



(51) International Patent Classification:
B66B 1/18 (2006.01)

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(21) International Application Number:
PCT/IB2009/007677

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(22) International Filing Date:
9 December 2009 (09.12.2009)

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2009-189642 19 August 2009 (19.08.2009) JP

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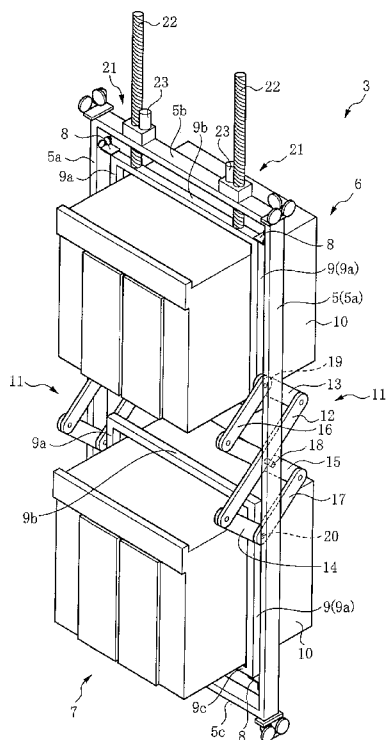
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(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE,

[Continued on next page]

(54) Title: DOUBLE-DECK ELEVATOR

FIG. 2



(57) Abstract: To provide a double-deck elevator characterized by the fact that by increasing the story height adjustment range in the direction in which the two cars approach each other, it is possible to increase the degree of building design freedom. Two up/down cars (6), (7) arranged in outer frame (5) are connected with each other by means of pantographic mechanisms (11) that can effect an expansion and contraction operation, and the two cars (6), (7) are driven to move towards each other or away from each other by means of pantographic mechanisms (11). The pantographic mechanisms (11) are arranged in the spaces between vertical beams (5a) and the two cars (6), (7) and each has a pivot point at the longitudinal central portion of vertical beams (5a) extending vertically in outer frame (5). Due to the pantographic mechanisms (11), the story height adjustment range in the direction in which the two cars (6), (7) approach each other is not restricted.



ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, **Published:**

MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM,

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,

ML, MR, NE, SN, TD, TG).

— *with international search report (Art. 21(3))*

DESCRIPTION

DOUBLE-DECK ELEVATOR

Technical Field

5 The present invention pertains to a double-deck elevator having a 2-story structure made of two cars stacked as upper/lower cars. In particular, the present invention pertains to a double-deck elevator that allows adjustment of the story height by changing the distance between the two cars.

10 **Background Art**

 For example, the technology described in Japanese Unexamined Patent Application Publication No. 10-279231 has been proposed for a double-deck elevator of this type. According to this reference, two cars are arranged as upper/lower cars in an outer frame having a rectangular front shape that moves
15 up/down in an elevator hoistway. The two upper/lower cars are connected to each other by a pantographic mechanism arranged between the two cars. The pivot point of the pantographic mechanism is arranged on a supporting frame connecting the intermediate portions in the longitudinal direction of the left/right vertical beams in the outer frame. According to this reference, the
20 upper car is driven to move up/down by a driving means, so that the two cars are driven to move towards or away from each other via the pantographic mechanism so that the distance between the two cars is changed. As a result, it is possible to adjust the story height between the two cars corresponding to the story height of the landing floor of the lower car with this reference.

25

Disclosure of Invention

Technical Problem

Since the pantographic mechanism in this reference is arranged between the two cars in the double-deck elevator, the story height adjustment range is limited in the direction in which the two cars to approach each other, and such a double-deck elevator cannot be adopted in a building having floors
5 with relatively small story height.

Technical Solution

The present invention provides a double-deck elevator characterized by the fact that the adjustment range of the story height in the direction in which
10 the two cars approach each other is increased, so that the degree of building design freedom can be increased.

The invention described in Claim 1 provides a double-deck elevator comprising a pair of cars arranged such that each can move up/down, a driving device that drives at least one of the two cars to move up/down, and a linking
15 mechanism that is arranged to connect the aforementioned two cars with each other and that operates to move the two cars towards each other or away from each other; wherein the linking mechanism is located along sides of the cars.

Consequently, according to the invention described in Claim 1, the linking mechanisms are arranged on the sides of the two cars, so that there is
20 no need to have a supporting frame arranged between the two cars. Consequently, it enables a greater range of story height adjustment in the direction in which the two cars approach each other.

Advantageous Effects

25 According to the present invention, it is possible to expand the adjustment range of the story height in the direction in which the two cars approach each other, so that the double-deck elevator of the present invention

can also be adopted in buildings with a relatively low story height. As a result, it is possible to dramatically increase the degree of building design freedom.

Brief Description of Drawings

5 Figure 1 is a schematic diagram illustrating the double-deck elevator as a preferred embodiment of the present invention.

Figure 2 is an oblique view of the car unit shown in Figure 1.

Figure 3 is a front view of the car unit shown in Figure 1.

10 Explanation of Reference

5 Outer frame

5a Vertical beam of outer frame

6 Upper car

7 Lower car

15 11 Pantographic mechanism (linking mechanism)

12 First link member

13 Second link member

14 Third link member

15 Fourth link member

20 16 Fifth link member

17 Sixth link member

18 Pin (pivot point of pantographic mechanism)

21 Driving device

25 Best Mode for Carrying Out the Invention

Figures 1-3 are diagrams illustrating one possible embodiment of the present invention. More specifically, Figure 1 is a schematic diagram

illustrating the constitution of the double-deck elevator. Figure 2 is an oblique view of the device shown in Figure 1. Figure 3 is a front view of the car unit shown in Figure 1.

The double-deck elevator shown in Figure 1 uses the so-called traction system. Car 3 is suspended from one end of main rope 2 running over drive sheave 1a and deflector sheave 1b of hoist 1, and counterweight 4 is suspended from the other end of main rope 2. As drive sheave 1a is driven to rotate by means of a motor not shown in the figure, car unit 3 and counterweight 4 are driven to move in elevator hoistway S while being guided by guide rails not shown in the figure.

In addition to Figure 1, as shown in Figures 2, 3, car unit 3 is formed mainly of outer frame 5 having a rectangular front shape. A pair of cars consisting of upper car 6 and lower car 7 is arranged in the outer frame 5 such that each can move up/down. The outer frame 5 has a pair of left/right vertical beams 5a extending vertically, crosshead 5b connecting the upper ends of the two vertical beams 5a, and bolster 5c connecting the lower ends of two vertical beams 5a. Here, guide rollers 8 arranged on the two cars 6, 7 are guided such that the two cars 6, 7 can move up/down along two vertical beams 5a of outer frame 5. Also, although not shown in the figure, it is well known that one end of main rope 2 is connected to crosshead 5b of outer frame 5.

Each of the two cars 6, 7 has inner frame 9 having a rectangular front shape, and car chamber 10 arranged within the inner frame 9. The inner frame 9 has a pair of left/right vertical beams 9a, crosshead 9b connecting the upper ends of the two vertical beams 9a, and bolster 9c connecting the lower ends of two vertical beams 9a. As one example of a linking mechanism to connect the two cars 6, 7, pantographic mechanism 11 is arranged in each of the gaps between left/right vertical beams 9a of inner frames 9 of the two cars 6, 7 and

left/right vertical beams 5a of outer frame 5. In other words, pantographic mechanism 11 is arranged on each of the left/right sides of the two cars 6, 7. Other linking mechanisms could be used with the present invention.

The two pantographic mechanisms 11 have nearly the same constitution.

5 The pantographic mechanisms 11 are oriented such that their width direction corresponds to the depth direction of the two cars 6, 7. More specifically, the two pantographic mechanisms 11 have first and fourth link members 12, 15 arranged such that their central portions cross each other, with second and fifth link members 13 and 16 connecting the upper ends of first and fourth link
10 members 12, 15, respectively, to upper car 6, and with third and sixth link members 14, 17 connecting the lower ends of first and fourth link members 12, 15, respectively, to lower car 7.

More specifically, while first link member 12 is arranged to incline downward going toward the front of the two cars 6, 7, that is, towards the
15 exit/entry side of the two cars 6, 7, fourth link member 15 is arranged to incline upward going toward the front of the two cars 6, 7. The intersection between the first link member 12 and fourth link member 15 is rotatably connected to the longitudinal central portions of vertical beams 5a by means of common pin 18 in outer frame 5. Also, the upper ends of second link member 13 and fifth
20 link member 16 are rotatably connected to the lower ends of vertical beams 9a by means of common pin 19 of inner frame 9 for upper car 6. In addition, the lower ends of third link member 14 and sixth link member 17 are rotatably connected to the upper ends of vertical beams 9a by means of common pin 20 of inner frame 9 for lower car 7.

25 As a result, a diamond shape is formed by the upper halves of first link member 12 and fourth link member 15 with second link member 13 and fifth link member 16. At the same time, a diamond shape is formed by the lower

halves of first link member 12 and fourth link member 15 with third link member 14 and sixth link member 17. Also, the second link member 13 and fifth link member 16 of pantographic mechanism 11 overlap in the width direction of upper car 6 at the lower end of upper car 6. Additionally, third link member 14 and sixth link member 17 of pantographic mechanism 11 overlap in the width direction of lower car 7 at the upper end of lower car 7.

Here, with pin 18 serving as the pivot, pantographic mechanism 11 can move to extend in the depth direction of the two cars 6, 7 while contracting in the vertical direction, so that the two cars 6, 7 move towards each other. On the other hand, when pantographic mechanism 11 moves to contract in the depth direction of the two cars 6, 7 while extending in the vertical direction, the two cars 6, 7 move away from each other.

In this embodiment, pantographic mechanism 11 is used as the linking mechanism to drive the two cars 6, 7 to move towards each other or away from each other. However, a scheme can also be adopted in which first link member 12 through third link member 14 or fourth link member 15 through sixth link member 17 of pantographic mechanism 11 are omitted to form a crank mechanism, and the crank mechanism can be used as the linking mechanism.

In addition, a pair of up/down driving devices 21 for upper car 6 is arranged on crosshead 5b of outer frame 5. The two driving devices 21 each have threaded shaft 22 extending in the vertical direction. The threaded shaft 22 is inserted passing through crosshead 5b of outer frame 5, and the lower end of threaded shaft 22 is connected to crosshead 9b of inner frame 9 for upper car 6. Here, when electric motor 23 of driving device 21 is turned on, the screwing movement function of threaded shaft 22 drives up/down so that upper car 6 is driven to move up/down.

In this embodiment with the constitution, when car unit 3 operates, the story height between the two cars 6, 7 is adjusted according to the story height of the floor where lower car 7 is to land, so that the two cars 6, 7 can land at adjacent floors, respectively. More specifically, when the two driving devices
5 21 are used to drive upper car 6 to move up/down, pantographic mechanism 11 operates to drive the two cars 6, 7 to move in opposite directions, respectively, so that the distance between the two cars 6, 7, that is, the story height, can be quickly adjusted.

Here, the weight of lower car 7 acts on pantographic mechanism 11 to
10 make the pantographic mechanism 11 extend in the vertical direction. On the other hand, the weight of upper car 6 acts on pantographic mechanism 11 to compress it in the vertical direction. As a result, the intrinsic weights of upper car 6 and lower car 7 cancel each other, so that electric motor 23 of driving device 21 needs only to drive according to the load difference between upper
15 car 6 and lower car 7, so that the electric motor 23 for carrying out the operation can have a lower capacity.

Here, pantographic mechanism 11 is positioned so that it is not located between the two cars 6, 7. In one embodiment, and as shown the figures, pantograph mechanism is arranged along the sides of the two cars 6, 7 and
20 more specifically in the space between vertical beams 5a of outer frame 5 and the two cars 6, 7. In other words, the pantographic mechanism 11 or other member is absent between the two cars 6, 7. Consequently, the adjustment range of the story height in the direction in which the two cars 6, 7 approach each other is not limited by the presence of pantographic mechanism 11.

25 Consequently, in this embodiment, it is possible to expand the adjustment range of the story height in the direction in which the two cars 6, 7 approach each other, so that the double-deck elevator can be adopted even in

buildings with relatively small story height. As a result, the degree of building design freedom can be increased significantly by using the double-deck elevator.

Also, by arranging the pivot point of pantographic mechanism 11 on
5 vertical beams 5a of outer frame 5, the supporting frame that used to be arranged between the two cars 6, 7 is no longer needed. As a result, outer frame 5 can be made smaller in size and lighter in weight, so that the system is favorable with respect to space reduction and energy consumption. This is an advantage.

CLAIMS

- 1 . A double-deck elevator comprising:
 - a pair of cars arranged such that each can move up/down,
 - 5 a driving device that drives at least one of said two cars to move up/down, and
 - a linking mechanism that is arranged to connect the aforementioned two cars with each other and that operates to move the two cars towards each other or away from each other;
 - 10 wherein said linking mechanism is located along sides of the cars.
- 2 . The double-deck elevator of claim 1, wherein said linking mechanism has a pivot point in the longitudinal central portion of a vertical beam extending up/down in an outer frame.
- 15 3 . The double-deck elevator of claim 2, wherein said linking mechanism is arranged in the gap between said vertical beam and said two cars.
- 4 . The double-deck elevator described in Claim 1, characterized by the
 - 20 fact that the two ends, that is, the upper/lower ends, of said linking mechanism are overlapped at the two cars in the width direction of said two cars.
- 5 . The double-deck elevator described in Claim 4, characterized by the
 - fact that when said linking mechanism expands and contracts about the pivot
 - 25 point, said two cars are driven to move towards or away from each other, and at the same time, the linking mechanism width is increased/decreased in the

depth direction of said two cars in conjunction with said expansion and contraction.

6 . The double-deck elevator described in Claim 5, characterized by the
5 fact that said linking mechanism has the following parts: a first link member that is rotatably connected to said pivot point at its longitudinal central portion, a second link member that connects the upper end of said first link member with the upper car, and a third link member that connects the lower end of said first link member with the lower car.

10

7 . The double-deck elevator described in Claim 6, characterized by the fact that said linking mechanism is a pantographic mechanism that has the following parts: a fourth link member that is arranged to cross said first link member and that is connected in a freely rotatable way to said pivot point at the
15 portion crossing the first link member, a fifth link member that connects the upper end of said fourth link member with the upper car, and a sixth link member that connects the lower end of said fourth linking mechanism with the lower car.

20 8 . The double-deck elevator described in any of Claims 1-7, characterized by the fact that said linking mechanism is arranged on each of the two sides in the width direction of said two cars.

9 . The double-deck elevator described in any of Claims 1-8, characterized
25 by the fact that said driving device is arranged on the crosshead that connects the upper ends of the left/right vertical beams in said outer frame, and this driving device is used to drive the upper car up/down.

FIG. 1

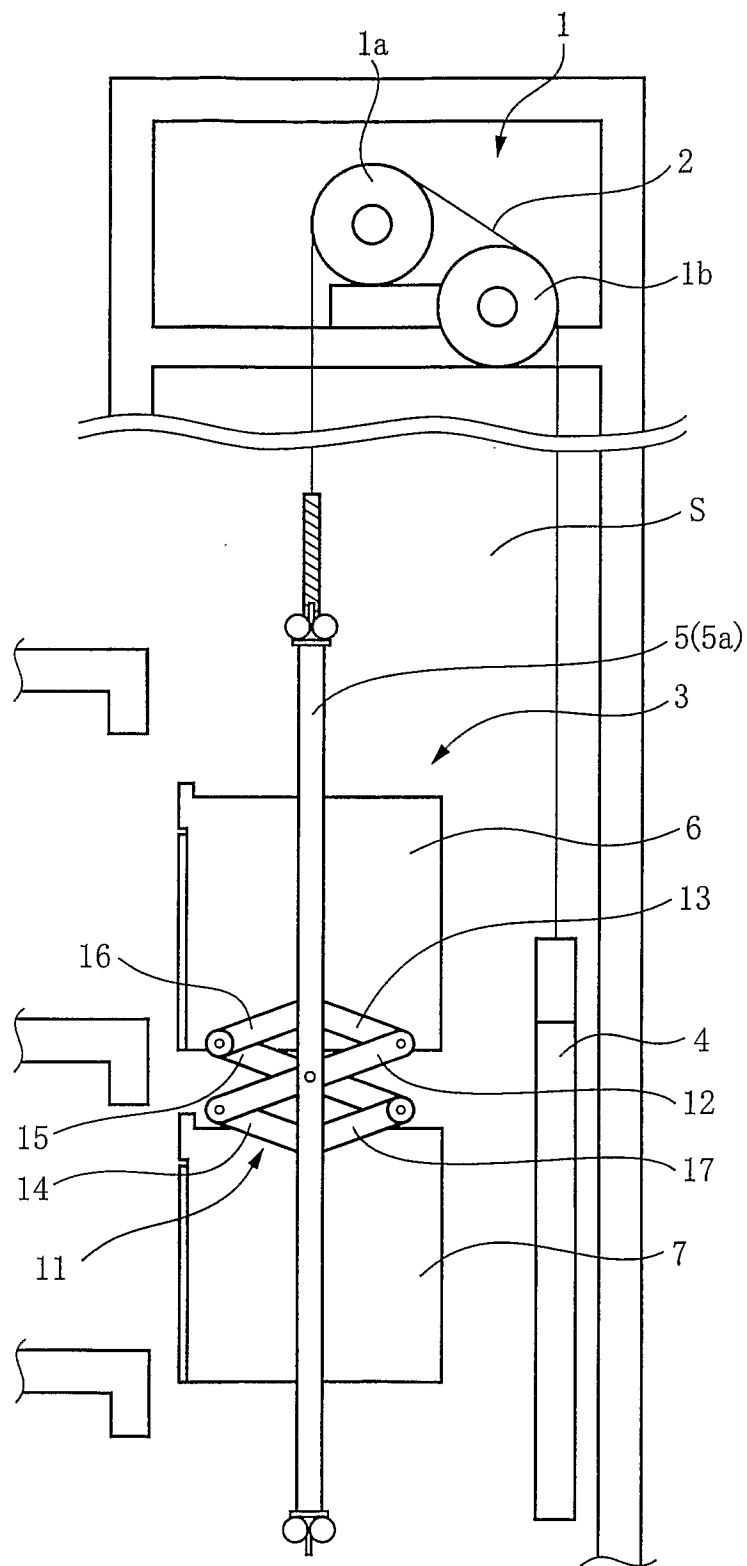


FIG. 2

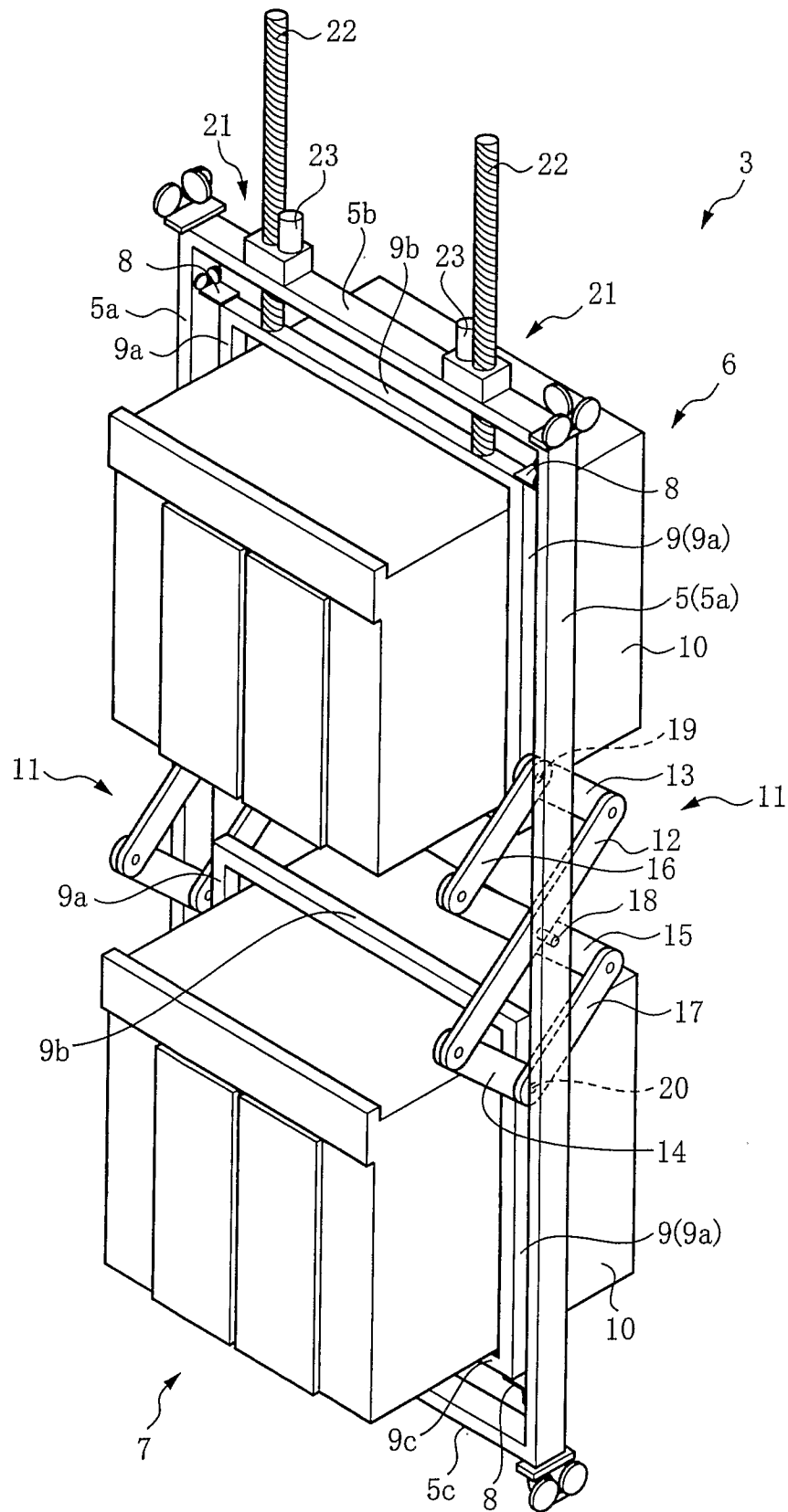
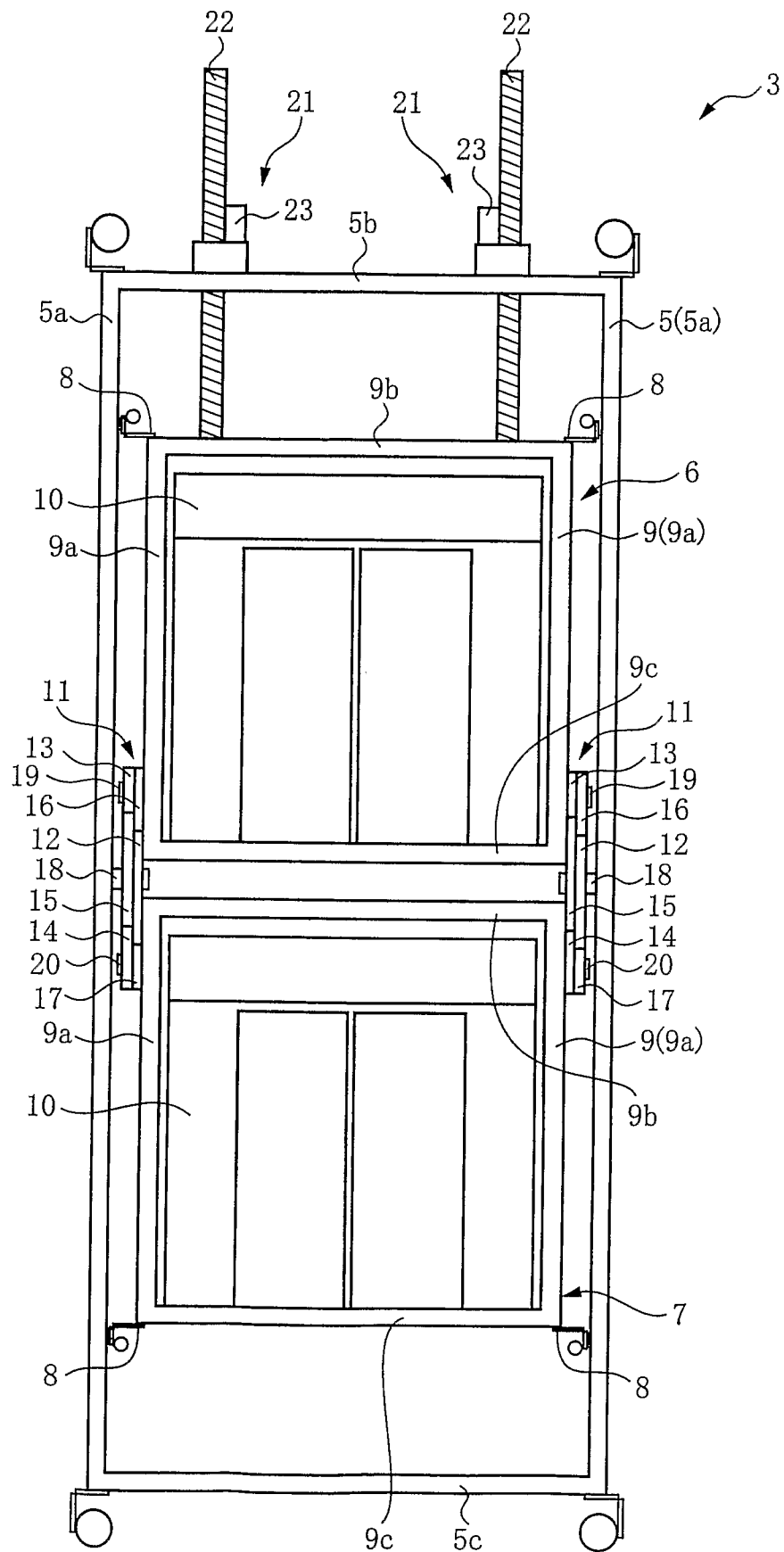


FIG. 3



A. CLASSIFICATION OF SUBJECT MATTER***B66B 1/18(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)

B66B 1/18; B66B 11/00; B66B 11/02; B66B 11/08; B66B 9/00

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

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

eKOMPASS(KIPO internal) & Keywords: elevator, double, deck, pivot, pantograph and similar terms"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-1998-0081321 A (오티스엘리베이터컴파니) 25 November 1998 See the abstract, all claims.	1-8
A	JP 2001-080856 A (TOSHIBA CORP) 27 March 2001 See the whole document.	1-8
A	JP 2002-179368 A (TOSHIBA ELEVATOR CO LTD et al.) 26 June 2002 See the whole document.	1-8



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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" 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

"&" document member of the same patent family

Date of the actual completion of the international search

31 AUGUST 2010 (31.08.2010)

Date of mailing of the international search report

02 SEPTEMBER 2010 (02.09.2010)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2009/007677**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 9
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/IB2009/007677

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 10-1998-0081321 A	25.11.1998	EP 0870716 A2 JP 10-279231 A US 5907136 A1	14.10.1998 20.10.1998 25.05.1999
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