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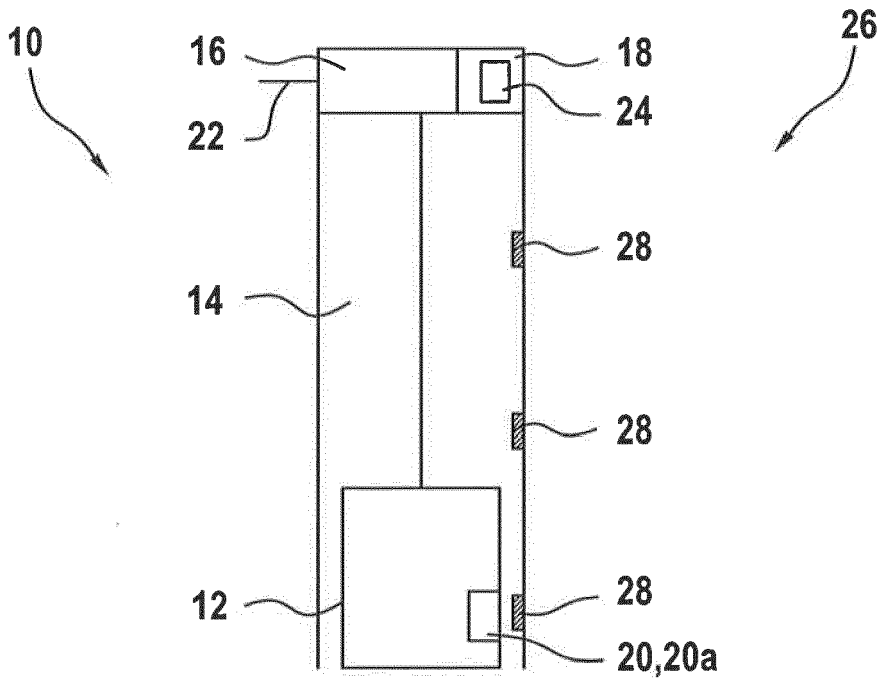
## (54) AVOIDING SYNCHRONISATION RUNS OF AN ELEVATOR

(57) A controller (18) for an elevator (10) comprises a non-volatile memory (24) for storing an elevator position during a power outage without power supply, wherein the controller (18) is adapted for determining an elevator position based on a signal from a sensor (20) of the elevator (10) and wherein the controller (18) is adapted for storing the elevator position in the non-volatile memory (24) and for initialising an actual elevator position by reading the stored elevator position from the non-volatile memory (24) after a reboot of the controller (18).

Fig. 1




EP 3 124 417 A1

## Description

**[0001]** The present invention relates to a controller for an elevator, a method to initialise an elevator and an elevator position determining system.

**[0002]** To save costs, some types of elevators do not have an auxiliary power supply, which supplies the control component of the elevator with electrical power, when the power supply of the elevator is interrupted. An interruption of the power supply may be caused by a power failure, when the elevator is disconnected from a supply grid (for example during the night) or during maintenance of the elevator.

**[0003]** When the power supply is restored, an elevator without auxiliary power supply usually has to perform a synchronisation run, to re-establish the position of the elevator car in the hoistway. This may even happen when the elevator car is stationery, i.e. has not moved during the power outage.

**[0004]** For example, in areas with non-optimal power supply, there may be an average of three power failures per day resulting in more than 1000 synchronisation runs per year.

**[0005]** However, every synchronisation run may result in a loss of elevator availability, a loss of energy and undesirable wear and tear of components/parts such as contactors, IGBTs, capacitors, mechanical moving parts, etc.

**[0006]** In JPH02305780 A, a backup battery circuit is used during outage of normal power to maintain electrical supply to a position encoder so that the position of the elevator can be continuously determined from the encoder pulse count so that the elevator can automatically resume normal operation on the resumption of the main power supply without the need for a synchronisation run.

**[0007]** EP 0 757 011 A2 mentions an independently powered transceiver disposed on the elevator car for generating a query signal and a transponder disposed in the elevator hoistway. According to EP 0 757 011 A2, for proper operation, a non-volatile memory requires a secondary power supply, such as a battery.

**[0008]** There may be a need for decreasing operation- and maintenance costs for an elevator caused by synchronisation runs.

**[0009]** Such a need may be met with the subject-matter of the independent claims. Advantageous embodiments are defined in the dependent claims.

**[0010]** Ideas underlying embodiments of the present invention may be interpreted as being based, inter alia, on the following observations and recognitions.

**[0011]** A first aspect of the invention relates to a controller for an elevator. For example, the controller may comprise a processor for executing a computer program, ASICs, etc. Also, the controller may comprise ROM (storing the computer program) and/or RAM (to be used by the computer program during the operation of the controller).

**[0012]** According to an embodiment of the invention, the controller comprises a non-volatile memory for storing an elevator position during a power failure, wherein the non-volatile memory is adapted for storing the elevator position without power supply. In other words, the non-volatile memory does not lose the stored values without power supply. For example, such a non-volatile memory may be based on an EPROM and/or a FLASH memory. The non-volatile memory does not need a battery and/or external capacitor to keep its contents.

**[0013]** Furthermore, the controller is adapted for determining an elevator position based on a signal from a sensor of the elevator, for storing the elevator position in the non-volatile memory and for initialising an actual elevator position by reading the stored elevator position from the non-volatile memory after a reboot of the controller. For example, every time the elevator position changes (for example, when the elevator car moves to another floor), the controller may update the value in the non-volatile memory. After a power outage (a power failure of a power grid or when the elevator is reconnected to its power supply), the controller reboots and reads the stored elevator from the non-volatile memory.

**[0014]** In such a way, the number of synchronisation runs of an elevator after power outages may be reduced without requiring an additional backup power supply or additional position sensors/encoders. Only the software of the controller may have to be modified and/or the controller may have to be equipped with a low cost non-volatile memory circuit.

**[0015]** A further aspect of the invention relates to a method for initialising an elevator. For example, the method may be performed by the controller. It may be possible that the method is implemented in software running in the controller.

**[0016]** According to an embodiment of the invention, the method comprises: storing an elevator position in a non-volatile memory of a controller of the elevator, the non-volatile memory being adapted for storing the elevator position without power supply; and after a reboot of the controller, reading the elevator position from the non-volatile memory to initialise an actual elevator position. During normal operation (i.e. when there is a normal supply of power of the elevator), the controller may determine the elevator position and may store it in the non-volatile memory. The storage of the elevator position may be performed on a continuously or on an intermediate basis, for example at floor levels. After a power outage, during reboot of the controller, the actual elevator position may be read from the non-volatile memory, i.e. it is assumed that the elevator car has not moved during the power outage.

**[0017]** According to an embodiment of the invention, the method further comprises: after a reboot of the controller, checking, whether the value stored in the non-volatile memory is invalid; and when the value is invalid, performing a synchronisation run of the elevator to determine the elevator position with the aid of a sensor.

**[0018]** For example, the value stored in the non-volatile

memory may be a floor number/floor level and/or may be a distance value to a base position. Bounds for these values may be provided in the controller. An invalid value may be a value outside of these bounds. It may be possible to reset the non-volatile memory and in this case, the elevator position may be invalid.

**[0019]** When no valid elevator position is stored in the non-volatile memory, the controller may perform a synchronisation run. For example, the controller may detect an actual position from a sensor signal and may compare it with the stored elevator position: If both positions are equal, then the stored elevator position may be declared as valid.

**[0020]** As an example, if there is no major change (i. e. movement) during the interim period of the power outage, then the controller may resume normal operation immediately without doing a synchronisation run. Otherwise, the elevator may execute a synchronisation run and then may switch into normal operation. In general, a synchronisation run may comprise moving the elevator car to a specific position (such as a base position) and then to determine the elevator position based on sensor signals.

**[0021]** According to an embodiment of the invention, the method further comprises: storing an invalid value in the non-volatile memory, when the elevator position becomes invalid. For example, during normal operation, the controller may decide that the stored position is invalid, which may be the case, when the elevator car is actually moving and/or when the elevator car is between two floors. In this case, the controller may actively store an invalid value in the non-volatile memory.

**[0022]** According to an embodiment of the invention, the method further comprises: determining the elevator position from a signal of a position encoding sensor adapted for determining a distance of an elevator car to a lowest floor. For example, the elevator may comprise a sensor adapted for encoding the elevator position itself. It has to be understood that in this case, an elevator position may be provided with a discrete set of numbers, which encodes much more positions than only the floor numbers.

**[0023]** For example, in the case of elevator positions provided by a sensor, a floor number may be determined from the elevator position with a mapping table. Dedicated ranges and/or values of elevator positions may be mapped to specific floor numbers.

**[0024]** According to an embodiment of the invention, the method further comprises: determining the elevator position from a signal of a door zone sensor adapted for determining, whether the elevator car is in a door zone or not. It may be possible that the elevator (and in particular the sensor) only detects that the elevator car has reached a floor level or not (the signal then may be a yes/no-signal). Such a sensor may comprise a magnet attached to the hoistway at every floor.

**[0025]** According to an embodiment of the invention, the elevator position is determined by counting up or down a floor number, when a door zone is passed. For example, the floor number may be increased, when the elevator car is moving up and the next floor level is reached. Analogously, the floor number may be decreased, when the elevator car is moving down and the next floor level is reached. During a synchronisation run, in the beginning the elevator car may be moved as much down as possible and the floor number may be set to 0.

**[0026]** According to an embodiment of the invention, the method further comprises: when the elevator car reaches a door zone, storing the elevator position (in the form of a floor number) in the non-volatile memory; and when the elevator car leaves the door zone, setting the elevator position to an invalid value. In this case, the elevator position after a reboot of the controller only may be valid, when the power outage takes place when the elevator car is resting at a floor level and/or at a door zone.

**[0027]** According to an embodiment of the invention, the method further comprises: after a reboot of the controller: checking, whether the elevator is in a door zone; and when the elevator is not in a door zone, performing a synchronisation run of the elevator to determine the elevator position with the aid of a sensor. It also may be possible that the synchronisation run is avoided, when the elevator car is in a door zone. In this case, it may be assumed that the power outage has not taken place during a time in which the elevator car was between two floor levels.

**[0028]** A further aspect of the invention relates to an elevator position determining system, comprising a sensor and a controller adapted for determining a position of an elevator car in a hoistway of the elevator from a signal of the sensor and adapted for performing the method as described in the above and in the following. In general, the system may comprise the controller and a sensor from which signal the controller determines the elevator position.

**[0029]** According to an embodiment of the invention, the sensor is a position encoding sensor adapted for determining a distance of an elevator car to a lowest floor, such as a sensor providing an encoded signal. It also may be possible that the sensor is a door zone sensor adapted for determining, whether the elevator car is in a door zone or not. A door zone of a specific floor may be a range of positions of the elevator car, in which the door of the elevator car at the specific floor may be opened and closed.

**[0030]** In the following, advantageous embodiments of the invention will be described with reference to the enclosed drawings. However, neither the drawings nor the description shall be interpreted as limiting the invention.

Fig. 1 schematically shows an elevator position determining system according to an embodiment of the invention.

Fig. 2 schematically shows an elevator position determining system according to a further embodiment

of the invention.

Fig. 3 shows a flow diagram for a method for determining and/or initialising an elevator position according to a further embodiment of the invention.

**[0031]** The figures are only schematic and not to scale. Same reference signs refer to same or similar features.

**[0032]** Fig. 1 schematically shows an elevator 10 comprising an elevator car 12 in a hoistway 14, which elevator car 12 may be moved via a motor 16 up and down in the hoistway 14. Furthermore, the elevator comprises a controller 18, which controls the movement of the elevator car 12 and upon signals from a sensor 20 determines the position of the elevator car 12 in the hoistway 14.

**[0033]** The elevator 10 (and its controller 18) is supplied via an electrical grid 22 with electrical power. The controller 18 does not need to have an auxiliary power supply such as a battery to maintain operation during a power outage, but has a non-volatile memory 24 adapted for storing data without a continuous power supply. The non-volatile memory 24 may be an EPROM or a FLASH memory.

**[0034]** Fig. 1 shows an elevator position determining system 26 which comprises the controller 18 and a door zone sensor 20a, which provides a simple yes/no-signal depending on the elevator car 12 being in a door zone or not. For example, the door zone sensor 20a may comprise magnets 28 indicating that a door zone has been reached.

**[0035]** The controller 18 may determine the elevator position by counting down and up a floor number, based on the movement of the elevator car 12 and the door zones reached.

**[0036]** Fig. 2 shows an elevator position determining system 26, which comprises the controller 18 and a position encoding sensor 20b, which is adapted for providing a signal encoding a position of the elevator car 12. The signal may encode a specific number indicating the actual position, which number may be mapped to a floor number.

**[0037]** Fig. 3 shows a flow diagram for a method that may be performed by the controller 18.

**[0038]** In step S10, during normal operation, the controller 18 determines an elevator position based on sensor signals and stores it in the non-volatile memory 24. As described above, the elevator position may be determined based on reached door zones via a sensor 20a and/or via a sensor 20b.

**[0039]** The controller 18 may be in normal operation, when it is not reset, rebooting or disconnected from its power supply via the electrical grid 22.

**[0040]** It also may be possible that the controller 18 decides that the value stored in the non-volatile memory 24 is not valid (any more). For example, this may be the case, when the elevator car 12 is between two floors and/or is moving. In this case, the controller 18 may store an invalid value in the non-volatile memory 24. For example, such an invalid value may be the Hex-Integer "FF" as floor number.

**[0041]** In step S12, after a power outage, the controller 18 reboots. For example, the power outage may have been caused due to a power failure or by disconnecting the elevator 10 from the power supply 22 on purpose.

**[0042]** The controller 18 then may read the elevator position stored in the non-volatile memory 24 and/or may determine whether this value is valid.

**[0043]** For example, the stored elevator position may be valid, when there was no elevator movement, which may be determined from a signal from a position encoding sensor 20b, which may be compared with the stored elevator position. When the stored position has not undergone any major change, then there may be no need for correction run and the elevator position may be declared as valid.

**[0044]** Furthermore, the stored elevator position may be valid, when the elevator car 12 is still in a door zone, which may be determined form a signal of a door zone sensor 20a. Also, the stored elevator position may be valid, when the value is within bounds of correct values and/or when it is not a specific invalid value (such as "FF", see above).

**[0045]** When the stored elevator position is valid, the controller 18 resumes in step S 14 and uses the stored elevator position as actual elevator position. After that, the controller 18 switches back into normal operation mode.

**[0046]** When the stored elevator position is not valid, the controller 18 resumes in step S16 and starts a synchronisation run, in which the actual elevator position is determined from sensor signals. After that, the controller 18 switches back into normal operation mode.

**[0047]** As example, when there is a reset of the controller 18, after the reboot, the controller 18 may check, if the elevator car 12 is in the door zone.

**[0048]** If it is in the door zone, the controller 18 may check the value in the non-volatile memory 24. If the value in the non-volatile memory 24 is a valid floor level, the controller 18 assumes that it is on a particular floor level any may resume normal operation immediately without doing a synchronisation run. However, if the value in the flash is not valid, the controller 18 may execute a synchronisation run and then may go into normal operation mode.

**[0049]** If the elevator car 12 is not in the door zone, the controller 18 may directly perform a synchronisation run and then may go into normal operation mode.

**[0050]** Finally, it should be noted that the term "comprising" does not exclude other elements or steps and the "a" or "an" does not exclude a plurality. Also elements described in association with different embodiments may be combined. It should also be noted that reference signs in the claims should not be construed as limiting the scope of the claims.

List of reference signs

**[0051]**

| | |
|---|---|
| 10 | elevator |
| 12 | elevator car |
| 14 | hoistway |
| 16 | motor |
| 18 | controller |
| 20 | sensor |
| 20a | door zone sensor |
| 20b | position encoding sensor |
| 2 2 | power supply |
| 24 | non-volatile memory |
| 26 | elevator position determining system |
| 28 | magnet |

**Claims**

**1.** A controller (18) for an elevator (10), comprising:

a non-volatile memory (24) for storing an elevator position during a power outage without power supply;
wherein the controller (18) is adapted for determining an elevator position based on a signal from a sensor (20) of the elevator (10);
wherein the controller (18) is adapted for storing the elevator position in the non-volatile memory (24) and for initialising an actual elevator position by reading the stored elevator position from the non-volatile memory (24) after a reboot of the controller (18).

**2.** The controller of claim 1,
wherein the non-volatile memory (24) comprises an EPROM.

**3.** The controller of claim 1 or 2,
wherein the non-volatile memory (24) comprises a FLASH memory.

**4.** A method for initialising an elevator (10), the method comprising:

storing an elevator position in a non-volatile memory (24) of a controller (18) of the elevator (10), the non-volatile memory (24) being adapted for storing the elevator position without power supply;
after a reboot of the controller (18):

reading the elevator position from the non-volatile memory (24) to initialise an actual elevator position.

**5.** The method of claim 4, further comprising:

after a reboot of the controller:

checking, whether the value stored in the non-volatile memory (24) is invalid;
when the value is invalid, performing a synchronisation run of the elevator to determine the elevator position with the aid of a sensor (20).

**6.** The method of claim 5, further comprising:

storing an invalid value in the non-volatile memory (24), when the elevator position becomes invalid.

**7.** The method of one of claims 4 to 6, further comprising:

determining the elevator position from a signal of a position encoding sensor (20b).

**8.** The method of claim 7,
wherein a floor number is determined from the elevator position with a mapping table.

**9.** The method of one of claims 4 to 8, further comprising:

determining the elevator position from a signal of a door zone sensor (20a) adapted for determining, whether the elevator car (12) is in a door zone.

**10.** The method of claim 9,
wherein the elevator position is determined by counting up or down a floor number, when a door zone is passed.

**11.** The method of one of claims 4 to 10, further comprising:

when the elevator car (12) reaches a door zone, storing the elevator position in the non-volatile memory (24);
when the elevator car (12) leaves the door zone, setting the elevator position to an invalid value.

**12.** The method of one of claims 4 to 11, further comprising:

after a reboot of the controller (18):

checking, whether the elevator (10) is in a door zone;
when the elevator (10) is not in a door zone, performing a synchronisation run of the elevator (10) to determine the elevator position with the aid of a sensor (20).

**13.** An elevator position determining system (26), comprising:

a sensor (20);
a controller (18) adapted for determining a position of an elevator car (12) in a hoistway (14) of an elevator (10) from a signal of the sensor (20) and adapted for performing the method of one of the preceding claims.

**14.** The system of claim 13,
wherein the sensor (20) is a position encoding sensor (20b); and/or
wherein the sensor (20) is a door zone sensor (20a) adapted for determining, whether the elevator car (12) is in a door zone or not.

Fig. 1

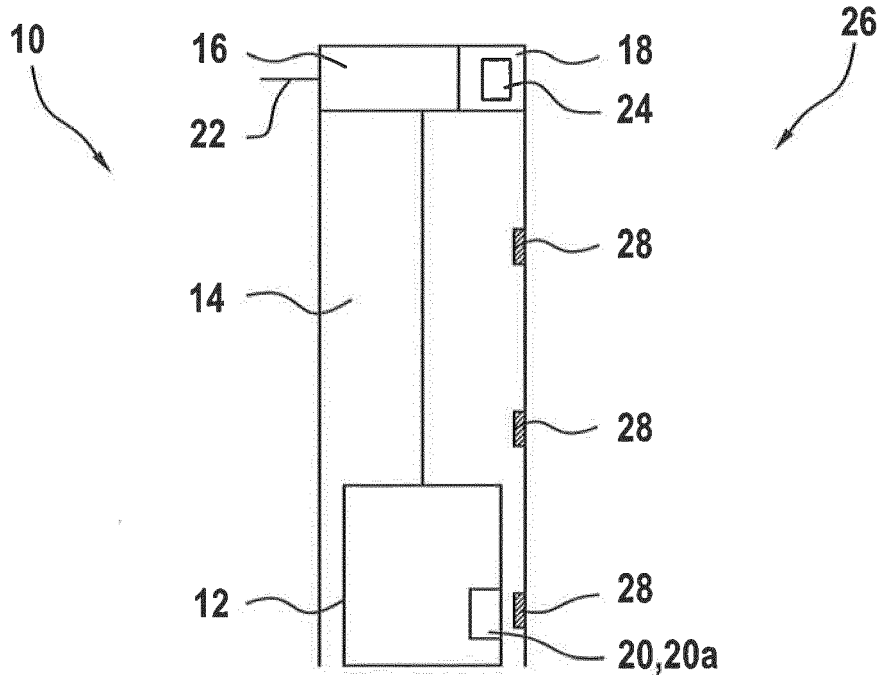



Fig. 2

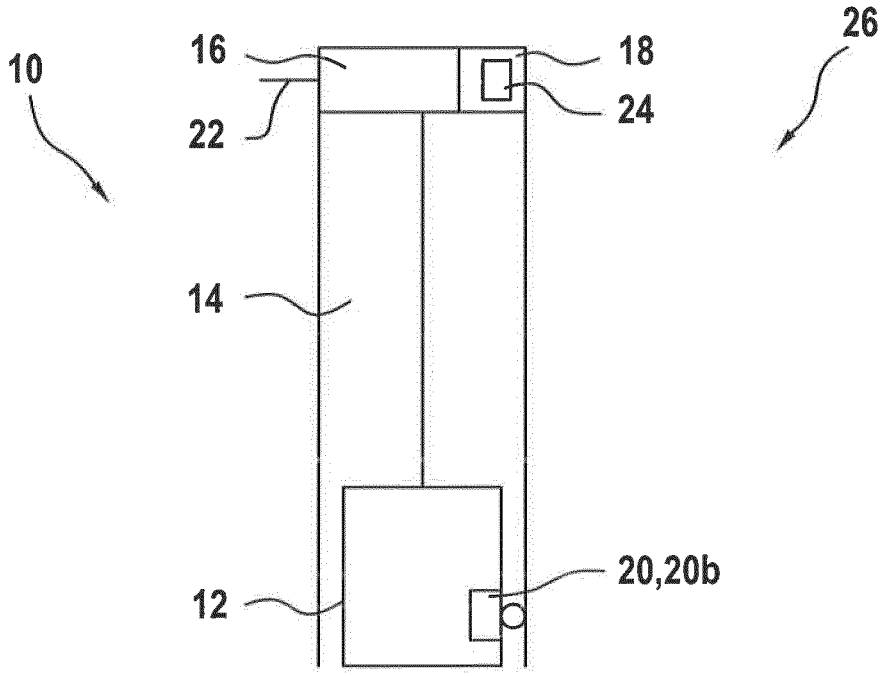
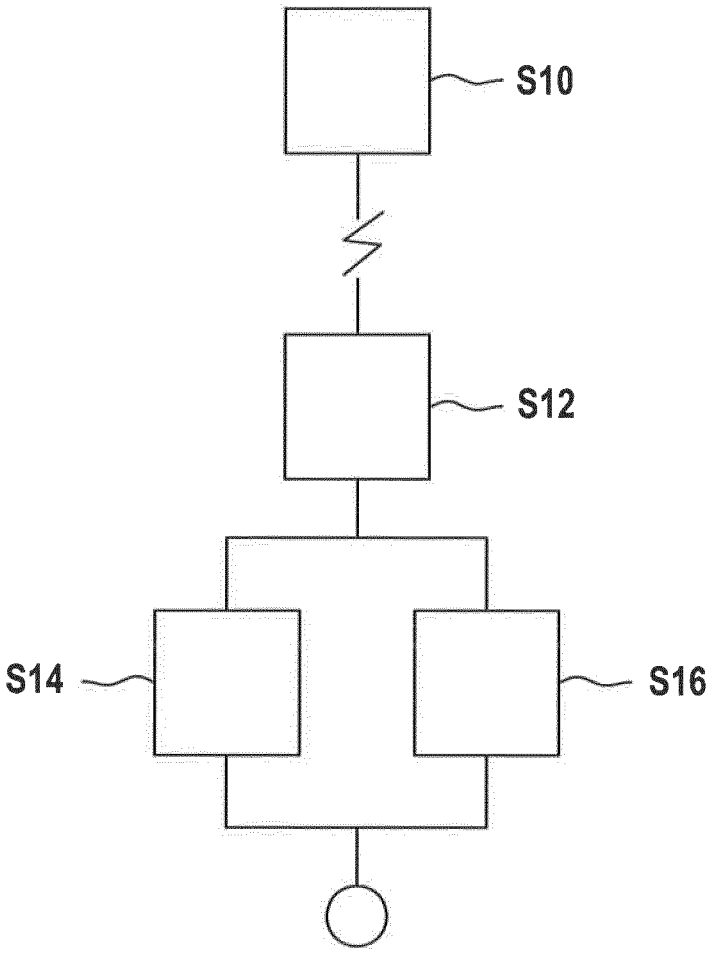


Fig. 3



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# EUROPEAN SEARCH REPORT

Application Number
EP 15 17 8969

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X<br>Y | US 5 153 390 A (BARKMAN WILLIAM F [US] ET AL) 6 October 1992 (1992-10-06)<br>* column 2, line 36 - column 3, line 58; figure 1 * | 1,4-6,13<br>2,3,<br>7-12,14 | INV.<br>B66B1/34<br>B66B3/00<br>B66B5/00 |
| Y<br>A | US 4 852 694 A (ARABORI NOBORU [JP] ET AL) 1 August 1989 (1989-08-01)<br>* column 1, line 66 - column 2, line 8; figures 1,3,5,6 * | 2<br>1 | |
| Y | WO 2014/191616 A1 (KONE CORP [FI])<br>4 December 2014 (2014-12-04)<br>* page 2 - page 9; figure 1 * | 7-12,14 | |
| Y<br>A | JP 2004 110400 A (TOSHIBA ELEVATOR CO LTD)<br>8 April 2004 (2004-04-08)<br>* abstract *<br>* paragraph [0021] *<br>* paragraphs [0049] - [0052] * | 3<br>1,2 | |

TECHNICAL FIELDS SEARCHED (IPC)

B66B

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 15 January 2016 | Iuliano, Emanuela |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 17 8969

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15-01-2016

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| US 5153390 A | 06-10-1992 | CA 2059009 A1 | 16-09-1992 |
| | | US 5153390 A | 06-10-1992 |
| US 4852694 A | 01-08-1989 | NONE | |
| WO 2014191616 A1 | 04-12-2014 | FI 124268 B | 30-05-2014 |
| | | WO 2014191616 A1 | 04-12-2014 |
| JP 2004110400 A | 08-04-2004 | JP 4115219 B2 | 09-07-2008 |
| | | JP 2004110400 A | 08-04-2004 |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- JP H02305780 A **[0006]**
- EP 0757011 A2 **[0007]**