

Method of controlling a lift installation, and a lift installation

The invention relates to a method of controlling a lift installation which comprises a lift cage transporting passengers between storeys of a building. The method proposes that the travel wishes of the passengers are input by way of a destination call control and booked by the destination call control as destination calls. In addition, an instantaneous load disposed in the lift cage is determined by a load measuring device at a fixable point in time. The invention further relates to a lift installation which is provided with a lift cage, a load measuring device determining an instantaneous load disposed in the lift cage and a destination call control by means of which travel wishes of passengers to be transported can be input and booked as destination calls.

In high buildings, particularly in so-termed skyscrapers, lifts are used which are controlled by a destination call control. In that case the travel destination must be input by way of a numerical keyboard or another form of input means by every passenger before the start of travel. The control of the lift installation notifies the passenger, on the basis of his or her travel destination input, a lift which guarantees for the passenger an optimised travel time. A lift installation with destination call control is described in, for example, WO 01/72621 A1. The basis for functioning of a lift installation based on a destination call control is a disciplined input of destination calls.

However, a disciplined behaviour of that kind of the passengers cannot always be presupposed. Situations can arise that only one person of a group undertakes a destination call input or it can happen that one person puts in several destination call inputs for a group, wherein, however, the number of persons does not correspond with the number of destination call inputs. This undisciplined input of destination calls in which the destination call control is not correctly operated frequently occurs when many persons have to be transported at the same time from a storey to, for example, the ground floor, wherein the bulk of passengers know that all lifts travel in the direction of the ground floor. An undisciplined input of destination calls can accordingly be regularly established when fixed working times exist and many office workers of a company leave their office spaces at almost the same time in order to travel to the ground floor. The lift cages are thereby usually fully laden already in the upper storeys without every passenger having individually booked his or her travel destination by means of the destination call input. The destination

call control undertaking allocation of the lifts proceeds only from the booked destination calls.

The problem therefore results that destination call inputs of passengers in the storeys lying
5 further down are allocated lift cages which are fully loaded, so that these passengers cannot be transported by the allocated lift cage. However, notwithstanding the full load the lift cage stops at every storey in which a destination call input was registered and a destination call allocated to the corresponding lift cage. This can lead to the situation that a passenger who would like to disembark at a storey above the ground floor is allocated
10 an already fully loaded lift cage. The lift cage then stops at the storey at which the passenger proposes to board, but the passenger cannot since the lift cage is full. The lift cage consequently also stops at the storey at which the passenger wanted to disembark, although nobody does disembark.

15 Due to the undisciplined inputs of destination calls substantial increases in transport times arise and ultimately this leads to a reduction in transport capacity, which leads to very long waiting times particularly in buildings with an otherwise small transport capacity.

A group control for lifts is described in EP 0 301 173 A1 which has a monitoring circuit
20 preventing allocation of a destination call to a lift with an overload. However, the starting point is a careful input of destination calls, since the overload is determined on the basis of booked passengers.

In WO 03/026997 A1 there is described a lift installation in which the lift load is measured
25 by continuous load measuring so that the number of passengers who have not input a destination call input can be determined.

The present invention has the object of avoiding the above-mentioned problems with incorrect operation of the destination call control and of indicating a method for controlling
30 a lift installation, and a lift installation, by which the transport time can be optimised and transport capacity maximised.

According to the invention this object is fulfilled in the case of a method of controlling a lift installation with the above-mentioned features in that the instantaneous load is compared
35 with a full load parameter and a bypass function is activated when the full load parameter

is exceeded. The bypass function is in that case activated for such storeys for which destination calls are booked and are still passed during a half circuit of the lift cage. By 'half circuit' in the sense of the present invention there is to be understood a travel of the lift cage between the points of reversal of the lift cage.

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The above-mentioned object is additionally fulfilled by a lift installation according to claim 9.

The invention is based on the concept that peak times, which in the case of a predominating downward travel are also termed 'down peak traffic', occur only at specific times. With the method according to the invention uniform waiting times and an optimised utilisation of the transport capacity are achieved in these peak times even in the case of possibly incorrect operation of the destination call control. It is ensured by means of the bypass function that a fully laden lift cage travels directly to the next disembarkation destination and destination call inputs of passengers waiting in the intermediate storeys are shifted to a next lift half circuit.

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Advantageous embodiments of the method according to the invention can be inferred from claims 1 to 8 and advantageous embodiments of the lift installation according to the invention can be inferred from claim 10.

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In an advantageous embodiment of the invention the lift cage, when the bypass function is activated, is not moved to the storeys for which destination calls booked by the destination call control are present and at which passengers of the half circuit would like to board until the instantaneous load again lies below the full load parameter. It is thereby achieved that a fully laden lift cage travels on a direct path from the higher storeys to the ground floor or to a main stopping storey without having to stop at already booked storeys and thus wasting transport time.

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In a further advantageous embodiment of the invention it is provided that destination calls which were booked before exceeding of the full load parameter occurred and which were not served on the half circuit are shifted to a priority half circuit with the same travel direction, wherein preferably the priority half circuit is covered by the lift cage subsequently to the first half circuit. It is thereby achieved that after arrival of the fully laden lift cage at the ground floor or at the main stopping storey the lift cage travels on a direct path to the

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upper storeys and collects the passengers who were already allocated this lift and could not be transported in the first downward half circuit due to the fully laden lift cage.

5 In an advantageous embodiment of the invention the storey at which exceeding of the full load parameter has occurred is moved to again by the lift cage only when all destination calls, which were booked before exceeding of the full load parameter occurred and which were not served on a first half circuit and/or following priority half circuits, are served. It is thereby avoided that the lift in its upward half circuit travels back to the storey at which not all passengers have input their travel destinations and the lift cage was fully laden without
10 the passengers having been already booked. A repetition of the situation of the first downward half circuit is thus avoided.

In a further advantageous embodiment of the invention it is provided that the lift after serving all destination calls booked before exceeding of the full load parameter occurred is
15 set to a normal mode (operation without bypass function). It is thus achieved that only after all passengers, who have not been transported, are transferred to the ground floor or to the main stopping storey from the storeys which were not moved to due to the bypass function, can newly input destination calls again be allocated to the lift by the destination call control.

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Measurement of the instantaneous load is advantageously undertaken at the instant of door closing. It is thus achieved that a change in the load of the lift can no longer take place, so that no errors can arise in the comparison of the instantaneous load of the lift cage with the full load parameter.

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In a further advantageous embodiment of the invention a number of free places is calculated from the disembarking and embarking passengers booked per the destination call control, wherein the lift cage moves to a storey only when the number of free places is greater than the number of destination calls of boarding passengers in the storeys to be
30 passed in the half circuit. Through this embodiment it is made possible for free places, which arise in the lift cage due to disembarking passengers before the main stop, can be occupied notwithstanding the bypass function being switched on. Through calculation of the number of free places it is made possible for the lift to stop in the case of that kind only when the number of free places is sufficient to be able to accept all passengers waiting at
35 a storey. Unnecessary stops are thus avoided. A storey lying between the ground floor

and the storey at which exceeding of the full load parameter has occurred counts as not moved to when at least one destination call of a passenger at this storey was not served. Storeys which the lift cage has moved past without stopping count as not moved to. Thereagainst, storeys which were moved to, notwithstanding the activated bypass
5 function, since passengers have disembarked, count as moved to when all passengers have been transported from this storey.

In a further advantageous embodiment of the invention there is provided a counter which counts the starts of journeys of the lift cage in which the instantaneous load is greater than
10 the full load parameter. The bypass function is activated, in an embodiment of that kind, only when a predetermined settable value for the maximum number of full load trips of that kind is exceeded. Through an embodiment of that kind it is made possible that a solitary incorrect operation of the destination call control does not immediately lead to activation of the bypass function, so that travel movements, which are incomprehensible for
15 passengers, of the lift cage are suppressed.

In this connection it is advantageously provided that with each start of the lift cage with a smaller instantaneous load than the full load parameter the value of the counter decremented. Thus, activation of the bypass function is avoided when it is not absolutely
20 necessary, for example when a fully laden lift cage has occurred only by chance and not within predetermined time periods or in typical situations. In addition, activation of the bypass function can advantageously be monitored by a time period, wherein the time period is used in common with the value of the counter for activation and/or deactivation of the bypass function. For this purpose the time period is set to, for example, 5 minutes and
25 the value of the counter for activation of the bypass function is periodically decremented, for example, every 2 minutes. The bypass function is deactivated only when not only the time period of 5 minutes has expired, but also the value of the counter lies below a value for activation of the bypass function due to the periodic decrementing and a priority half circuit no longer exists.

30 In an advantageous embodiment of the invention it is provided that activation of the bypass function is undertaken in the case of a counter value which is greater than the value for deactivation of the bypass function. In this manner there is achieved a hysteresis function avoiding an unnecessary switching back and forth between activated and
35 deactivated bypass function.

In a further advantageous embodiment of the invention the lift installation comprises a group of lifts, wherein the bypass function can be separately activated for each lift of a lift group so that the priority half circuits, which are to be inserted, for transporting the non-transported passengers to the storeys which have not been moved to can be covered or served solely by the lift concerned. In an alternative embodiment the bypass function is activated in common for all lifts belonging to a group, wherein only a part of the lifts is used for serving the storeys, which have not been moved to, with the waiting passengers during the priority half circuits. The other lifts belonging to this group can consequently already operate again in normal mode or they can further operate in bypass function in that the storey at which the overload has occurred is preferentially served.

In a further advantageous embodiment of the invention all input destination calls are assigned to the first downward priority half circuit in the case of activation of the bypass function and an upward travel direction. This is required particularly when, with activated bypass function, the lift cage is disposed at the ground floor or at the main stopping storey and its next travel direction is the upward travel direction. Accordingly, it is ensured in this case that the passengers left standing at the storeys, which are not moved to, in the case of the upward travel direction are moved to in the case of the following downward priority half circuit and their destination calls are served.

In a further advantageous embodiment of the invention in the case of activation of the bypass function and a downward travel direction all input destination calls below the lift cage position in the first downward priority half circuit are served and all destination calls input above the lift cage position are served in the next following downward priority half circuit. It is thereby made possible that in the case of activated bypass function and a position of the lift cage within the upper storeys the destination calls below the lift cage position are served in the first downward priority half circuit and the destination call lying above the storey in which the overload has occurred are served in the next following downward priority half circuit.

The invention is explained in more detail in the following on the basis of an example of embodiment which is schematically illustrated in the drawings, in which:

Fig. 1 shows a diagram for clarification of the problem in the case of incorrect operation of a destination call control according to the state of the art and

Fig. 2 shows a diagram for clarification of the bypass function according to the present invention.

The problem of an incorrect operation of the destination call control is schematically illustrated in Fig. 1. Fig. 1 symbolises 18 storeys of a building. In addition, half circuits HR1 to HR5 are illustrated by arrows. A lift cage EC is disposed at storey 15. The following situation can be presented in order to explain the problem.

A normal public traffic prevails in the building, but at the same time a conference ends at storey 10. Virtually all conference participants would like to travel to the main stop at storey 1, but only a few actuate the terminal for the destination call input. This has the consequence that the destination call control is falsely informed about the number of persons who are waiting and assigns destination calls of embarking persons below the storey 10 to the lift.

This is explained in the following by way of a numerical example. In that case the lift cage size with 15 persons is defined. At floor 10, 7 boarders who have the destination 1 are allocated by the destination call control. This means only 7 participants of the conference have input a destination call. At storey 8, 2 boarders who have the travel destination of storey 5 are allocated. At storey 6, 1 boarder who has the destination of storey 1 is allocated and, at storey 12, 3 boarders who would like to travel to storey 15 are allocated. The journeys of the lift cage EC are planned in so-termed half circuits HR1, HR2, HR3, HR4 and HR5. In that case a half circuit HR represents a journey in one direction between two points of reversal, wherein intermediate stops are also included. The storeys in which at least one boarding passenger is allocated are denoted by a plus "+". The storeys in which 1 passenger would like to disembark are characterised by a minus "-". If 15 passengers board at storey 10 instead of the 7 reported passengers, the lift cage EC is fully occupied and can no longer pick up any passengers at storeys 8 and 6. However, the lift cage EC nevertheless stops at the storeys 8 and 6. At storey 5 the lift cage EC also stops for the booked boarding passenger from storey 8, who does not find any space in the lift cage EC since the lift cage EC was already fully occupied at storey 8.

Subsequently to the half circuit upwardly to the storeys 12 and 15, further boarders board at storey 10. Even when the passengers continuing to wait at storeys 8 and 6 put in their destination call once again and these are noted in the half circuit HR3, the lift cage could again be filled at storey 10 in such a manner that it is fully occupied so that the situation for the passengers at storeys 8 and 6 would be repeated.

Fig. 2 schematically shows the method according to the invention. Again, 18 storeys are illustrated and the lift cage EC is disposed at the storey 15. The number of passengers is as in the example previously explained on the basis of Fig. 1. The bypass function is already activated during the first half circuit HR1 as soon as the full load of the lift cage EC is recognised by a load measuring device measuring the instantaneous load of the lift cage EC and the function displaces the destination calls of the passengers to the storeys 8 and 6 to the next priority half circuit HR3 and the upward call of storey 12 to storey 15 from the half circuit HR2 to the half circuit HR4. In addition, all newly input destination calls, for example at storey 10, are correspondingly shifted to the half circuits HR4, PHR5 after the priority half circuit PHR3. Thus the lift cage EC travels, subsequently to unloading the passengers at the storey 1, upwardly to the storeys 8, 6, 5 in order to transport passengers who were not transported in the first half circuit HR1 due to the bypass function. The passengers at storey 12 are transported in the next upward half circuit HR4 to a storey 15. Only after all forgotten passengers have been transported are later input destination calls from the storey 10 taken into consideration. In the allocation of new destination calls possibly further lifts of the lift installation will help to relieve the situation.

The activation of the bypass function can also be activated, apart from in the above-described situation, in dependence on further circumstances. Thus, unnecessary activations of the bypass function as a result of only random erroneous inputs of the destination call control are avoided. In order to make this possible there is provided a counter which counts the starts of the lift cage, in which the full load is exceeded, by the value CFLDP. Thereafter, the bypass function is only activated when, for example, the full load was exceeded three times ($CFLDP = 3$) in successive half circuits HR. If the full load is not exceeded in a half circuit HR, then the value CFLDP is decremented again. The necessity of activation of the bypass function is thus defined more precisely.

The deactivation of the bypass function can also be undertaken in time-controlled manner. For that purpose there are used a time period TDP and the value CFLDP. The time period

TDP begins to run after the first exceeding of the full load parameter. It can also be provided that the time period TDP begins to run only after the first start in which the instantaneous load of the lift cage EC is smaller than full load. However, the bypass function is deactivated only when, in addition to the value CFLDP, a predetermined value DPOFF was reached. In this example the value CFLDP of the counter is periodically decremented.

In order to avoid unnecessary switching to and fro between activation and deactivation of the bypass function a hysteresis can be implemented in the values DPON and DPOFF for activation or deactivation of the bypass function.

The afore-described method of controlling a lift installation is distinguished by a tolerance with respect to incorrect operation in the destination call control. It is principally attributable to the bypass function which prevents a fully laden lift cage stopping, during a half circuit HR, at storeys 8, 6, 5 for which destination calls are indeed booked, but at which no passengers can board due to the loading of the lift cage EC. The method thus contributes to an optimised utilisation of the transport capacity of the lift cage EC and additionally guarantees swift transport of passengers.

Patent Claims

1. Method of controlling a lift installation which comprises a lift cage (EC) transporting passengers between storeys (for example, 1 to 18) of a building, with the following method steps:

- a) the travel wishes of the passengers are input by way of a destination call control and booked by the destination call control as destination calls and
- b) an instantaneous load disposed in the lift cage (EC) is determined by a load measuring device at a fixable point in time,

characterised in that

- c) the instantaneous load is compared with a full load parameter and in the case of exceeding full load parameter a bypass function is activated, wherein the bypass function is activated for those storeys (for example, 8, 6, 5) for which destination storeys are booked which are still passed during a half circuit (HR1) of the lift cage (EC); and wherein
- d) destination calls which were booked before exceeding of the full load parameter occurred and which were not served on the half circuit (HR1) due to the activated bypass function are shifted to a priority half circuit (PHR3) with the same direction of travel, wherein preferably the priority half circuit (PHR3) is covered by the lift cage (EC) in the journey following the half circuit (HR1) in the same direction of travel.

2. Method according to claim 1, characterised in that, when the bypass function is activated, movement by the lift cage (EC) to the storeys (for example, 8, 6, 5) for which destination calls are booked and which are passed during the half circuit (HR1) of the lift cage is suppressed until the instantaneous load again lies below the full load parameter.

3. Method according to one of claims 1 to 2, characterised in that the storey (10) at which exceeding of the full load parameter has occurred is moved to again by the lift cage (EC) only when all destination calls which were booked before exceeding of the full load parameter occurred and which were not served on a first half circuit (HR1) and/or following priority half circuits (PHR3, possibly PHR5, ...) are served.

4. Method according to one of claims 1 to 3, characterised in that a number of free places is calculated from the disembarking and embarking passengers booked by the destination call control, wherein the lift cage (EC) moves to a storey when the number of free places is greater than the number of destination calls of boarding passengers in the storeys to be passed in the half circuit (HR1).

5. Method according to one of claims 1 to 4, characterised in that a counter (CFLDP) counts the starts of trips of the lift cage (EC) in which the instantaneous load is greater than the full load parameter, wherein in the case of exceeding a predetermined value for activation of the bypass function the bypass function is activated.

6. Method according to claim 5, characterised in that the value of the counter is decremented for each start of the lift cage (EC) with a smaller instantaneous load than the full load parameter.

7. Method according to claim 5 or 6, characterised in that after activation of the bypass function a time period is monitored and the value of the counter is periodically decremented, wherein the bypass function is deactivated only when the time period has expired and the value of the counter lies below the value for activation of the bypass function.

8. Lift installation with a lift cage (EC), a load measuring device determining an instantaneous load disposed in the lift cage (EC) and a destination call control by means of which travel wishes of passengers to be transported can be input and booked as destination calls, characterised in that the instantaneous load is compared with a full load parameter and when the full load parameter is exceeded a bypass function is activated, wherein the bypass function is activated for those storeys (8, 6, 5) for which destination calls are booked and which are passed during a half circuit (HR) of the lift cage (EC) and wherein the bypass function shifts the destination calls not served on the half circuit (HR1) and booked before exceeding of the full load parameter to a priority half circuit (PHR3) with the same direction of travel.

9. Lift installation according to claim 8, characterised by a counter (CFLDP) which with each start of the lift cage (EC) with an instantaneous load greater than the full load parameter increments a value for activation of the bypass function and the bypass function

is activated on attainment of a predetermined maximum value, wherein the counter decrements the value for activation of the bypass function with each travel of the lift cage (EC) with an instantaneous load smaller than the full load parameter.