Method for an Elevator

The present invention relates to a method for commissioning an elevator.

In an elevator system, a car is typically moved vertically along a travel path between different floors or levels within a building. An elevator car can have more than one car door.

Modern elevators have floor doors that have their own drive mechanism. The international application WO 2022 228 959 A1 discloses such an elevator. The shaft doors and car doors each have their own drives. To ensure that the shaft doors only open when the car is present on the floor, the shaft doors have presence detectors that detect the presence of the car in front of the shaft doors.

If the car has only one car door and is located at a floor, the floor door opposite the car door will recognize the car. If the car has two car doors, and the car has stopped at a floor where there are two shaft doors of this elevator, then two of the plurality of shaft doors will recognize a car. These are the two shaft doors on this floor. However, it is not immediately clear which of the two shaft doors forms a passage with which of the two car doors. The elevator control system must first learn which of the shaft doors on which floor belongs to the first car door, and which shaft doors belong to the second car door. For this, the installation technician must manually train this via a control interface of the controller. This is very time-consuming and prone to errors, and therefore expensive.

Therefore, one goal can be seen as making the process of commissioning such an elevator more convenient and error-free.

According to a first aspect of the invention, the object is achieved by a method for commissioning an elevator. A car of the elevator can travel between a plurality of floors. The car has a first car door and a second car door. On at least one of the plurality of floors, there is a front shaft door and a rear shaft door. Either the front shaft door or the rear shaft door is designed to allow, together with the first car door, initial passage into the car. The other of the front shaft door or the rear shaft door is designed to allow, together with the second car door, a second passage into the car. Each of the doors has an

independent door drive. A first sensor monitors the first passage. A second sensor monitors the second passage.

The method comprises the steps of:

- stopping the car on one of the floors with one of the front shaft doors and one of the rear shaft doors,
- opening the front shaft door or the rear shaft door on this floor,
- opening the first car door or the second car door,
- evaluating the sensor associated with the open car door to determine whether the passage through the open car door is open, and
- assigning one of the two shaft doors of the front shaft door or the rear shaft door to one of the first or the second car doors.

Possible features and advantages of embodiments of the invention can be regarded, *inter alia* and without limiting the invention, as being based upon the concepts and findings described below.

After the elevator is installed, a commissioning procedure is typically performed on the elevator. During commissioning, the elevator's control system is supplied with information that the control system needs for the safe and productive operation of the system. The controller can, for example, control and monitor, among other things, the drive of the elevator, the locking of the doors, the movement of the doors by a door drive, and safety functions of the elevator. The controller can be located in one control device or distributed across a plurality of control devices.

An elevator can be commissioned immediately after its installation or at a later time. For example, the elevator may need to be recommissioned after a software update. The steps of this method can be described as a learning run.

The elevator typically includes a car used to transport people or goods from one floor to another. The car has a first car door which, together with a shaft door, can open a passage from the car to a floor. The car also has a second car door. The second car door can also open a passage to another floor in conjunction with other floor doors.

The first car door is typically located opposite the second car door. Cars are also known in which the first and second car doors are located on two adjacent walls of the car. They can be arranged at an angle of 90° to each other.

The elevator has front shaft doors and rear shaft doors. Both are referred to as shaft doors. The front shaft doors are assigned to either the first or the second car door. This means they are arranged in the shaft in such a way that the shaft door, together with the associated car door, can form a passage if the car is on the correct floor. The rear shaft door is then assigned to the other of the two car doors, either the first or second car door. If the first and second car doors are located on two adjacent walls of the car, then in this case as well one of the two shaft doors is a front shaft door and the other of the two shaft doors is a rear shaft door. Basically, the control system does not know, at least before commissioning is complete, whether the first car door interacts with the front shaft doors, or whether the second car door interacts with the front shaft doors. To determine this, the method presented here is carried out.

Each shaft door is equipped with a presence detector that detects a presence indicator on the car door. Once the car has arrived on a floor, the presence indicator on that floor can detect the presence indicator.

For floors that have only a front shaft door or a rear shaft door, the control system can easily determine whether the front shaft door or the rear shaft door is present on that floor. Only the existing shaft door can detect one of the two car doors. Preferably, the presence indicators of the car door are also designed as detectors, and the presence detectors are also designed as presence indicators. Thus, not only can each of the shaft doors detect one of the car doors, but each of the shaft doors that are present can also detect one of the car doors.

For those floors having both a front shaft door and a rear shaft door, the analysis of the signals from the presence detectors is not sufficient to determine which car door is assigned to which of the shaft doors. If there were only one car door, the only shaft door that detects a car door would obviously open a passage with that car door. If there are two shaft doors, both of which detect a car door, the assignment is for the time being unknown. The control system only recognizes that both a front shaft door and a rear shaft door are present, but it cannot assign them to either of the two car doors. It is true that this

would allow both passages to be opened reliably at the same time. However, if only one of the two car doors is to be opened, it is unclear before the method is carried out which of the two shaft doors is to be opened together with this car door. The method makes it possible to make this assignment.

In the context of the present document, doors refer to car doors or shaft doors, each of which can close off a passage to the car, in the case of the car door, or to the floor, in the case of the shaft door. For this purpose, the door can have one, two, three, four or more door leaves. In an arrangement with two or more door leaves, these can be slightly offset from each other, so that this forms a telescopic door. The door leaves of a door are typically driven by a single common door drive, but each individual door leaf can also have its own door drive. At the least, every door, i.e., a car door or shaft door, has its own door drive.

In the method, a single one of the two car doors and a single one of the two shaft doors are opened. This choice can, for example, be made purely randomly. The order in which they are opened is irrelevant. Thus, either the shaft door can be opened before the car door, the car door before the shaft door, or both at the same time. In this case, either one of the two passages is opened if, by chance, two doors assigned to each other have been opened simultaneously. Or the passages remain substantially closed, i.e., one of the two doors remains closed for both passages.

The first sensor detects whether the first passage has been opened, and the second sensor detects whether the second passage has been opened. If opening one of the two car doors and one of the two shaft doors has opened a passage, this will be detected by the first or the second sensor. In this case, one of the two car doors and one of the two shaft doors belong to the passage that has opened. The passage that has opened therefore comprises one of the two car doors and one of the two shaft doors that has opened. The other passage then comprises the other of the two car doors and the other of the two shaft doors, both of which have not opened. If opening one of the two car doors and one of the two shaft doors has not opened a passage, then neither sensor will detect an open passage. In this case, by definition, the first passage includes the first car door, and, if the rear shaft door was opened with the first car door, the front shaft door, or, alternatively, if the front shaft door was opened with the first car door, the rear shaft door. The evaluation can cover all possible conclusions shown here, or it can include only some of the conclusions,

and if the conditions are not met, open another of the two car doors and/or another of the two shaft doors to arrive at an open passage.

By assigning one of the two shaft doors, front shaft door or rear shaft door, to one of the first or second car doors, the elevator, and in particular an elevator control system, is given the ability to selectively open one passage into the car and to keep the other passage closed. The assignment specifies in the control system which of the shaft doors (rear or front shaft door) must be opened together with which car door (first or second) to open a desired passage.

According to a preferred embodiment, the method comprises the step of:

- assigning the front shaft door to the open car door if the passage is open, or assigning the open shaft door to the closed car door if the passage is closed.

In principle, many analyses are conceivable as to how the assignment can be deduced from the opening of the doors and the evaluation of the first and second sensors. If, by chance, the car door and the shaft door were chosen in such a way that a passage was opened, this shaft door can be assigned to the opened car door. The same evaluation also shows that the unopened shaft door can be assigned to the unopened car door.

Alternatively, if, by chance, the car door and the shaft door were chosen in such a way that no passage was opened, then the selection made does not correspond to any possible assignment. This shaft door can therefore be assigned to the unopened car door. The same evaluation also shows that the unopened shaft door can be assigned to the opened car door.

According to a preferred embodiment, the method has the further step of:

- repeating the method with opening the first car door or the second car door and opening the assigned shaft door.

This allows verification of whether the assignment is correct. For example, opening the first car door with the assigned shaft door should open the first passage, which can be detected by the first sensor. By opening the second car door, with the shaft door assigned to the second car door, the second passage should open, which can be detected with the second sensor.

According to a preferred embodiment, the method has the further step of:

- repeating the method for each floor.

This allows specification for each floor of which of the shaft doors on the corresponding floor is to be assigned to which of the two car doors.

According to a preferred embodiment, a travel path of the elevator runs vertically. A vertically oriented travel path offers the advantage that parts of the car pass each floor at a constant distance. Furthermore, vertical travel paths are very easy to implement in most buildings. In an elevator with a vertical travel path, the front shaft doors are preferably also arranged vertically one above the other. In an elevator with a vertical travel path, the rear shaft doors are preferably also arranged vertically one above the other.

In a typical design, all front shaft doors are arranged one above the other, and each can open a passage with the same car door, while all rear shaft doors can open a passage with the other car door. In an alternative embodiment, the front shaft doors and the rear shaft doors can be arranged in reversed positions on one or more of the floors. As a result, then, not all front shaft doors are located on the same side of the elevator car, or not all front shaft doors can open a passage with the same car door. However, it remains the case that on every floor where the elevator has two shaft doors, one of them is the front shaft door and the other is the rear shaft door.

According to a preferred embodiment, the first sensor and/or the second sensor detects a reflection in the passage. An obstacle in the passage, such as one of the car doors or one of the shaft doors, can act as a reflector to cause the reflection. Preferably, acoustic waves, such as ultrasound, or optical waves, such as light, are used to be reflected by the obstacle and detected by the first or second sensor.

According to a preferred embodiment, the first sensor and/or the second sensor is designed as a camera system. The camera system detects whether there is an obstacle in the passage. For this purpose, the camera system can also have systems such as image analysis or AI evaluation to decide whether there is an obstacle in the passage. In addition, the camera system can for example also categorize the obstacles. Such categories could, for example, be people, doors, luggage, or pets. Preferably, the camera

system detects light, in particular visible or infrared light. Alternatively, camera systems that evaluate sound signals can also be used.

According to a preferred embodiment, the markings is configured as a three-dimensional body.

The shape of the body itself can encode a property. For example, bodies such as cubes, cylinders, or pyramids could encode different properties. Preferably, the body serves as confirmation that a property arranged on the body, e.g., a QR code, is also actually part of a marking. Since the marking is located on a body, in the three-dimensional image of a TOF camera, the marking also stands out from the surroundings in the depth information.

According to a preferred embodiment, the camera system is designed to recognize a marking and to assign a property encoded in the marking to this passage. The marking can for example be designed as a card with a visual imprint such as a symbol or text. However, a body such as a die can also serve as a marking. The encoded property could, for example, be that the marked passage shall be treated as the front side of the elevator. Alternatively or additionally, a marking can also encode the property that this shaft door is to be used as a lobby, as a parking position overnight, or as a safe stopping place for fire control. The camera system recognizes the marking and transmits the property to be stored for this passage to the controller of the elevator system.

According to another embodiment, the marking is located on the floor of the car, in front of one of the car doors. This makes it possible, for example, to specify which of the first or second car doors should be considered the primary car door. For example, special properties can be assigned to the primary car door. For example, the primary car door could wait in the lobby for passengers with the doors open.

According to a preferred embodiment, the marking is arranged on the floor of the building floor, in front of one of the shaft doors. Before carrying out the learning run, the technician can lay out the markings to be used in front of the shaft doors on all floors. It is also possible to designate multiple markings for multiple properties to be assigned.

According to a preferred embodiment, the marking comprises a QR code. QR codes can be recognized very reliably and accurately by camera systems. Furthermore, QR codes

allow many different properties to be easily encoded. Cards or even bodies can be used as markings. These can have a QR code. In addition to the QR code, the markings can also include letters or symbols that clearly indicate to the installation technician which property the respective marking encodes, so that the installation technician can easily select the marking to be used for a passage.

According to a preferred embodiment, the first sensor and/or the second sensor is designed as a time of flight camera. A time of flight camera is also referred to as a TOF camera for short. A TOF camera allows an item of distance information for each pixel to be read simultaneously with the camera image. This allows the TOF camera to create a three-dimensional image of the captured segment of the image. In this three-dimensional image, the bodies, used for example as markings, are then very easy to identify. The three-dimensional image can also be easily analyzed to determine whether a door is closed, which is indicated by a short distance from the TOF camera, or whether the door is open, which results in a large distance at the same location in the image.

Further advantages, features, and details of the invention can be found in the following description of exemplary embodiments and with reference to the drawings, in which like or functionally like elements are provided with identical reference signs.

In the drawings:

Fig. 1 shows an elevator,

Fig. 2 shows a car in the shaft in a top view with closed doors,

Fig. 3 shows the car from Fig. 2 after opening the first car door and a floor door,

Fig. 4 shows the car from Fig. 2 with one open and one closed passage,

Fig. 5 shows the car in a side view, sectioned according to the line A-A shown in Fig. 2,

Fig. 6 shows the car in a side view, sectioned according to the line A-A shown in Fig. 2, with one open and one closed passage,

Fig. 7 shows the car in a side view, sectioned as in Fig. 2, with a marking,

Fig. 8 shows a schematic representation of the method.

Fig. 1 is a schematic side view of an elevator 1. A car 2 travels along a travel path 4 between the individual floors 3. The travel path 4 can be located in an elevator shaft. The car 2 has a first car door 11 and a second car door 12. Along the travel path 4, there are arranged a series of front shaft doors 20, all of which are suitable for forming a first

passage 53 together with the first car door 11. The car 2 is shown on the floor with the front shaft door 21. Further front shaft doors 22 and 23 are shown further up along the travel path 4. Along the driving path 4, a series of rear shaft doors 30 are arranged, all of which are suitable for forming a second passage 54 together with the second car door 12. The car 2 is shown on the floor with the rear shaft door 31. Another rear shaft door 32 is shown further up along the travel path 4.

Fig. 2 shows a horizontal section from above through the elevator of Fig. 1. The first car door 11, the second car door 12, the front shaft door 21 and the rear shaft door 31 are designed with two door leaves. For each of these four doors, the two door leaves are each connected to a separate door drive 80. This has the advantage that no mechanical connection is formed between the car doors 11 or 12 and the shaft doors 21 or 31. The shaft doors close the openings in the shaft walls 42.

A presence detection system ensures that one of the shaft doors, e.g., the front shaft door 21, can only be opened if the corresponding car door, in this case the first car door 11, is correctly aligned in front of the shaft door. The presence detection system is designed in two parts. A car-side presence indicator 61 is attached to the car and a shaft-side presence detector 62 is attached to the shaft door. If the two are aligned within a specified tolerance, the presence detector 62 detects the presence indicator 61. Only then will the shaft door receive the authorization to open. This ensures that the shaft door can be opened safely, because car 2 is located in front of the shaft door. Typically, the presence indicator 61 includes a magnet which is detected by a Hall sensor of the presence detector 62. Alternatively, a QR code or other symbolic images can be recognized as a presence indicator 61 by a camera as a presence detector 62.

Because there are now two shaft doors on the floor, viz., the rear shaft door 31 and the front shaft door 21, the presence of the car 2 means that both shaft doors 21 and 31 are authorized to open. Before the learning run, the controller can assign the two shaft doors to neither the first car door 11 nor the second car door 12.

A first sensor 51 monitors a first passage 53 and a second sensor 52 monitors a second passage 54. The sensor can determine whether an object is present in the passage, or whether the passage is free - for example, for a passenger to pass through.

Fig. 3 substantially shows the horizontal section from Fig. 2, but now in a situation that can occur during the method during the learning run. The car has moved to one of the floors 3. Both the front shaft door 21 and the rear shaft door 31 can be opened. As part of the method, the controller has opened the front shaft door 21 and the second car door 12. The second car door 12 was selected from the set containing the elements first car door 11 and second car door 12. Likewise, the selection of the front shaft door 21 was made arbitrarily from the set containing the elements front shaft door 21 and rear shaft door 22.

In this situation, both the first passage 53 and the second passage 54 are not open. By evaluating the second sensor 52, which is assigned to the second car door 12 and thus also to the second passage 54, the controller can determine that the second passage 54 is not open. The control system can now thus determine that opening the front shaft door 21 together with the second car door 12 has not opened the second passage. Thus, the controller can assign the rear shaft door 31 to the second car door 12. Furthermore, the front shaft door 21 is also to be assigned to the first car door 11.

Fig. 4 substantially shows the horizontal section from Fig. 2, but now in a situation that can occur during the method during the learning run. Here again, the car has moved to one of the floors 3. As part of the method, the controller has essentially arbitrarily opened the rear shaft door 31 and the second car door 12.

In this situation, the second passage 53 is open, i.e., passable. By evaluating the second sensor 52 assigned to the second car door 12 and thus also to the second passage 54, the controller can determine that the second passage 54 is open. The controller can therefore determine that opening the rear shaft door 31 together with the second car door 12 has opened the second passage 54. Thus, the controller can assign the rear shaft door 31 to the second car door 12. Furthermore, the front shaft door 21 is also to be assigned to the first car door 11.

The situation shown in Fig. 4 shows a situation during the execution of the method that can occur as an alternative to the situation shown in Fig. 3. The correct assignment of the shaft doors 21 or 31 to the corresponding car doors 11 or 12 can, via a situation as in Fig. 3, as in Fig. 4, or via the two other possible permutations, such as one of the shaft doors 21 or 31 and one of the car doors 11 or 12 can be opened.

Fig. 5 and Fig. 6 show an elevator which has substantially the same components as the elevator in Fig. 2 in a sectional view analogous to the section shown in Fig. 2. However, here, the first car door 11 opens a passage together with the rear shaft door 31. The car 2 comprises a car floor 2b and a car ceiling 2a. The first sensor 51 is arranged in the car 2. It is aligned such that the first sensor 51 monitors the first passage 53. The arrow and the propagation waves in Figures 5 and 6 symbolize this monitoring of passage 53. If the first car door or the first rear shaft door 31 is still in the first passage 53 after opening, the first sensor 51 detects that the passage is still closed. In the first passage 53, there is also a marking 100. This marking defines this side of the elevator car as the front door. The front side of the door is defined on the side where, when the door is open, the sensor - either the first sensor 51 or the second sensor 52 - detects the marking 100.

Fig. 6 shows the same illustration as Fig. 5, but now with the first car door 11 open and the first rear door 31 open. The sensor can now detect the marking 100, which is designed here as a three-dimensional body. Here, the three-dimensional body is a die. The installation technician placed the marking 100 there to mark this door as the rear shaft door 31. The controller recognizes from the presence of the marking 100 that the rear door 31 is the rear door, and assigns it the associated properties.

In an alternative embodiment, the marking 100 could serve to identify the front door. For this, the installation technician would then place the marking 100 at the front door, and the method is adapted so that the presence of the marking 100 indicates the front door.

Fig. 7 shows a schematic flowchart of the method.
The block "Stop" describes the stopping of car 2 on one of the floors 3 with one of the front shaft doors 20, 21, 22 or 23 and one of the rear shaft doors 30, 31 or 32.

The block "Open" describes the opening of the front shaft door 20, 21, 22 or 23 or the rear shaft door 30, 31 or 32 on this floor 3 and the opening of the first car door 11 or the second car door 12. It is irrelevant here whether the shaft door is opened before, after, or simultaneously with the car door.

The "Evaluate" block describes the evaluation of the sensor 51 or 52 assigned to the open car door in order to determine whether the passage through the open car door is open.

The block "Assign" describes the assignment of one of the two shaft doors 20, 21, 22, 23, 30, 31 or 32 of the front shaft door 20, 21, 22 or 23 or the rear shaft door 30, 31 or 32 to one of the first car door 11 or the second car door 12.

The blocks "Test 1" and "Test 2" describe the repetition of the method, with opening of the first car door 11 or the second car door 12 and opening of the assigned shaft door. They differ in that, in Test 1, the first car door 11 is opened, and, in Test 2, the second car door 12 is opened. Both tests are optional.

The loop describes the repetition of the method for each floor 3.

Finally, it should be noted that terms such as “having,” “comprising,” etc., do not preclude other elements or steps, and terms such as “a” or “one” do not preclude a plurality. Furthermore, it should be noted that features or steps which have been described with reference to one of the above exemplary embodiments may also be used in combination with other features or steps of other exemplary embodiments described above. Reference signs in the claims should not be considered to be limiting.

Claims

1. A method for commissioning an elevator (1), wherein a car (2) of the elevator (1) can be moved between multiple floors (3),
the car (2) has a first car door (11) and a second car door (12),
on at least one of the plurality of floors, there are arranged a front shaft door (20, 21, 22, 23) and a rear shaft door (30, 31, 32),
either the front shaft door (20, 21, 22, 23) or the rear shaft door (30, 31, 32) is designed to open, with the first car door (11), a first passage (53) into the car,
the other of the front shaft door (20, 21, 22, 23) or the rear shaft door (30, 31, 32) is designed to open, with the second car door (12), a second passage (54) into the car,
each of the doors (11, 12, 21, 22, 23, 31, 23) has an independent door drive (80), and
a first sensor (51) monitors the first passage (53),
a second sensor (52) monitors the second passage (54), and
the method comprises the following steps:
- stopping the car (2) on a floor (3) with one of the front shaft doors (20, 21, 22, 23) and one of the rear shaft doors (30, 31, 32),
- opening the front shaft door (20, 21, 22, 23) or the rear shaft door (30, 31, 32) on this floor (3),
- opening the first car door (11) or the second car door (12),
- evaluating the sensor (51, 52) associated with the open car door to determine whether the passage through the open car door is open, and
- assigning one of the two shaft doors, the front shaft door (20, 21, 22, 23) or the rear shaft door (30, 31, 32), to one of the first or the second car doors (11, 12).

2. The method according to claim 1, wherein the method comprises the additional step of:
- assigning the front shaft door (20, 21, 22, 23) to the open car door if the passage is open, or
assigning the open shaft door to the closed car door if the passage is closed.

3. The method according to one of the preceding claims, characterized in that the method further comprises the step of:
- repeating the method, with opening the first car door (11) or the second car door (12) and opening the assigned shaft door.

4. The method according to one of the preceding claims, characterized in that the method further comprises the step of:

- repeating the method for each floor (3).

5. The method according to one of the preceding claims, characterized in that a travel path (4) of the elevator (1) runs vertically.

6. The method according to one of the preceding claims, characterized in that the first sensor (51) and/or the second sensor (52) detects a reflection in the passage (53, 54).

7. The method according to one of the preceding claims, characterized in that the first sensor (51) and/or the second sensor (52) is configured as a camera system.

8. The method according to claim 7, characterized in that the camera system is designed to detect a marking (100) and to assign a property, encoded in the marking (100), of the car door (11, 12) or the shaft door (20, 21, 22, 23, 30, 31, 32) to this passage (53, 54).

9. The method according to claim 8, characterized in that the marking is arranged on the floor of the car (2) in front of one of the car doors (11, 12).

10. The method according to claim 8 or 9, characterized in that the marking is arranged on the floor of the building floor (3) in front of one of the shaft doors (20, 21, 22, 23, 30, 31, 32).

11. The method according to one of the preceding claims, characterized in that the marking (100) comprises a QR code.

12. The method according to one of the preceding claims, characterized in that the first sensor (51) and/or the second sensor (52) is designed as a time of flight camera.

13. The method according to one of the preceding claims, characterized in that the markings (100) is designed as a three-dimensional body.