(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
29 June 2006 (29.06.2006)

PCT

(10) International Publication Number
WO 2006/067542 A1

(51) International Patent Classification:
B66B 5/00 (2006.01)

(21) International Application Number:
PCT/IB2004/004249

(22) International Filing Date:
21 December 2004 (21.12.2004)

(25) Filing Language: English

(26) Publication Language: English

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

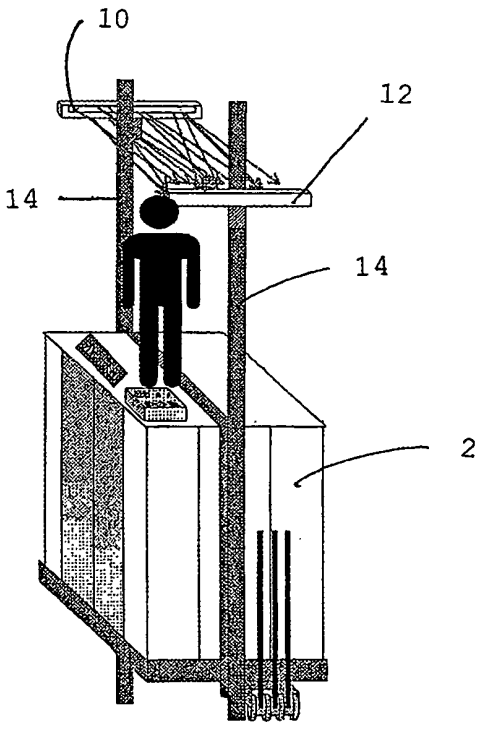
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv))*

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ELEVATOR SAFETY SYSTEMS



(57) Abstract: An elevator system comprisingt a hoistway (4) and an alevator car (2) arranged to travel vertically within the hoistway, the hoistway is provided with a sensing arrangement such as an infra-red curtain (10,12) for detecting the presence of a person on top of the car as the car approaches the top of the hoistway (8). The elevator system is arranged to limit further upward movement of the car in the event that a person is detected.

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Elevator Safety Systems

This invention relates to enhancements in the safety of elevators, particularly the detection of the unauthorised presence of a person on top of an elevator car.

It is becoming increasingly common in elevator installations to provide very little space above the ordinary travel of the elevator car as this reduces building costs and increases the available flexibility in building design. However, there is a risk of injury in low overhead elevator installations as there is less refuge space for a person riding on top of the elevator car as the car approaches the uppermost landing. It is therefore necessary to provide a series of safety systems such as a retractable balustrade and a special inspection mode for the elevator controller which prevent the car from travelling to the top of the hoistway. These permit authorised inspections to be carried out safely by an engineer riding on top of the car. However, if these safety measures are not all properly employed or are inadvertently or deliberately overridden, there is an increased risk of injury. This could result from an engineer not adhering to an approved procedure for carrying out inspection or could result from an unauthorised person gaining access to the top of the car.

In view of the above, it is desirable automatically to prevent the elevator car moving to the uppermost end of its travel if a person is present on top of the car.

When viewed from a first aspect the present invention provides an elevator system comprising a hoistway and an elevator car arranged to travel vertically within the hoistway, the hoistway being further provided with a sensing arrangement for

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detecting the presence of a person on top of the car as the car approaches the top of the hoistway, the elevator system being arranged so as to limit further upward movement of the car in the event that a person is detected.

When viewed from a second aspect the invention provides a method of preventing injury to a person riding on top of an elevator car in a low-overhead elevator system the method comprising detecting the presence of a person on top of the car as the car approaches the top of a hoistway using means provided in the hoistway and limiting further upward movement of the car in the event that a person is detected.

Thus it will be seen by those skilled in the art, that in accordance with the invention a person at risk of being injured at the top of the hoistway as the elevator car moves up will be detected and the elevator system will limit upward movement of the car to reduce the risk of injury to that person.

The means for detecting a person on top of the car could be one that is able to distinguish between a living person and an inanimate object so that it does not sense the presence of the car itself during normal operation. For example, the sensing arrangement could comprise a passive infrared sensor for sensing the body heat of the person on top of the car. Preferably, however, the sensing arrangement is adapted to detect the presence of an object at the relevant vertical point of the hoistway.

A point in the hoistway above the normal travel of the elevator could be chosen but in very low overhead installations this may not give sufficient distance in which to stop the car safely without causing injury to the person on top of it. In accordance with preferred embodiments therefore the sensing point is within the normal travel of the car and the elevator system is arranged to be able to distinguish between a person

riding on top of the car and the car itself having traveled to the vertical sensing point during normal operation. Whilst there are many ways of achieving this, it is preferred to use an existing position reference system to determine the position of the car and to limit upward movement of the car in accordance with the invention only if it is determined via the position reference system that the elevator car is not intended to be in a position where it will be detected by the sensing arrangement. One way of doing this would be for the sensing arrangement to send a signal to the elevator controller and for the elevator controller to be arranged to limit upward movement of the car based on the signals from the sensing arrangement and the position reference system.

Alternatively, the sensing arrangement may be enabled when the elevator car is towards the top of the hoistway but still low enough that there is sufficient space between the top of the car and the top of the hoistway to accommodate a person. For example, the sensing arrangement could be activated when the elevator car is at the landing below the uppermost landing. By positioning the sensing arrangement above the position of the elevator car when the sensing arrangement is activated, the sensing arrangement will only detect an object on top of the car rather than the car itself. Of course, if the position of the sensing arrangement is such that it will be passed by the elevator car during normal operation, this should not set off the safety system to limit movement of the car. One possibility would be for a second position signal to be used to deactivate the sensor. Alternatively the sensing arrangement could be enabled when the elevator car is above the penultimate landing a time measurement made to determine whether an object is detected before it would be expected for the car itself to be detected.

Upon detection of an unauthorised person on top of the car there are a number of possibilities for taking action to prevent injury to that person. For example the elevator controller may immediately prevent any further upward movement of the car by interrupting power to the elevator motor and applying the brake. Additionally, or alternatively, a physical safety device may be automatically employed.

In a preferred set of embodiments the sensing arrangement comprises means for emitting a sensing radiation and means for detecting the emitted radiation so as to enable the presence of an object in the path of the radiation to be detected. The sensing arrangement could be such that radiation reflected from the detected body is sensed but preferably the arrangement is such that the radiation travels across the hoistway to be detected so that the presence of a body at that vertical point in the hoistway interrupts the sensing of the radiation. Most preferably the sensing arrangement comprises a plurality of beams spanning the hoistway and one or more sensors arranged to detect said beam(s).

The radiation employed may be of any convenient nature such as ultrasound, microwave or visible light but preferably infrared radiation is employed since the associated sensors and emitters are relatively easily available and inexpensive whilst being reliable.

A preferred embodiment of the present invention will now be described, by way of example only with reference to the accompanying drawings in which:

Fig. 1 is a front view of a low overhead elevator hoistway showing the danger posed to persons on top of the car;

Figs. 2a and 2b are front and perspective views respectively of an elevator system embodying the invention showing activation of the infrared curtain;

Figs. 3a and 3b are front and perspective views respectively showing detection of an unauthorised person on top of the car; and

Fig. 4 is a front view of the embodiment of Figs. 2 and 3 where the car is safely stopped to prevent injury to the person on top of the car.

Fig. 1 shows an elevator car 2 which is arranged to move vertically within a hoistway 4. It will be seen that when the car 2 is adjacent the uppermost landing 6 there is very little space 7 between the top of the car 2 and the ceiling 8 of the hoistway. In particular, there is no refuge space for a person who happens to be on top of the car.

In low overhead systems such as that shown, a series of safety measures is required to ensure that the car cannot reach the uppermost landing 6 with someone riding on top of it. Normally such systems are linked to certain conditions like putting the elevator in a special inspection mode or the detection of unauthorised opening of a hoistway door indicating access to the top of the car by an unauthorised person.

However, it is not impossible that detection elements can be overridden or the elevator not properly put into inspection mode. Specifically, a door detection system can be overridden by an unauthorised user who can then ride on top of the car in normal mode. As will be seen from Fig. 1, this is extremely dangerous and potentially fatal. This may be prevented in accordance with the invention as will now be described with reference to Figs. 2 to 5.

According to the embodiment of the invention described herein, in the uppermost part of the hoistway 2 there is provided an infrared sensor and emitter arrangement comprising an elongate emitter array 10 and a corresponding elongate sensor array 12 disposed horizontally within the elevator shaft by being attached to the respective guide rails 14. In the embodiment

shown in the Figures the emitter array 10 comprises a plurality of separate emitters which emit infrared beams spanning the hoistway at a number of different angles to be sensed by a corresponding plurality of sensors at the sensor array 12 on the other side of the hoistway. By having a plurality of independent emitters and sensors the probability of spurious detection e.g. from small pieces of debris or flying insects in the hoistway may be reduced. However, it is envisaged that a single beam could be employed which could span the hoistway just once or alternatively which could be reflected one or more times to provide a greater spatial extent.

It will be seen that the sensor and emitter arrays 10,12 are provided approximately one third of the way up the uppermost landing space 6. The sensing arrangement 10,12 is activated when the elevator car 2 is adjacent the landing 16 below the uppermost landing 6. As will be seen now with reference to Figs. 3A and 3B, as the elevator car moves up beyond the penultimate landing 16 the unauthorised person 18 on top of the car will break the infrared beam between the emitter array 10 and the sensor array 12 which will be detected by the sensor array 12 as an interruption to its signal. Once this has been detected, further upward movement of the elevator car 2 will be prevented and the brake will be applied. As may be seen in Fig. 2A, this means that enough space remains above the top of the car 2 to prevent injury to the unauthorised person 18 on top of the car. The system could be arranged so as to require a manual reset e.g. by an authorised engineer before it may recommence normal operation although this is not essential.

If there is no unauthorised person on top of the car, the top of the car itself will eventually break the beam between the emitter array 10 and sensor array 12 as the car moves up to the uppermost landing 6. However, this does not lead to suspension of operation of the car

since the position reference system (PRS) signal indicates that the car is expected to be at a position such that it breaks the beam.

It will be appreciated by those skilled in the art that variations and modifications to the described embodiment may be made without departing from the scope of the invention. For example, other means for sensing the presence of a person on top of the car may be provided such as visible light, ultrasonic, microwave or other sensors. Moreover timing signals could be used rather than position signals to distinguish between the car and an unauthorised person on top of it.

Claims:

1. An elevator system comprising a hoistway (4) and an elevator car (2) arranged to travel vertically within the hoistway, the hoistway being further provided with a sensing arrangement (10,12) for detecting the presence of a person on top of the car as the car approaches the top of the hoistway (8), the elevator system being arranged so as to limit further upward movement of the car in the event that a person is detected.

2. An elevator system as claimed in claim 1 wherein the sensing arrangement (10,12) is adapted to detect the presence of an object at a predetermined vertical point of the hoistway.

3. An elevator system as claimed in claim 1 or 2 wherein said predetermined vertical point is within the normal travel of the elevator car (2), the elevator system being arranged to be able to distinguish between a person riding on top of the car and the car itself having travelled to said point during normal operation.

4. An elevator system as claimed in claim 3 arranged in use to use a position reference system to determine the position of the car (2) and to limit upward movement of the car only if it is determined via the position reference system that the elevator car is not intended to be in a position where it will be detected by the sensing arrangement (10,12).

5. An elevator system as claimed in claim 4 wherein said sensing arrangement (10,12) is arranged to send a signal to an elevator controller, the elevator controller being arranged to limit upward movement of

the car (2) based on said signal and an output from the position reference system.

6. An elevator system as claimed in claim 4 wherein the sensing arrangement (10,12) is arranged so as to be enabled when the elevator car (2) is towards the top of the hoistway (4) but still low enough that there is sufficient space between the top of the car and the top of the hoistway to accommodate a person.

7. An elevator system as claimed in claim 6 arranged such that the sensing arrangement (10,12) is enabled in use when the elevator car is at a landing (16) below an uppermost landing (6).

8. An elevator system as claimed in any of claims 4 to 7 comprising means for generating a position signal for disabling said sensing arrangement (10,12) as the sensing arrangement is approached by the car (2).

9. An elevator system as claimed in any of claims 4 to 7 comprising means for making a time measurement when the car (2) has passed a predetermined point, said elevator system being arranged to limit movement of the car if the sensing arrangement (10,12) detects an object before it would be expected for the car itself to be detected.

10. An elevator system as claimed in any preceding claim comprising means for immediately preventing any further upward movement of the car (2) upon detection of an unauthorised person on top of the car.

11. An elevator system as claimed in any preceding claim comprising means for automatically employing a physical safety device upon detection of an unauthorised person on top of the car (2).

12. An elevator system as claimed in any preceding claim wherein the sensing arrangement comprises means for emitting a sensing radiation (10) and means for detecting the emitted radiation (12) so as to enable the presence of an object in the path of the radiation to be detected.

13. An elevator system as claimed in claim 12 wherein the sensing arrangement (10,12) is such that the radiation travels substantially horizontally across the hoistway (4).

14. An elevator system as claimed in claim 12 or 13 wherein the sensing arrangement (10,12) comprises a plurality of beams spanning the hoistway and one or more sensors (12) arranged to detect said beam(s).

15. An elevator system as claimed in claim 12, 13 or 14 wherein said radiation is substantially infrared radiation.

16. A method of preventing injury to a person riding on top of an elevator car (2) in a low-overhead elevator system the method comprising detecting the presence of a person on top of the car as the car approaches the top of a hoistway (8) using means (10,12) provided in the hoistway and limiting further upward movement of the car in the event that a person is detected.

17. A method as claimed in claim 16 comprising detecting the presence of an object at a predetermined vertical point of the hoistway (4).

18. A method as claimed in claim 16 or 17 comprising distinguishing between a person riding on top of the car (2) and the car itself.

19. A method as claimed in claim 18 comprising using a position reference system to determine the position of the car (2) and limiting upward movement of the car only if it is determined via the position reference system that the elevator car is not intended to be in a position where it will be detected by the sensing arrangement (10,12).

20. A method as claimed in claim 19 comprising sending a signal to an elevator controller, the elevator controller limiting upward movement of the car (2) based on said signal and an output from the position reference system.

21. A method as claimed in claim 19 comprising enabling the sensing arrangement (10,12) when the elevator car (2) is towards the top of the hoistway (4) but still low enough that there is sufficient space between the top of the car and the top of the hoistway to accommodate a person.

22. A method as claimed in claim 21 comprising enabling the sensing arrangement (10,12) when the elevator car (2) is at a landing (16) below an uppermost landing (6).

23. A method as claimed in any of claims 19 to 22 comprising generating a position signal for disabling said sensing arrangement (10,12) as the sensing arrangement is approached by the car (2).

24. An elevator system as claimed in any of claims 19 to 22 comprising making a time measurement when the car (2) has passed a predetermined point and limiting movement of the car if the sensing arrangement (10,12) detects an object before it would be expected for the car itself to be detected.

25. A method as claimed in any of claims 16 to 24 comprising immediately preventing any further upward movement of the car (2) upon detection of an unauthorised person on top of the car.

26. A method as claimed in any of claims 16 to 25 comprising automatically employing a physical safety device upon detection of an unauthorised person on top of the car (2).

27. A method as claimed in any of claims 16 to 24 comprising emitting a sensing radiation and detecting the emitted radiation thereby to detect the presence of an object in the path of the radiation.

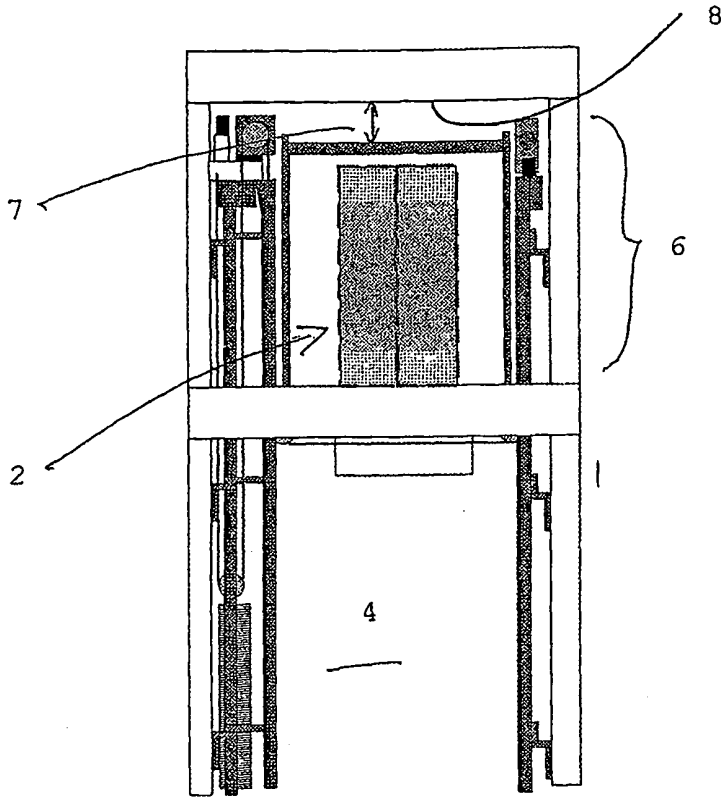


Fig. 1

Fig. 2a

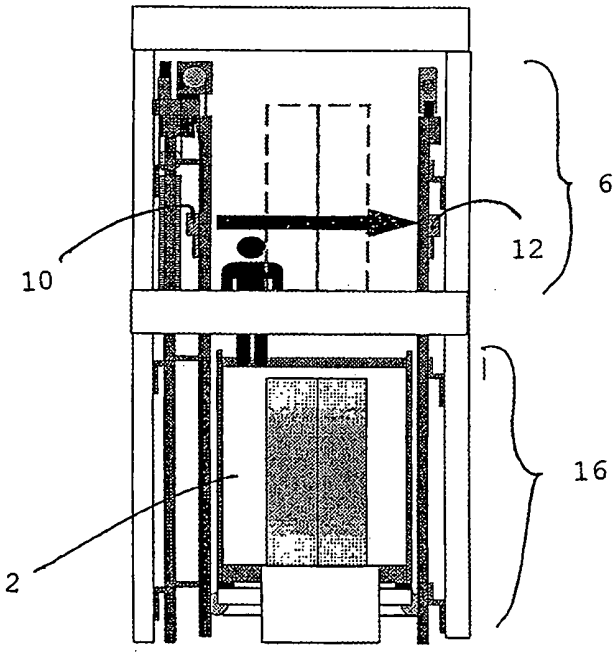
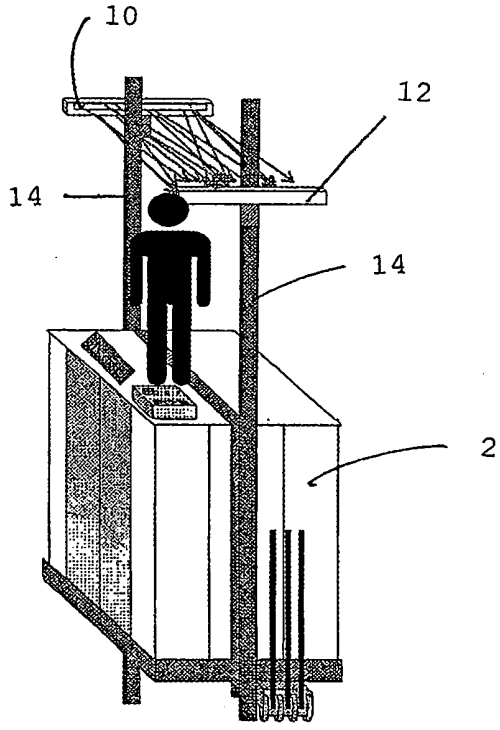


Fig. 2b



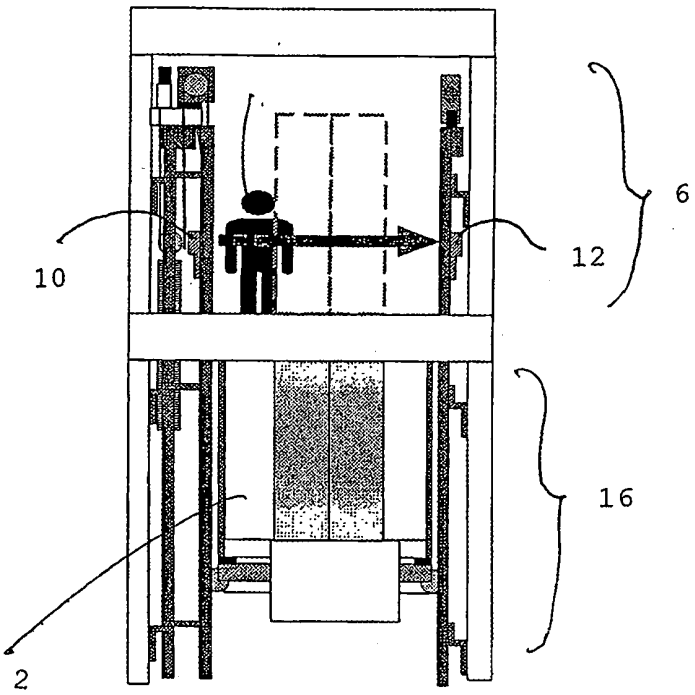


Fig. 3a

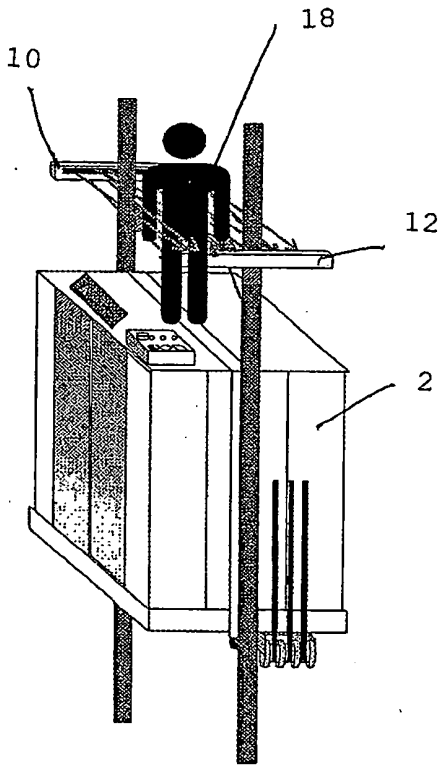


Fig. 3b

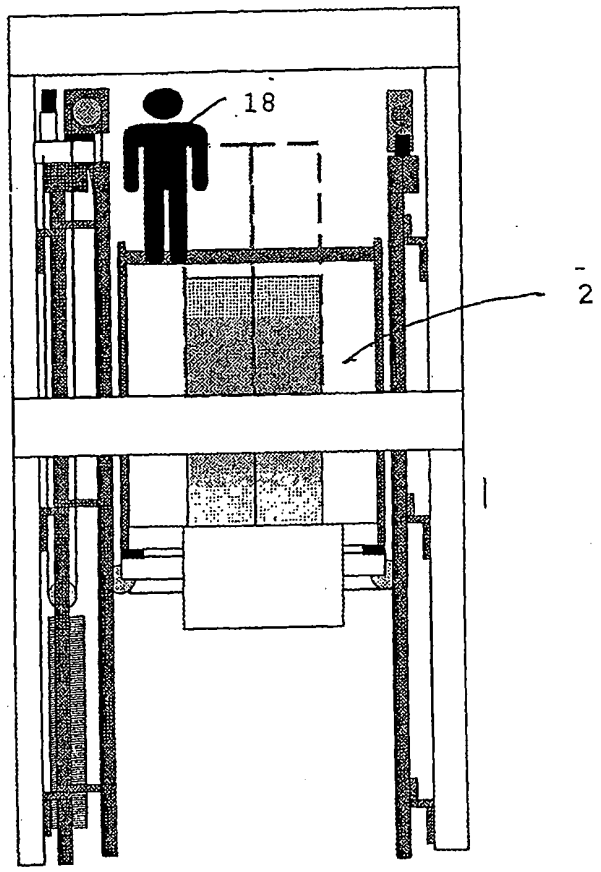


Fig. 4

INTERNATIONAL SEARCH REPORT

Int ɔnal Application No
PCT/IB2004/004249

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B66B5/00

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)
IPC 7 B66B

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 practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 167 268 A (MITSUBISHI DENKI KABUSHIKI KAISHA) 2 January 2002 (2002-01-02)	1,2,6,7, 10-17, 21,22, 25-27
A	column 5, line 50 - column 6, line 36	3-5,8,9, 18-20, 23,24
X	US 2004/173414 A1 (DEPLAZES ROMEO ET AL) 9 September 2004 (2004-09-09)	1,2,6,7, 10-17, 21,22, 25-27
A	paragraph '0035! - paragraph '0044!	3-5,8,9, 18-20, 23,24

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"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

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Date of the actual completion of the international search	Date of mailing of the international search report
26 August 2005	12/09/2005

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Ir tional Application No
PCT/IB2004/004249

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 02 046788 U (UNKOWN) 30 March 1990 (1990-03-30)	1,2,6,7, 10-17, 21,22, 25-27
A	figure 7	3-5,8,9, 18-20, 23,24

INTERNATIONAL SEARCH REPORT

Inte ›nal Application No
PC1/iB2004/004249

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		WO 03008316 A1	30-01-2003
		CN 1524058 A	25-08-2004
JP 2046788 U	30-03-1990	NONE	

[19] 中华人民共和国国家知识产权局

[51] Int. Cl.
B66B 5/00 (2006.01)

[12] 发明专利申请公布说明书

[21] 申请号 200480044658.7

[43] 公开日 2007 年 12 月 5 日

[11] 公开号 CN 101084157A

[22] 申请日 2004.12.21
[21] 申请号 200480044658.7
[86] 国际申请 PCT/IB2004/004249 2004.12.21
[87] 国际公布 WO2006/067542 英 2006.6.29
[85] 进入国家阶段日期 2007.6.20
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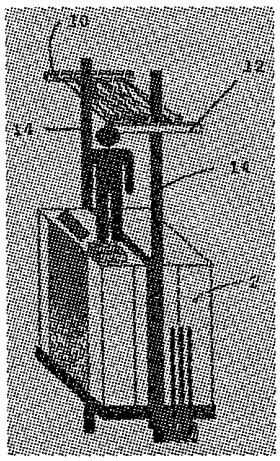
权利要求书 3 页 说明书 5 页 附图 4 页

[54] 发明名称

电梯安全系统

[57] 摘要

一种电梯系统，所述电梯系统包括井道(4)和被布置以在所述井道内垂直地行进的电梯轿厢(2)，所述井道设有当所述轿厢接近所述井道顶部(8)时用于检测所述轿厢顶部上的人员的存在情况的传感布置如红外帘幕(10、12)。所述电梯系统被布置以便在检测到人员的情况下限制所述轿厢产生进一步的向上移动。



1、一种电梯系统，所述电梯系统包括井道（4）和被布置以在所述井道内垂直地行进的电梯轿厢（2），所述井道进一步设有当所述轿厢接近所述井道顶部（8）时用于检测所述轿厢顶部上的人员的存在情况的传感布置（10、12），所述电梯系统被布置以便在检测到人员的情况下限制所述轿厢产生进一步的向上移动。

2、根据权利要求1所述的电梯系统，其中所述传感布置（10、12）适于在所述井道的预定垂直点处检测物体的存在情况。

3、根据权利要求1或2所述的电梯系统，其中所述预定垂直点位于所述电梯轿厢（2）的正常行程内，所述电梯系统被布置以便能够在站在所述轿厢顶部上的人员与在正常运行过程中已经行进至所述点的所述轿厢本身之间加以区分。

4、根据权利要求3所述的电梯系统，所述电梯系统在使用过程中被布置以利用位置参考系统确定所述轿厢（2）的位置，并且只有当通过所述位置参考系统确定出所述电梯轿厢并未旨在处于将由所述传感布置（10、12）检测到的位置处时，才限制所述轿厢的向上移动。

5、根据权利要求4所述的电梯系统，其中所述传感布置（10、12）被布置以将信号发送至电梯控制器，且所述电梯控制器被布置以基于所述信号和来自所述位置参考系统的输出限制所述轿厢（2）的向上移动。

6、根据权利要求4所述的电梯系统，其中所述传感布置（10、12）被布置以使得当所述电梯轿厢（2）朝向所述井道（4）的顶部移动但仍足够低以使得在所述轿厢的所述顶部与所述井道的所述顶部之间仍存在能够容纳人员的足够空间时，启动所述传感布置。

7、根据权利要求6所述的电梯系统，所述电梯系统被布置以使得当所述电梯轿厢处于低于最上部层站（6）下方的层站（16）处时，启动所述传感布置（10、12）处于使用状态。

8、根据权利要求4至7中任一项所述的电梯系统，包括当所述轿厢（2）接近所述传感布置时用于产生使所述传感布置（10、12）处于禁用状态的位置信号的装置。

9、根据权利要求4至7中任一项所述的电梯系统，包括当所述轿厢（2）已经通过预定点时用于进行时间测量的装置，所述电梯系统被

布置以使得如果在将预期检测到所述轿厢本身之前所述传感布置（10、12）检测到物体的存在，则限制所述轿厢的移动。

10、根据前述权利要求中任一项所述的电梯系统，包括在检测到未授权人员位于所述轿厢顶部上时用于立即防止所述轿厢（2）产生任何进一步的向上移动的装置。

11、根据前述权利要求中任一项所述的电梯系统，包括在检测到未授权人员位于所述轿厢（2）的顶部上时用于自动地采用物理安全装置的装置.

12、根据前述权利要求中任一项所述的电梯系统，其中所述传感布置包括用于发射传感射线的装置（10）和用于检测发射出的射线以使得能够检测所述射线路径中的物体的存在情况的装置（12）。

13、根据权利要求 12 所述的电梯系统，其中所述传感布置（10、12）使得所述射线大体上水平地行进穿过所述井道（4）。

14、根据权利要求 12 或 13 所述的电梯系统，其中所述传感布置（10、12）包括横跨所述井道的多条射束以及被布置以检测所述射束的一个或多个传感器（12）。

15、根据权利要求 12、13 或 14 所述的电梯系统，其中所述射线是大体上的红外射线。

16、一种防止站在低顶层电梯系统中的电梯轿厢（2）的顶部上的人员受伤的方法，所述方法包括当所述轿厢接近井道顶部（8）时，利用设置在所述井道中的装置（10、12）检测所述轿厢顶部上的人员的存在情况并且在检测到人员的情况下限制所述轿厢产生进一步的向上移动。

17、根据权利要求 16 所述的方法，包括在所述井道（4）的预定垂直点处检测物体的存在情况。

18、根据权利要求 16 或 17 所述的方法，包括在站在所述轿厢（2）的顶部上的人员与所述轿厢本身之间加以区分。

19、根据权利要求 18 所述的方法，包括利用位置参考系统确定所述轿厢（2）的位置，并且只有当通过所述位置参考系统确定出所述电梯轿厢并未旨在处于将由所述传感布置（10、12）检测到的位置处时，才限制所述轿厢的向上移动。

20、根据权利要求 19 所述的方法，包括将信号发送至电梯控制器，

所述电梯控制器基于所述信号和来自所述位置参考系统的输出限制所述轿厢（2）的向上移动。

21、根据权利要求 19 所述的方法，包括当所述电梯轿厢（2）朝向所述井道（4）的顶部移动但仍足够低以使得在所述轿厢的所述顶部与所述井道的所述顶部之间仍存在能够容纳人员的足够空间时，启动所述传感布置（10、12）。

22、根据权利要求 21 所述的方法，包括当所述电梯轿厢（2）处于低于最上部层站（6）下方的层站（16）处时，启动所述传感布置（10、12）。

23、根据权利要求 19 至 22 中任一项所述的方法，包括当所述轿厢（2）接近所述传感布置时产生使所述传感布置（10、12）处于禁用状态的位置信号。

24、根据权利要求 19 至 22 中任一项所述的方法，包括当所述轿厢（2）已经通过预定点时进行时间测量，并且如果在将预期检测到所述轿厢本身之前所述传感布置（10、12）检测到物体的存在，则限制所述轿厢的移动。

25、根据权利要求 16 至 24 中任一项所述的方法，包括在检测到未授权人员位于所述轿厢顶部上时立即防止所述轿厢（2）产生任何进一步的向上移动。

26、根据权利要求 16 至 25 中任一项所述的方法，包括在检测到未授权人员位于所述轿厢（2）的顶部上时自动地采用物理安全装置。

27、根据权利要求 16 至 24 中任一项所述的方法，包括发射传感射线并检测发射出的射线由此检测所述射线路径中的物体的存在情况。

电梯安全系统

本发明涉及对电梯安全性的改进，特别是涉及对电梯轿厢顶部上的人员的未授权存在情况的检测。

电梯设施中在电梯轿厢的常规行程上方设置非常小的空间变得越来越普遍，原因在于这降低了建筑成本，且增加了建筑设计可能获得的灵活性。然而，由于当轿厢接近最上部层站时，为站立在电梯轿厢顶部上的人员提供的避难空间变得更小，因此在低顶层电梯设施中进行作业存在受伤的风险。因此有必要设置一系列安全系统如可伸缩扶手栏杆和用于电梯控制器的防止轿厢行进至井道顶部的专用检查模式。这些措施允许站立在轿厢顶部上的工程师安全地实施经过授权的检查。然而，如果未全部适当地采用这些安全措施或者由于疏忽或故意的原因而对这些安全措施加以滥用，则增加了受伤的风险。这可能是由于工程师未坚持在批准的程序下实施检查过程而造成的或可能是由于未授权人员获得了接近轿厢顶部的机会而造成的。

就上述情况而言，所希望的是如果在轿厢顶部上存在人员则可自动地防止电梯轿厢移动至其行程的最上端。

从第一方面来看，本发明提供了一种包括井道和被布置以在所述井道内垂直地行进的电梯轿厢的电梯系统，所述井道进一步设有当所述轿厢接近所述井道顶部时用于检测所述轿厢顶部上的人员的存在情况的传感布置，所述电梯系统被布置以便在检测到人员的情况下限制所述轿厢产生进一步的向上移动。

从第二方面来看，本发明提供了一种防止站在低顶层电梯系统中的电梯轿厢顶部上的人员受伤的方法，所述方法包括当所述轿厢接近井道顶部时，利用设置在所述井道中的装置检测所述轿厢顶部上的人员的存在情况并且在检测到人员的情况下限制所述轿厢产生进一步的

向上移动。

因此，本领域的技术人员将意识到，根据本发明，当所述电梯轿厢向上移动时，将检测到处于在所述井道的顶部处受伤的危险中的人员，且所述电梯系统将限制所述轿厢的向上移动以降低该人员受伤的危险。

用于检测所述轿厢顶部上的人员的装置可以是能够在有生命的人与无生命的物体之间加以区别的装置，以使得在正常运行过程中，所述装置不会感测到所述轿厢本身的存在。例如，所述传感布置可包括用于感测所述轿厢顶部上的人员的体热的无源红外传感器。然而，所述传感布置优选适于在所述井道的相关垂直点处检测物体的存在情况。

可选择在所述井道中的位于所述电梯的正常行程上方的点，但在极低顶层的设施中，这可能无法提供足够的距离以便在不导致轿厢顶部上的人员受伤的情况下安全地停止所述轿厢。因此，根据优选实施例，感测点位于所述轿厢的所述正常行程内且所述电梯系统被布置以便能够在站在所述轿厢顶部上的人员与在正常运行过程中已经行进至所述垂直感测点的所述轿厢本身之间加以区分。尽管存在多种实现上述目的的方式，但优选的方式是利用现有位置参考系统以确定所述轿厢的位置，并且根据本发明，只有当通过所述位置参考系统确定出所述电梯轿厢并未旨在处于将由所述传感布置检测到的位置处时，才限制所述轿厢的向上移动。实现上述目的的一种方式是通过所述传感布置将信号发送至所述电梯控制器且所述电梯控制器被布置以基于来自所述传感布置和所述位置参考系统的信号限制所述轿厢的向上移动。

另一种可选方式是，当所述电梯轿厢朝向所述井道的所述顶部移动但仍足够低以使得在所述轿厢的所述顶部与所述井道的所述顶部之间仍存在能够容纳人员的足够空间时，启动所述传感布置。例如，当所述电梯轿厢处于低于所述最上部层站下方的层站处时，可启动所述传感布置。通过将所述传感布置定位在启动所述传感布置时所述电梯轿厢所处的位置上方，所述传感布置将仅检测到位于所述轿厢顶部上的物体而不是所述轿厢本身。当然，如果所述传感布置的位置使得所述电梯轿厢在正常运行过程中将经过所述传感布置，则这不应引起所述安全系统对所述轿厢移动的限制。一种可能性是利用第二位置信号

使所述传感器处于停用状态。另一种可选方式是，当所述电梯轿厢处于倒数第二层站上方时，进行时间测量以确定在将预期检测到所述轿厢本身之前是否检测到了物体的存在，此时可启动所述传感布置。

在检测到未授权人员位于所述轿厢顶部上时，存在多种采取行动以防止该人员受伤的可能性。例如，所述电梯控制器可通过切断所述电梯马达的电源并施加制动从而立即防止所述轿厢产生任何进一步的向上移动。此外，或另一种可选方式是，可自动地采用物理安全装置。

在一组优选的实施例中，所述传感布置包括用于发射传感射线的装置和用于检测发射出的射线以使得能够检测所述射线路径中的物体的存在情况的装置。所述传感布置可使得感测到从受到检测的本体反射回来的射线，但所述布置优选使得所述射线行进通过要进行检测的所述井道从而使得由于本体存在于所述井道中的该垂直点处而中断了对所述射线进行的感测。最优选地，所述传感布置包括横跨所述井道的多条射束以及被布置以检测所述射束的一个或多个传感器。

所采用的射线可具有任何适宜本征，如超声波、微波或可见光，但优选采用红外射线，原因在于相关联的传感器和发射器在可靠的同时相对易于获得且成本低廉。

下面将仅通过实例并结合附图对本发明的优选实施例进行描述，其中：

图 1 是低顶层（low overhead）电梯井道的前视图，图中示出了位于轿厢顶部上的人员所处的危险状态；

图 2a 和图 2b 分别是体现本发明的电梯系统的前视图和透视图，图中示出了启动红外帘幕（infrared curtain）的情况；

图 3a 和图 3b 分别是前视图和透视图，图中示出了检测到位于所述轿厢顶部上的未授权人员的情况；和

图 4 是图 2 和图 3 所示实施例的前视图，其中所述轿厢安全地停止以防止位于所述轿厢顶部上的人员受伤。

图 1 示出了被布置以在井道 4 内垂直移动的电梯轿厢 2。可以看到，

当轿厢 2 邻近最上部层站 6 时，在轿厢 2 的顶部与井道的顶板 8 之间存在非常小的空间 7。特别是，没有为碰巧位于轿厢顶部上的人员提供的避难空间。

在低顶层系统例如如图所示的系统中，需要采取一些列安全措施以确保顶部上有人的轿厢不能到达最上部层站 6。通常情况下，这些系统与特定条件相关联，如将电梯置于专用检测模式或检测以未授权方式打开井道门的情况从而表明有未授权人员接近了轿厢顶部。

然而，检测元件被滥用（overridden）或电梯未被适当地置于检查模式都是有可能的。特别是，门检测系统可被随后可站在处于正常模式下的轿厢顶部上的未授权使用者滥用。从图 1 中可以看到，这是极为危险并且可能是致命的。根据本发明可防止这种情况的发生，现在将结合图 2 至图 5 对本发明进行描述。

根据在此所述的本发明的实施例，在井道 2 的最上部分中，设置了红外传感器和发射器布置，所述布置包括通过被附接到相应的导轨 14 上而被水平地设置在电梯竖井内的细长的发射器阵列 10 和相应的细长的传感器阵列 12。在如图所示的实施例中，发射器阵列 10 包括多个独立的发射器，所述发射器发射出以多个不同角度横跨井道且将要由位于井道另一侧上的传感器阵列 12 中的相应的多个传感器感测到的红外射束。通过设置多个独立的发射器和传感器，可降低对例如井道中的小块碎片或飞动的昆虫进行误检测的可能性。然而，设想可采用单条射束，所述单条射束可仅横跨井道一次或另一种可选方式是可被反射一次或多次以提供更大的空间范围。

可以看到，传感器和发射器阵列 10、12 被设置在沿最上部层站空间 6 向上延伸的路径的约三分之一的位置处。当电梯轿厢 2 邻近最上部层站 6 下方的层站 16 时，传感布置 10、12 被启动。正如现在结合图 3A 和图 3B 可以看到地，当电梯轿厢向上移动超出倒数第二层站 16 时，位于轿厢顶部上的未授权人员 18 将阻断发射器阵列 10 与传感器阵列 12 之间的红外射束，这种情况将作为传感器阵列信号中断的情况而被传感器阵列 12 检测到。一旦已经检测到这种情况，则将防止电梯轿厢 2 产生进一步的向上移动且将施加制动。从图 2A 中可以看到，这意味着在轿厢 2 的顶部上方保留有足够的空间以防止位于轿厢顶部上的未授权人员 18 受伤。尽管并非必要，但该系统可被布置以便在其可

重新开始正常运行之前需要例如由授权工程师进行手动重置。

如果在轿厢顶部上没有未授权人员，则当轿厢向上移动至最上部层站 6 时，轿厢顶部本身将最终阻断发射器阵列 10 与传感器阵列 12 之间的射束。然而，这不会导致轿厢中止运行，原因在于位置参考系统（PRS）信号表明轿厢正按预期情况处于使其中断射束的位置处。

本领域的技术人员应该意识到，可在不偏离本发明的范围的情况下对所述实施例作出多种改变和变型。例如，可设置用于检测轿厢顶部上的人员的存在情况的其它装置，如可见光、超声、微波或其它传感器。此外，可利用定时信号而不是位置信号以在轿厢与位于轿厢顶部上的未授权人员之间加以区分。

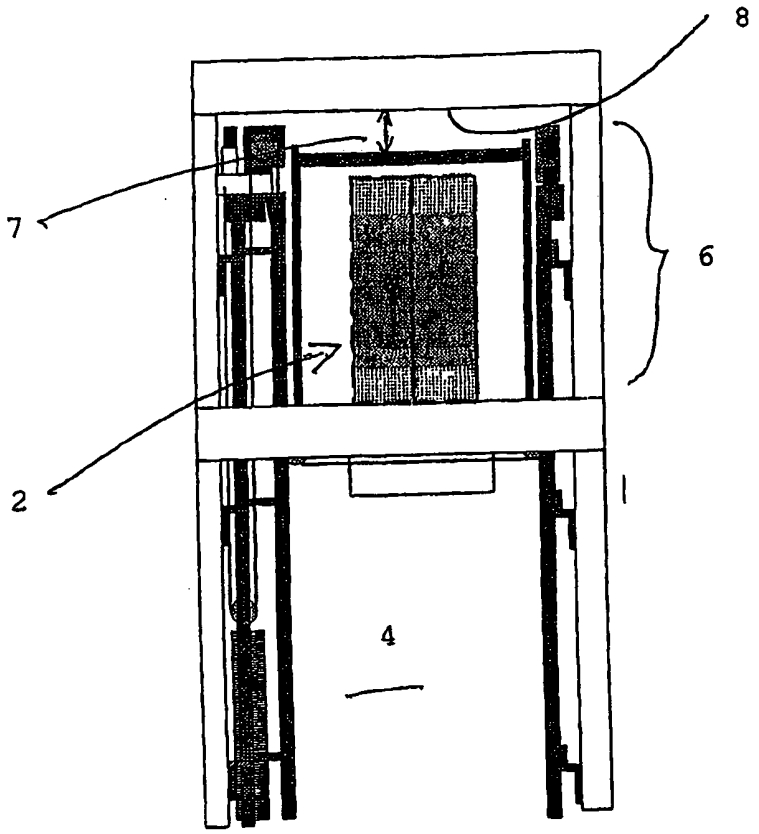


图 1

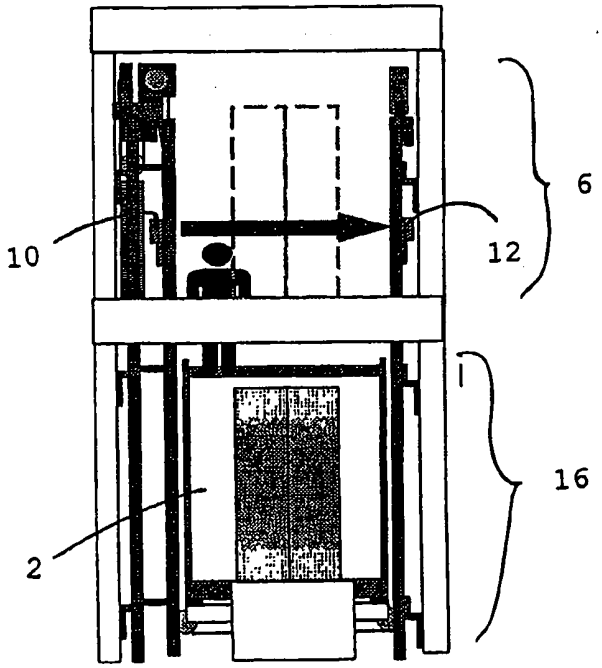


图 2a

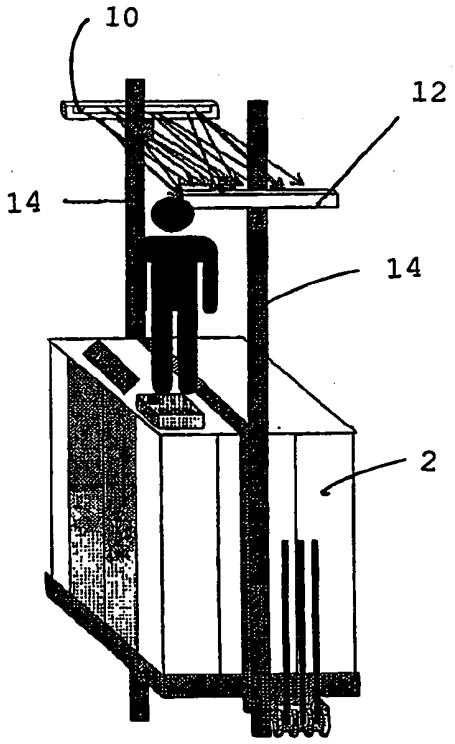


图 2b

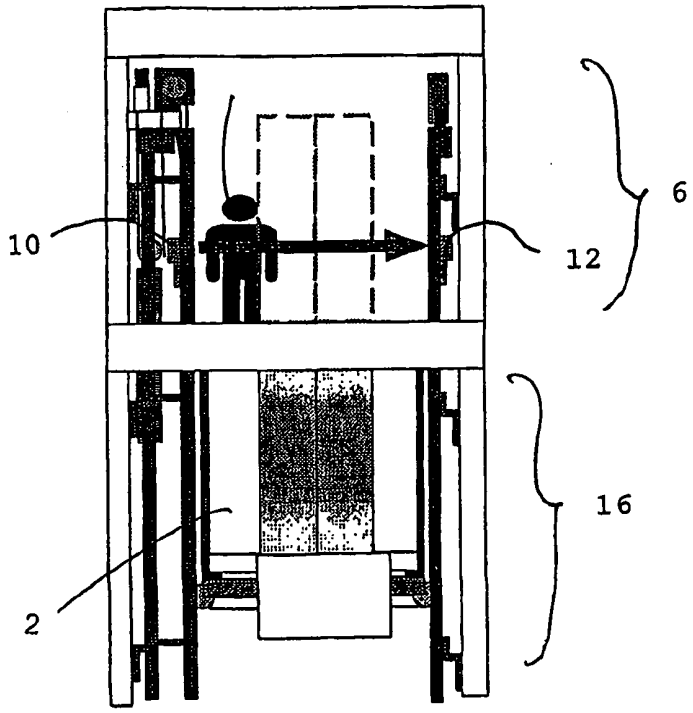


图 3a

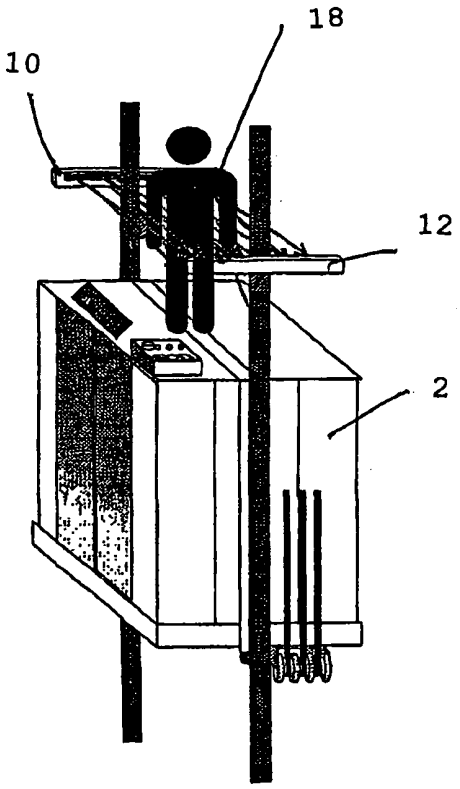


图 3b

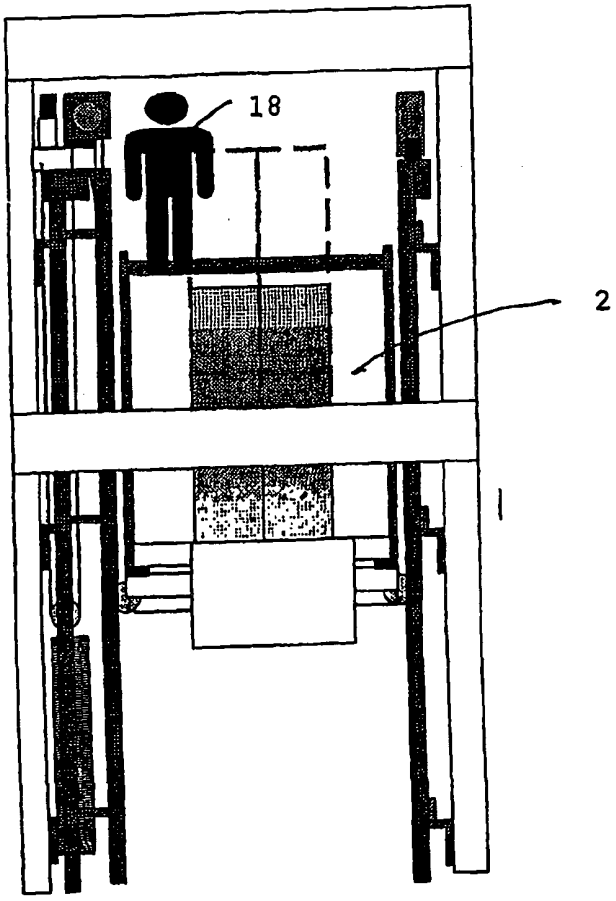


图 4