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

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**AVOIDING SYNCHRONISATION RUNS OF AN ELEVATOR**

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

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.

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 stationary, i.e. has not moved during the power outage.

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.

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.

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.

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.

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

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

Ideas underlying embodiments of the present invention may be interpreted as being based, inter alia, on the following observations and recognitions. Such a need may be met with the subject-matter of the independent claims. Advantageous embodiments are defined in the dependent claims.

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).

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.

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.

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.

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.

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.

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.
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 car is moving 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.
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.

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

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.

The controller 18 may be in normal operation, and/or via a sensor 20b. The controller 18 may determine the elevator position based on sensor signals and stores it in the non-volatile memory 24. After that, the controller 18 switches back into normal operation mode.

As described above, the elevator position 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.

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 a sensor 20b. The controller 18 then may read the elevator position as actual elevator position. After that, the controller 18 switches back into normal operation mode.

In step S11, during normal operation, the controller 18 determines an elevator position based on sensor signals and stores it in the non-volatile memory 24. After that, the controller 18 switches back into normal operation mode.

As example, such an invalid value may be the Hex-Integer "FF" as floor number.
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
22 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. 3
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<th>Relevant to claim</th>
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The present search report has been drawn up for all claims.

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

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