

Lift installation and method of operating a lift installation

The present invention relates to a lift installation and to a method of operating a lift installation with a shaft, in which at least one first lift car and second lift car are separately movable upwardly and downwardly for serving destination calls. In addition, a control device which determines a suitable lift car for serving the destination calls is provided.

In order to convey a multiplicity of persons within the shortest possible time by means of a lift installation in, in particular, business or office buildings so-termed double-storey lifts are known in which two cages directly above one another and fixedly connected together always move simultaneously to two adjacent storeys.

Thus, a method of controlling a lift installation with a multiple cage having an upper deck and a lower deck is known from EP 1 193 207 A1, in which two storeys can be served simultaneously by one stop. Allocation of a travel request from a start storey to a destination storey of a cage deck takes place shortly before reaching the start storey. A travel request can also be re-allocated until shortly before reaching the start storey or allocated to the other deck. The allocation of the travel request is carried out in dependence on general criteria and/or in dependence on allocated travel requests for the region of the start storey and/or in dependence on travel requests for the region of the destination storey.

Moreover, lift installations for the transport of a multiplicity of persons within a short time are known in which at least two lift cars can move upwardly and/or downwardly independently of one another in a common shaft.

With respect to this, a method of controlling a lift installation with at least one shaft and several lift cars is known from WO 2004/048243 A1, wherein at least two lift cars are separately movable upwardly and downwardly along a common travel path. After a passenger has placed a destination call, an allocation evaluation is carried out for each lift car, subsequently the allocation evaluations of all lift cars are compared with one another and finally the destination call, in order to be served, is assigned to the lift car with the best allocation evaluation. As soon as the destination call has been assigned to the lift car, the travel path section, which is required for serving the destination call, of the shaft is blocked, for the time of performance of the trip for serving the destination call, to the other

lift cars movable along the common travel path. If serving the destination call requires a journey over a plurality of storeys a comparatively large travel path section is thus blocked to all remaining lift cars, whereby a significant restriction of transport capacity occurs particularly in high-rise buildings with many storeys.

In the case of the present invention it is provided in correspondence with the lift installation and the method according to the independent claims that the first lift car is moved, in dependence on at least one operating parameter, either synchronously in time with the second lift car or displaced in time relative to the second lift car, but still within the time duration of a journey of the second lift car.

There are understood by 'operating parameter' in the sense of the present invention all factors which influence utilisation of the lift installation with respect to an already past use, the instantaneous use and a future use. Preferably, this dependence refers to only one operating parameter. The operating parameter can, in the case of need, also change in the course of the operating duration of the lift installation.

Advantageous developments of the invention are described in the dependent claims.

In preferred embodiments the operating parameter is oriented towards the transportation or traffic amount, i.e., for example, the number of destination calls issued by the users or the number of persons or articles to be conveyed. In this connection the transportation amount is preferably determined by the number of issued destination calls. Alternatively or additionally the transportation amount can be determined by the number of persons or articles to be conveyed. The number of issued destination calls can be detected in simple manner by the control device. Equally, the number of persons to be conveyed can be ascertained in simple manner by means of at least one detecting device, such as, for example, a sensor or a light barrier, which can then transmit the ascertained data to the control device. Such a detection device can be provided in, for example, the access region of a passenger lift or loading region of a freight or goods lift.

A higher transport capacity is thus achieved, since movement of the lift cars simultaneously for at least a time is made possible particularly also for the case that the travel paths for the first and second lift cars embrace a common travel path section. This leads to an increase in performance capability of the lift installation and can be used for

both oppositely directed and identically directed travel directions of the lift cars.

It is thus made possible to form, for example, a virtual pair from the individual lift cars movable upwardly and/or downwardly separately from one another, wherein the respective individual cages forming one pair can lie closely one above the other or, however, far apart. In addition, virtual lift car groups can be formed from more than two individual lift cars. Moreover, the method according to the invention makes it possible for two lift cars to be able to be moved simultaneously over a longer path in the same travel direction or also in opposite travel directions.

In a further advantageous development it is provided that the first and second travel cage are mechanically coupled by way of a coupling in the case of movement synchronously or displaced in time. In this manner there is formed, during the movement synchronously or displaced in time, a temporary double-decker in which the small distance from one to the other lift car does not have to be checked by way of further, special collision avoidance means such as sensors, controls, etc. Beyond that it is advantageous that the distance of the coupling from one to the other lift car is settable so that compensation can be provided for different storey heights.

The invention can be used in passenger lifts, freight lifts and goods lifts.

Advantageously the first and second lift car are moved synchronously or displaced in time from a predetermined limit value of the operating parameter. This first limit value can, for example, be fixed by means of values established in advance or fixed and changed on the basis of operating data continuously ascertained during the operating period of the lift installation, for example by means of average values over specific time periods. Moreover, the limit value can be calculated to be at different levels for different times of the day, for example in peak times at the beginning and end of a working day and depending on the respective day of the week.

In a further advantageous embodiment, from a predetermined further limit value of the operating parameter the first and second lift cars are no longer moved synchronously or displaced in time. Advantageously, the lower limit value lies at a lower transportation incidence than the first limit value.

The advantage of this switching-on and switching-off of the movement of the lift car synchronously or displaced in time resides in the fact that, in the case of low traffic, destination calls can be allocated to individual lift cars not moving synchronously or displaced in time and that, in the case of dense traffic, a collective operation with lift cars moving synchronously or displaced in time takes place.

In addition, the operating parameter can also be established by means of the ratio of the orientations of the travel directions of the first and second lift cars. Thus, the first lift and the second lift car can, for example, be moved synchronously in time relative to one another if both lift cars were allocated, by the control device, the same travel direction for providing the lift car at the start storey or for serving the respective destination call from the start storey. In addition, a movement of first and second lift car displaced in time can be provided when one of the lift cars has to cover a comparatively short travel path by comparison with the other lift car in order to serve the respective destination call. The advantage thus results that a lift car can, even before the journey of the other lift car has ended, be set into motion and thus it is not necessary to wait until the journey thereof is completely concluded.

In a further advantageous embodiment the operating parameter can be determined by a travel path section of the shaft. In this connection a specific travel path section, for example between two predetermined storeys, or the length of the travel path section, can be used as a decisive factor.

In an advantageous development it is provided that the first travel cage or the second travel cage is moved in empty state. Thus, the travel paths which have to be overcome for serving a destination call can be kept free in critical cases. In addition, lift cars moved displaced in time can, through travel of at least one lift car in empty state, be moved again synchronously with one another at the latest on the occasion of the next journey. The position of the obstructing lift car and the positions of the destination storeys of the destination calls can be utilised to determine the length and direction of the travel in empty state.

Advantageously the destination call is delivered to the control device by means of a destination call panel, a destination call terminal or a mobile communications unit, such as, for example, a mobile telephone.

The invention is explained further in the following with reference to the drawings. In that case, Fig. 1 shows a schematic vertical section through a lift installation for performance of the method according to the invention. Different variants of embodiment for use in the case of the installation illustrated in Fig. 1 are explained by way of Figs. 2 to 6.

Fig. 1 schematically shows the lift installation in the form of a passenger lift for a commercial building. The lift installation comprises a shaft 10 in which a first lift car 20 and a second lift car 30 are separately movable upwardly and/or downwardly. In addition, the building has eight storeys 50 to 57, which can be reached via the lift installation by persons located in the building. Disposed on each of these storeys 50 to 57 at the outer side of the shaft wall is a destination call panel 60 which makes it possible for the user to issue a destination call with the desired destination storey.

The lift installation according to Fig. 1 is a drive-pulley lift installation, wherein the first lift car 20 is moved and braked by means of, respectively, a drive unit 22 and a brake unit 24. Equally, the second lift car 30 is moved and braked by means of, respectively, a drive unit 32 and a brake unit 34. The support cables or support belts and counterweights required for operation are constructed in conventional manner and, just as the shaft and cage doors as well as further operating and display elements, for the sake of simplicity are either not illustrated or are shown schematically.

A first control unit 42 is connected with the drive unit 22 and the brake unit 24. The second control unit 44 is connected with the drive unit 32 and the brake unit 34. In addition, a control device 40 is provided, which stands in data exchange communication with the first control unit 42 and the second control unit 44 as well as with all destination call panels 60 of the individual storeys 50 to 57.

Several variants of the method according to the invention for operating this lift installation are explained in the following by way of Figs. 2 to 6 on the basis of the lift installation according to Fig. 1. In that case so-termed reporting journeys, i.e. journeys of a lift car from the illustrated start setting to the start storey are shown in dashed lines. The serving journeys from the start storey to the destination storey for serving the destination calls are shown by solid lines. For safe embarking and disembarking of persons the cage floors of the lift cars 20, 30 are, at the stop of the lift cars 20, 30 at a storey 50 to 57, aligned to be

substantially flush with the storey floors of the respective storeys 50 to 57.

In the starting situation shown in Fig. 2 a number of persons is located on the second storey 51 and these persons wish to be conveyed to the sixth storey 55 and have issued the corresponding travel wish, which is termed first destination call in the following, to the control device 40 by way of the destination call panel 60. In addition, several persons wishing to be conveyed to the eighth storey 57 are located on the fifth storey 54. This travel wish shall here represent the second destination call. The first lift car 20 is located on the first storey 50 and the second lift car 30 is located at the level of the third storey 52.

After the control device 40 has determined the first travel cage 20 to be the suitable travel cage for serving the first destination call and the second travel cage 30 to be the suitable travel cage for serving the second destination call the first travel cage 20 and the second travel cage 30 are moved, starting from the initial situation according to Fig. 2, synchronously in time in the direction of the two start storeys 51, 54 on which the persons to be conveyed are located. In other words, the two travel cages 20, 30 are set in motion at substantially the same point in time.

After the first travel cage has arrived at the second storey 51, the shaft cage doors open so that the persons on the second storey 51 can enter the cage of the first lift car 20. At the same time the persons on the fifth storey 54 can, after arrival of the second lift car 30, enter the cage thereof.

Subsequently the first lift car 20 travels from the start storey 51 to the desired destination storey 55, whilst the second lift car 30 is moved from the start storey 54 to the destination storey 57. The first lift car 20 reaches its start storey 51 first due to the shorter travel path. The first lift car 20 can therefore also begin its serving journey at an earlier point in time than the second lift car 30. The serving journeys of the two lift cars 20, 30 thus do not, in fact, start at the same point in time, but nevertheless run simultaneously at least for a time, so that here reference can be made to a movement of the two lift cars 20, 30 displaced in time. In the case of reporting journeys of the lift cars 20, 30 to the respective start storeys 51, 54 there is, thereagainst, travel synchronous in time.

In the example of embodiment according to Fig. 2 the serving journeys of the two lift cars 20, 30 embrace a common travel path section along the storeys 54, 55. In addition, the

two lift cars 20, 30 have the same travel direction not only during the reporting journeys, but also during the serving journeys.

The example of embodiment according to Fig. 3 differs from the example of embodiment according to Fig. 2 in that the second lift car 30 is initially positioned at the second storey 51. Starting from this situation initially the second lift car 30 is moved in the direction of the start storey 54. As soon as the second lift car 30 is located in the region of the third storey 52, the first lift car 20 is moved from the first storey 50 to the start storey 51. The first lift car 20 is thus set in motion displaced in time relative to the second lift car 30. After the two lift cars 20, 30 have reached their respective start storey 51 or 54, the serving journeys are undertaken correspondingly to the above example of embodiment according to Fig. 2.

The examples of embodiment according to Figs. 4 and 5 differ from the example of embodiment according to Fig. 3 in that the first lift car and the second lift car 30 are mechanically coupled by way of a coupling 23 in the case of movement synchronously or displaced in time. Such a coupling 23 enables coupling together and decoupling and can be realised by mechanically positive coupling means known to the expert, such as a detent coupling, but also by way of force-locking means such as a magnetic coupling, etc. The coupling together or decoupling advantageously takes place automatically on approach or movement apart of the lift cars 20, 30. In addition, the coupling 23 can be provided with or without security against undesired decoupling. With knowledge of the present invention the expert can realise numerous variants of such a coupling.

Beyond that it is advantageous for the distance of the coupling 23 from one to the other lift car 20, 30 to be settable so that compensation can be provided for different storey heights. Thus, the example of embodiment according to Fig. 5 shows a hotel with a lobby in the lower storey 50', which is higher than the upper storeys 51 to 57 with identical storey heights. The example of embodiment according to Fig. 4 shows an office building in which all storeys 50 to 57 are of identical height. The travel cars 20, 30 are positioned in the storeys 50 or 50' and 51 and coupled by way of the coupling 23. The cage floors are aligned to be flush with the storey floors. Comparison of the examples of embodiment according to Figs. 4 and 5 shows that the distance of the coupling 23 of the lift cars 20, 30 is so set that compensation is provided for the height difference between the lobby 50' and the other storeys 51 by enlargement of the distance of the coupling. Such a setting of the

distance of the coupling 23 can be realised in simple and quick manner by the expert with known means such as a spindle drive, a pantograph, etc. Here, too, the expert can, with knowledge of the present invention, realise numerous variants of such a setting of the distance of the coupling.

In the initial situation, which is shown in Fig. 6, of a further example of embodiment of the method several persons are again located on the second storey 51, these persons wishing to be conveyed to the sixth storey 55 and having delivered the corresponding travel wish, which here shall be termed first destination call, to the control device 40 by way of the destination call panel 60. In addition, several persons wishing to be conveyed to the fifth storey 55 are located on the seventh storey 56. This travel wish shall here represent the second destination call. In addition, the first lift car is located at the first storey 50, whereagainst the second lift car 30 stands at the eighth storey 57.

After the control device has determined the first lift car 20 to be the suitable lift car for serving the first destination call and the second lift car 30 to be the suitable lift car for serving the second destination call, the first lift car 20 and the second lift car 30 are moved, starting from the initial situation, synchronously in time in the direction of the two start storeys 51 and 56, respectively, i.e. the two lift cars 20, 30 are set in motion at substantially the same point in time.

After the first lift car 20 has arrived at the start storey 51 the persons on the second storey 51 can enter the cage of the first lift car 20. After arrival of the second lift car 30 at the start storey 56 the persons on the seventh storey 56 can enter the cage thereof. Due to the simultaneous instant of starting and the same travel path up to the respective start storey 51, 56 the two lift cars 20, 30 arrive at the start storeys 51, 56 approximately simultaneously.

The second lift car 30 now initially travels from the start storey 56 in the direction of the desired destination storey 54 in order to execute the serving journey for serving the first destination call. At a spacing in time therefrom, thus displaced in time, but still during the travel duration of the serving journey of the second lift car 30, the first travel car 20 starts from the start storey 51 in the direction of the destination storey 55. The displacement in time is selected in such a manner that sufficient time is present in order to move the second lift car 30, after transport of the persons to the fifth storey 54, immediately again in

upward direction and at least to the seventh storey 56. The first lift car 20 can thus then move to the destination storey 55 of the second destination call without obstruction.

The reporting journeys of the lift cars 20, 30 thus begin at substantially the same point in time, i.e. synchronously in time, whereas the lift cars 20, 30 are moved displaced in time relative to one another in the subsequent serving journeys. In the example of embodiment according to Fig. 6 the two travel cars 20, 30 have mutually opposite travel directions not only during the reporting journeys, but also during the serving journeys.

The afore-described examples of embodiment of the method according to Figs. 2 to 6 are distinguished particularly by the fact that especially in the case of a number of persons to be conveyed, i.e. in the case of a high incidence of transport, the two travel cars 20, 30 are moved either synchronously in time or displaced in time relative to one another. The selection of the mode of movement is carried out by means of the control device 40 and suitable algorithms. In this manner, for example, it is possible to dispense with keeping a travel path section, which is common to both lift cars 20, 30, free for only one travel car and completely blocking the section to the other travel car until conclusion of the respective serving journey. An increase in transport capacity can thus be achieved in simple manner.

It shall be noted that the method, which for the sake of simplicity was explained only by means of two travel cars, for operating the lift installation can also be performed with more than two travel cars.

Patent Claims

1. Method of operating a lift installation with a shaft (10) in which at least one first lift car (20) and second lift car (30) are separately movable upwardly and downwardly for serving destination calls and with a control device (40), which determines a suitable lift car (20, 30) for serving the destination calls, characterised in that the first lift car (20) is moved either synchronously in time with the second lift car (30), or displaced in time relative to the second lift car (30), in dependence on at least one operating parameter, but still within the time duration of a journey of the second lift car (30).
2. Method according to claim 1, characterised in that the operating parameter is determined by the transportation amount.
3. Method according to claim 2, characterised in that the transportation amount is determined by the number of issued destination calls.
4. Method according to one of claims 2 and 3, characterised in that the transportation amount is determined by the number of persons or objects to be conveyed.
5. Method according to one of claims 1 to 4, characterised in that from a predetermined limit value of the operating parameter the first lift car (20) and the second lift car (30) are moved synchronously or displaced in time.
6. Method according to claim 5, characterised in that from a further predetermined limit value of the operating parameter the first lift car (20) and the second lift car (30) are no longer moved synchronously or displaced in time.
7. Method according to any one of claims 1 to 6, characterised in that the operating parameter is determined by the ratio of the orientations of the travel directions of the first lift car (20) and second lift car (30).
8. Method according to any one of claims 1 to 7, characterised in that the operating parameter is determined by a travel path section of the shaft (10).
9. Method according to any one of claims 1 to 8, characterised in that the first lift car

(20) and the second lift car (30) are mechanically coupled by way of a coupling (23) during movement synchronously or displaced in time.

10. Method according to claim 9, characterised in that a distance of the coupling (23) from the first lift car (20) to the second lift car (30) is set in order to compensate for different storey heights.

11. Method according to any one of claims 1 to 10, characterised in that the first lift car (20) or the second lift car (30) is moved in empty state.

12. Method according to any one of claims 1 to 11, characterised in that the destination call is delivered to the control device (40) by means of a destination call panel (60), a destination call terminal or a mobile communications unit.

13. Lift installation with a shaft (10) in which at least one first lift car (20) and second lift car (30) are separately movable upwardly and downwardly for serving destination calls and with a control device (40), which determines a suitable lift car (20, 30) for serving the destination calls, characterised in that the first lift car (20) is moved either synchronously in time with the second lift car (30), or displaced in time relative to the second lift car (30), in dependence on at least one operating parameter, but still within the time duration of a journey of the second lift car (30).

14. Control device for operating a lift installation in the method according to any one of claims 1 to 12.

15. Coupling for operating a lift installation in the method according to one of claims 9 and 10.