stopper 60a provided in the projecting portion 66, the axial line of the stopper being arranged in a direction intersecting with the straight line 63a at right angle; and a nut 60b for fixing the stopper 60a. The gap between the stopper 60a and the main link 10a becomes narrow as the car-side door 6a is being closed, and the stopper 60a is in contact with the main link 10a when the car-side door 6a is completely closed to prevent the relative angle α from decreasing further smaller. In this embodiment, the relative angle α between the main link 10a and the auxiliary link 8a is limited so as to not become smaller than the relative angle α_0 between the main link 10a and the auxiliary link 8a at the closed state of the car-side door. Thereby, increase of the manual door-opening force is prevented. In this case, the stopper 60a is also screwed to the projecting portion 66 and fixed by the nut 60b so that the gap between the stopper 60a and the main link 10a may be adjusted.

Further, as a fifth embodiment shown in Fig. 6, the first preventive means may be constructed by fixing an L-shaped metal fitting 67 to a position in the side surface of the main link 10a near the auxiliary link 8a, and

screwing the stopper 60a to the L-shaped metal fitting 67 so that the axial line of the stopper becomes nearly parallel to the above-mentioned straight line 65a. The position in the axial line direction of the stopper 60a is
5 adjusted so as to contact to the end surface in the longitudinal direction of the auxiliary link 8a and the stopper is fixed with the nut 60b. The same effect as in the above-mentioned can be obtained by this embodiment.

Fig. 12 shows a sixth embodiment in accordance with
10 the present invention. The stopper 60a in each of the above-mentioned embodiments has a bolt-shape and the head of the stopper is covered with the elastic body 61a. On the other hand, the stopper 67a in the present embodiment has an L-shape, and an elastic body 68a is provided in the
15 contact portion of the stopper 67a. The same effect can be obtained by exchanging the stopper 60a to the stopper 67a depending on the installing place.

Although description in each of the embodiments above-mentioned has been made on a case where there is a
20 single car-side door, the present invention can be similarly applied to a case of a double door type where there are two doors.



WHAT IS CLAIMED IS;

1. An elevator door apparatus having a door provided on the elevator car to be able to move to a horizontal direction, a pair of first links, an end thereof being
5 connected to be rotatable to a part of the elevator car, a pair of second links, an end thereof being connected to be rotatable to other end of said first links, other end of said second links being connected to be rotatable to said door of the elevator car, a third link being connected to
10 a portion between said pair of the first links, and restraining said pair of the first links to rotate in symmetry to a vertical central axis of an entrance of the elevator car, and a driving means to add a rotational power to said pair of first links, said elevator door
15 apparatus comprising
first temporary fixing means holding department for restraining a relative angle of said first links and said second links to keep an constant value, second temporary
fixing means holding department for restraining a
20 relative angle of said second links and said car door to keep an constant value, first adjusting means for adjusting position of at least one of two junction points provided between said third link and said first links, and second adjusting means for adjusting a position of a
25 junction point between said driving means and said first links.
2. An elevator door apparatus as defined in claim 1,



comprising a temporary fixing means being a removable pin penetrated to both of said through holes, wherein said first temporary fixing means holding department are through holes respectively provided near junction points
5 of said first links and said second links, and said second temporary fixing means holding department are through holes respectively provided near junction points of said second links and said door.

3. An elevator door apparatus as defined in claim 1 or 2,
10 wherein said first and second adjustment means respectively comprises a flange connected to be rotatable respectively to said third link and said driving means, a plurality of long holes provided on said flange, a plurality of long holes provided on said first links
15 corresponding to said long holes provided on said flange, volt penetrating said long holes provided on said flange and said first links, and nut concluded by the volt.

4. An elevator door apparatus as defined in claim 1, 2 or 3, wherein said second adjustment means comprises a
20 pulley for taking out an output from said driving means, fourth link connected so as to be rotatable to said pulley in one end thereof and to the first link in another end thereof, a stopper for limiting position of said pulley when the door is opened, and adjusting means for
25 adjusting position of said stopper.

5. An installation method of an elevator door apparatus having doors provided on the elevator car to be able to



move to a horizontal direction, a pair of first links, an end thereof being connected to be rotatable to a part of the elevator car, a pair of second links, one end thereof being connected to be rotatable to other end of said first
5 links, other end of said second links being connected to be rotatable to said doors of the elevator car, a third link being connected between said pair of the first links, and restraining said first links to rotate in symmetry to a central axis of an entrance of the elevator car, and a
10 driving means to add a rotational power to said pair of first links, said installation method of said elevator door apparatus comprising the steps of temporarily fixing said doors to be closed with a removable temporary fixing means for restraining the door to move horizontally,
15 connecting said second link to be rotatable to said doors, temporarily fixing said second links to be closed with a temporary fixing means for restraining a relative angle of the second links and the doors to keep a constant value, rotatably connecting said first links between said second
20 links and said part of the elevator car, temporarily fixing said second links and said first links with a removable temporary fixing means for restraining a relative angle of the first links and the second links to keep a constant value, connecting said third link and one
25 end of said first links with said driving device, removing all of said temporarily fixing means after that and opening said doors, searching differential of right



and left transfer distance of said doors, closing door again, and adjusting the position of at least one of the two junction points with the said third link and said first link according to said differential.

- 5 6. An elevator door apparatus having a door provided on the elevator car to be able to move to a horizontal direction, a first link, one end thereof being connected to a part of the elevator car so as to be rotatable around a first rotational axis which is perpendicular to a moving
10 plane of said door, a second link, one end thereof being connected to other end of said first link so as to be rotatable around a second rotational axis which is parallel to said first rotational axis, other end of said second link being connected to said door of the elevator
15 car so as to be rotatable around a third rotational axis which is parallel to said first rotational axis, and a driving means to add a rotational power to said first link so as to rotate it around said first rotational axis, relative angle α being smaller one of relative angles
20 between a straight line connecting said first rotational axis and said second rotational axis and a straight line connecting said second rotational axis and said third rotational axis, in a plane being perpendicular to said first rotation axis, is determined so as to increase a
25 manual door opening force, said elevator door apparatus comprising one of a first protective means for maintaining said relative angle α in a closed condition of



the door and for preventing said relative angle α from becoming smaller than a relative angle α_0 when the door closes, and a second protective means for maintaining a relative angle β being smaller one of relative angles
5 between a straight line connecting said second rotating axis and said third rotating axis and vertical line in a closed condition of the door, and for preventing said relative angle β from becoming smaller than a relative angle β_0 when the door closes.

- 10 7. An elevator door apparatus having a pair of doors provided on the elevator car to be able to respectively move to reverse horizontal directions, a pair of first links, one end thereof being connected to a part of the elevator car so as to be rotatable around a first
15 rotational axis which is perpendicular to a moving plane of said door, a pair of second links, one end thereof being connected to other end of said first links so as to be rotatable around a second rotational axis which is parallel to said first rotational axis, other end of said
20 second links being connected to said door of the elevator car so as to be rotatable around a third rotational axis which is parallel to said first rotational axis,

a third link being connected to respective said the first links, and restraining said pair of the first links to
25 rotate in symmetry to a central axis of an entrance of the elevator car, and a driving means to add a rotational power to said first links so as to rotate them around said



first rotational axis, wherein relative angle α being smaller one of relative angles between a straight line connecting said first rotational axis and said second rotational axis, and a straight line connecting said
5 second rotational axis and said third rotational axis in a plane being perpendicular to said first rotation axis, is determined so as to increase a manual door opening force, said elevator door apparatus comprising one of a first protective means for maintaining said relative angle α in
10 a closed condition of the door and for preventing said relative angle α from becoming smaller than a relative angle α_0 when the door closes, and a second protective means for maintaining a relative angle β being smaller one of relative angles between a straight line connecting said
15 second rotating axis and said third rotating axis and a vertical line in a closed condition of the door, and for preventing said relative angle β from becoming smaller than a relative angle β_0 when the door closes.

8. An elevator door apparatus as defined in claims 6,
20 wherein said first protective means is a stopper which is provided on at least one of said first link and said second link, and contacts with at least other of said first link and said second link.

9. An elevator door apparatus as defined in claims 7,
25 wherein said first protective means is a stopper which is provided on at least one of said first links and said second links, and contacts with at least other of said



first links and said second links. 10. An elevator door apparatus as defined in claims 6, wherein wherein said second protective means is a stopper which is provided on one of said second link and said door, and contacts with
5 other of said second link and said door in a closed condition of the door. 11. An elevator door apparatus as defined in claims 7, wherein wherein said second protective means is a stopper which is provided on one of said second links and said door, and contacts with other
10 of said second links and said door in a closed condition of the door.