

Inputting or adjusting reference positions in a door controller

The invention relates to a door controller and a method for inputting or adjusting one or more reference positions used by the door controller and, in particular, to a method for quickly teaching the controller accurate reference positions along a door travel path.

Modern elevator door controllers use travel curves to dictate the movement of a door along a track between its closed and open positions. Such travel curves define the desired door speed as a function of the door position or of the time. A pulse encoder is frequently used to provide the controller with a signal indicating the door position. Such a system is described in EP-A1-0665182. In an initial learning run, the controller implements a door opening operation during which the door is moved by a drive along a track from the closed position to a fully open position where further movement of the door in the opening direction is prevented by a mechanical stopper or alternatively by an open-limit switch mounted on the track. Whereas the stopper physically restricts motion of the door along the track, the open-limit switch, when activated, signals the controller to stop the drive and thereby also restricts motion of the door along the track. During this learning run the total distance from the closed position to the fully open position is registered by the pulse encoder into a memory accessible by the controller. Accordingly, the total travel path for the door is known to the controller. Intermediate switches may be mounted along the track to signal changes in the desired travel curve to the controller (for example there may be an intermediate switch to indicate the position where the motion of the door should change from a constant creeping speed to full acceleration). Alternatively, the controller can automatically calculate these intermediate reference positions using the total travel distance and register these into the memory as discussed in JP-A-2000016730.

After initial installation, it is important to make adjustments to the reference positions so as to compensate for mechanical tolerances and most importantly to ensure that the edge of the fully open door is flush with the door jamb. Adjustment may also be required during modernization or maintenance of the elevator installation.

Conventionally, any adjustment of the reference positions is performed by manually accessing the door track and shifting the respective switches or stoppers along the track until they are in the correct positions and then instructing the controller to repeat the learning run. This is a laborious and time-consuming task, particularly in an elevator

installation where it may have to be repeated for each individual landing of the installation. Furthermore, the task can be very frustrating if only minor adjustment is required.

Accordingly, the objective of the present invention is to ease the task of adjusting the
5 reference positions used in a controller for automatic doors and in particular to reduce the time and labour required to make the necessary adjustments. The fully open or any other reference position can be registered into the door controller without requiring the door to interact with any device such as a stopper or switch mounted along the door guidance track. Hence, to reconfigure the controller it is no longer necessary to gain access to the
10 track and move the stoppers or switches to a new position.

This objective is achieved by the method and controller according to claims 1 and 8, respectively. The door is freely movable to any intermediate position along the door track meaning that the door is not physically obstructed (i.e. by a stopper) nor does the door
15 interact with any means signalling the controller to restrict further motion (i.e. a limit switch), nor does the door interact with any means signalling the controller to restrict motion to a specified pattern (i.e. an intermediate switch). In other words, the door is freely movable between the mechanical ends of the door and the reference position may be registered at any position along the track. Indeed, the limit switches, intermediate switches
20 or stoppers of the prior art are superfluous to the present invention since the reference positions are registered independently of any physical restriction in, or interaction along, the door track. To input or adjust a reference position, the controller is switched to a learning mode and the door is merely moved to the required position which is an unrestricted position along the track and that position as recorded by the position
25 monitoring means is registered as a reference position. Hence, to configure or reconfigure the controller there is no longer a requirement to access the door track and manually move any stoppers or switches.

Preferably, the controller can automatically register the reference position in memory. As
30 the door is moved to and held stationary at the desired position, the controller verifies that there is no change in the position as recorded by the position monitoring means for a specific period of time and automatically registers this position into memory as the reference position. Hence, no additional equipment is required for the engineer to register the reference position in the memory. Since the door must be held in the desired position
35 for a specific time period, it is beneficial that the door is moved by hand rather than by the door drive, otherwise the door drive would tend to continue to move the door at the

desired position and the engineer would have to counteract the force developed by the drive in order to keep the door stationary. The door drive could be completely deenergized to facilitate manual movement. More beneficially, the control force signal to the driver could be set at a value sufficient only to overcome any biasing force acting on the door.

5 This would make it very easy for the engineer to manually move the door to the desired position.

Alternatively, an input device may be provided for the engineer to directly trigger the registration of the reference position into the memory of the controller. In this case, the door can be moved manually as described above or alternatively the controller could be used to automatically move the door at a slow speed such that when the door reaches the desired position, the engineer manually activates the input device. In the latter case the engineer does no need to move the door at all.

15 The invention is particularly advantageous when applied to the door controller of an elevator installation since by its very nature an elevator has multiple landings each of which may require the individual input or adjustment of several reference positions. To access the door track for each landing is time consuming and labour intensive. With the present invention, the engineer need only move the door to the desired reference positions and register these in the memory without having to access the door track.

The easiest reference position to register using the method and controller of the invention is the fully open position of the door. No measurement or judgement is required from the engineer as all he has to do is move the door until the edge of the door lies flush with the neighbouring door frame and then register this position in the memory as the fully open position.

Furthermore, since the same position monitoring means is used both during normal operation of the controller and to actually register the reference positions in the learning mode there is inherently less likelihood of error.

The invention is herein described by way of a specific example with reference to the accompanying drawings of which:

Figure 1 is a schematic diagram of an elevator door controller in accordance with a preferred embodiment of the invention; and

Figure 2 is a routine performed by the door controller of Fig. 1 in accordance with a preferred embodiment of the invention.

A door controller 11 according to the present invention is illustrated in Fig. 1. An elevator
5 car 1 has a pair of door panels 2 which are driven along a track 22 by a door drive 9. The
drive 9 has an electrical motor 3 driving a first toothed belt 4 which rotates a drive roller 6.
The drive roller 6 drives a second toothed belt 5 which rotates a first deflecting roller 7
attached to a pulse encoder 8. The door panels 2 are connected to and move
10 simultaneously with the second toothed belt 5. A pair of arrows P2 indicates the opening
direction of movement of the door panels 2 from a central closed position X1 to the
respective fully opened positions X2. The motor 3 is supplied with electrical energy from a
power unit 12 within the controller 11. Each door panel 2 is connected to a closing weight
21 by a cable pull 19 which extends around a second deflecting roller 20. The closing
weight 21 biases the panel 2 to the central closed position X1.

15 The movement of the door panels 2 is controlled by a microcomputer 13 within the
controller 11. The microcomputer 13 contains a central processor 10 communicating with
a non-volatile memory register 14, a travel curve generator 16 and externally with the
power unit 12. The pulse encoder 8 has an output connected to a central processor 10 to
20 provide a signal representing the distance travelled by the door panels 2. Algorithms
implemented in the travel curve generator 16 utilize the signal from the pulse encoder 8 to
generate target values to control the operation of the door drive 9 via a power unit 12. The
power unit 12 outputs a control force signal to the drive 9. This control force signal is
dependent upon the position of the door panels 2 and represents the force to be applied
25 by the drive 9 at any given moment in time to produce the desired door motion.

An elevator controller 18, connected to and superordinate to the door controller 11,
initiates the opening movement of the door panels 2 and dispatches the elevator car 1
when the door is closed.

30 As a safety margin, the track 22 from which the car door panels 2 are suspended and
guided is always manufactured to have a length sufficient to permit the doors panels 2 to
open wider than actually required on-site. Accordingly, on installation of the elevator it is
always necessary to adjust the factory preset opening width to that actually required X2.
35 Furthermore, different floors of the building may have different door frames defining

different opening widths, in which case the fully open position X2 of the car door panels 2 would vary between floors.

Fig. 2 shows the structure and sequence of a routine according to the present invention to
5 adjust the fully open position X2 for a given floor. This learning mode is initiated at a first
step S1 by the engineer using an input device 15 connected to the microcomputer 13. On
occurrence of the next open command, when the car 1 reaches a requested landing in a
second step S2, the controller 11 opens the door partially, e.g. to 90% of the factory
preset opening width S3. Then the controller 11 reduces the control force signal output to
10 the door drive 9 for all positions of the door panels 2 in a fourth step S4. This may be
accomplished by deenergizing the door drive 9. The engineer, in a fifth step S5, is then
able to easily shift the door panels 2 manually against the bias of the weights 21 until the
panel edges are flush with the door frame of the given landing. In a sixth step S6, a timer
or clock 23 within the controller 11 recognises the fact that the position signal from the
15 encoder 8 has not changed for a specific period of time for example 3s (indicating that the
door panels 2 are stationary) and triggers the controller 11 to register this positional value
in the non-volatile memory register 14 as the fully open position X2 for that specific floor in
a seventh step S7. The travel curve generator 16, using this new information, can then
compute and store the most effective travel curve to control the operation of the door drive
20 9 for that particular floor. In an eighth step S8 the engineer can put in a car call for another
floor and repeat this procedure until the accurate, fully open positions X2 have been
registered in the controller 11 for every floor of the installation. Alternatively, the engineer
can terminate the learning routine using the input device 15 and the door controller 11
returns to normal operation in step S9.

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Instead of completely deenergizing the door drive 9 in the fourth step S4, the control force
signal from the power unit 12 could be reduced to a constant value so that the force
applied by door drive 9 is sufficient only to counteract the closing force of the biasing
weights 21. This arrangement would allow the engineer to manually move the door panels
30 2 more easily as there is no effective biasing force acting on the panels 2.

The sixth step S6 establishes that the door panels 2 are in the correct reference position
to be registered in memory 14. Instead of waiting until there is no change in the positional
signal from the encoder 8 as described above, the controller 11 may require an interaction
35 from the engineer using the input device 15. Indeed, if the input device is used to record
the reference position X2 in the memory 14, then in steps S4 and S5, the control force

signal could be set to a reduced level which automatically opens the door panels 2 at a slow speed and when the door panels 2 reach the reference position X2, the engineer can simply trigger the input device 15 to record the position X2 into the memory.

5 Although described specifically for the learning of the fully open position X2, it will be readily appreciated that the routine can be used for registering any reference position used by the travel curve generator 16. For example, the reference position could be the position along the travel path at which the driver 9, having initially moved the door panels 2 at a constant creep speed from the fully closed position, is instructed by the controller 11
10 to apply maximum acceleration. The controller and method could also be used to define the subsequent position from which the speed of the door panels 2 should be held constant and/or the position at which deceleration must be commenced to ensure the door panels 2 decelerate smoothly to the fully open position X2.

15 The input device 15 could be a button (or a series of buttons if more than one reference position is to be registered in memory 14), but preferably the input device 15 is a keypad. This is particularly advantageous if more than one reference position is to be registered for each floor as the engineer can initiate the routine on a single input device for each reference position rather than pressing individual buttons.

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Although the invention has been specifically described with reference to elevator doors, it will be appreciated that it is equally applicable to any type of powered sliding doors, whether they are centre opening or side opening. The doors may be biased to the fully closed position by any suitable means such as a closing weight 21 or a spring, or they
25 may rely solely on the driver 9 to provide all intended motion.

Claims

1. A method for inputting one or more reference positions (X2) into a door controller (11) having means (8) for continually monitoring a position of a door (2) along a door track (22) and a memory (14) for storing the reference position (X2),
5 comprising:
 - a. moving the door (2) to the reference position (X2); and
 - b. registering the reference position (X2) as recorded by the position monitoring means (8) in the memory (14)
- 10 CHARACTERIZED IN THAT the door (2) is freely movable about the reference position (X2) on the door track (22).
2. A method according to claim 1, whereby step b) is automatically carried out if the controller (11) determines that there has been no change in the position as
15 recorded by the position monitoring means (8) for a specific period of time.
3. A method according to claim 1, whereby step b) requires manual activation of an input device (15) to trigger the registration of the reference position (X2).
- 20 4. A method according to claim 2 or claim 3, whereby the controller (11) normally outputs a control force signal to a driver (9) to control the motion of the door and prior to step a) either the driver (9) is deenergized, or the control force signal is reduced to a value sufficient to counteract any biasing force acting on the door (2).
- 25 5. A method according to claim 3, whereby the controller (11) normally outputs a control force signal to a driver (9) to control the motion of the door and prior to step a) the control force signal is set to a reduced level to automatically open the door (2) at a slow speed.
- 30 6. A method according to any preceding claim applied to the door controller (11) of an elevator installation, wherein steps a) and b) are carried out consecutively for each landing of the elevator installation and the reference position (X2) is stored in the memory (14) for each landing.

7. A method according to claim 6, wherein the reference position is a fully open position (X2) at which an edge of the door (2) lies flush with a door frame of an elevator landing.
- 5 8. A door controller (11) for controlling movement of a door (2) along a door track (22) comprising:
means (8) for continually monitoring a position of the door (2);
a memory (14) for storing one or more reference positions (X2);
an input device (15) to selectively switch the controller (11) from normal operating
10 mode to a learning mode; and
means (23;15) for triggering registration of a position along the door track (22) as recorded by the position monitoring means (8) as the reference position (X2) in the memory (14) during the learning mode
CHARACTERIZED IN THAT the door (2) is freely movable about the reference
15 position (X2) on the door track (22).
9. A door controller (11) according to claim 8, wherein the triggering means is a timer (23) triggering the registration of the reference position (X2) if the position as recorded by the position monitoring means (8) has not changed for a specific
20 period of time
10. A door controller (11) according to claim 8, wherein the input device (15) is manually operable as the triggering means.