

Method of and device for controlling a lift installation with zonal control

The invention relates to a method of and a device for controlling a lift installation with several lift cages in a building or the like, the storeys of which are subdivided into several zones, wherein several travel orders are allocated to the lift cages.

A lift installation for zonal operation has become known from EP 0 624 540 B1. In the case of this lift installation the traffic of persons between at least one main stopping point and zones in the high building is managed, with immediate allocation of zone calls, by a lift installation consisting of three lifts. Each lift user filling the building passes a portal which is associated with a zone in which a sensor registers the lift user. Through selection of the corresponding portal the lift user communicates his or her desired zone without manual actuation of a call registration device of the lift control. The lift cages travel in specific, fixedly associated zones. The zonal division serves the purpose of being able to fill a high building particularly quickly. For that purpose there are express lifts which travel past storeys not served by these lifts.

On the same basis a zonal division is carried out also in the case of the lift installation which has become known from US-A 5 511 634. In that case, of the respectively free lift cages there is allocated a new call to a new zone to that cage which can serve this call most quickly.

The object of the invention is to construct a method of and a device for controlling a lift installation of the kind stated in the introductory part of claim 1 in such a manner that a zonal control can be carried out with separation of user groups associated with the zones in such a manner that waiting times for individual user groups are minimised as far as possible.

This object is fulfilled by a method with the steps of the accompanying claim 1.

Advantageous refinements of the invention are subject of the subclaims.

In the case of the control method according to the invention the zones are preferably to be assigned to individual user groups with restricted access authorisation. By contrast to the previously described lift installations and the controls thereof, in the case of the method

according to the invention a zonal operation serves for security purposes in order to strictly separate user groups from one another. If a lift with a travel order assigned to a zone is busy, then further travel orders may be allocated thereto only from the same zone. The lift cage can be allocated to another zone only when it has finished all travel orders allocated thereto and thus is free. Before a call in accordance with a new travel order is allocated, in accordance with the invention, however, firstly the number of free lift cages is compared with the number of still unallocated, i.e. currently unserved, zones. It is thereby established whether still sufficient free lift cages are present for all zones. This is then taken into consideration in the decision to where the new call is to be allocated.

In a preferred embodiment a call which is assigned to a zone already served by the lift installation is allocated to a free lift cage only when a free lift remains for each unserved zone. The calls are thereby so distributed to the individual zones of associated user groups that at least one lift is always available for each group.

A particularly preferred form of embodiment solves problems which arise in the case of a physical separation of user groups on the basis of the access authorisation thereof for a different lift layout. Thus there can be lift installations in which some storeys can be served only by a subgroup of lifts. If now specific user groups are assigned or to be assigned to these storeys able to be served only in restricted manner, substantially increased waiting times can in part occur with these or with the other user groups depending on travel destination, or the persons of other user groups can no longer be allocated.

According to the preferred embodiment this can be solved in that in the case of a new call it is established whether it is assigned to a zone which comprises at least one storey able to be served only in restricted manner. Such zones are here termed "favourite zones". Calls assigned to such a favourite zone are here termed "favourite calls". For the decision how a call is allocated it is preferably to be initially established whether it is a favourite call or not a favourite call, i.e. a non-favourite call. The allocation is then carried out in dependence on this determination.

In a further preferred embodiment such favourite calls are preferentially assigned to lift cages which can serve all storeys of a favourite zone. Such a lift cage is here termed "favourite cage". In the case of allocation of a call it is preferably initially established

whether or not the call is a favourite call, wherein for the allocation of favourite calls the number of free favourite cages is compared with the number of still unallocated favourite zones in order as far as possible to always be able to keep free one favourite cage per unallocated favourite zone. In the case of a non-favourite call the number of non-favourite cages is compared with the still unallocated non-favourite zones in order as far as possible to always be able to keep free one free non-favourite cage per unallocated non-favourite zone.

In this manner, notwithstanding a heterogeneous lift structure the individual user groups are handled uniformly and the waiting times for each specific user group are minimised. However, in the case of a correspondingly larger number of lift cages to be allocated it is possible to react to an increased incidence of passengers in a user group.

It is thus also possible that several lift cages are assigned to one zone. Then, also all lift cages can be busy. If, however, a lift cage fails for whatever reason, then one of the user groups could thereby be disadvantaged if now a lift was no longer available for its assigned zone.

For such a case it is provided in a preferred embodiment that when there are less free lift cages than unserved zones, but one zone is served by several lifts, one of the lift cages of these lifts serving these several zones is blocked for further orders. This cage is then free after processing its orders and can be allocated to the unserved zone.

Examples of embodiment of the invention are explained in more detail in the following on the basis of the accompanying drawings, in which:

- Fig. 1 shows a diagram for clarification of a zonal control for lift installations;
- Fig. 2 shows a schematic illustration of a lift installation with several lifts and a heterogeneous lift layout;
- Fig. 3 shows a schematic illustration of a first zone of the lift installation of Fig. 2;

- Fig. 4 shows a schematic illustration of a second zone of the lift installation of Fig. 2;
- Fig. 5 shows a schematic illustration of a third zone of the lift installation of Fig. 2;
- Fig. 6 shows an example of a call allocation to the lift installation of Fig. 1;
- Fig. 7 shows an example of a call allocation as would be achieved by conventional controls proceeding from the situation of Fig. 6;
- Figs. 8A to 8E show illustrations of different call allocations and new calls, starting out from the situation illustrated in Fig. 6;
- Fig. 9 shows a flow chart for an algorithm in the control of a lift installation, such as is illustrated by way of example in Figs. 2 to 5;
- Fig. 10 shows a part of the flow chart of Fig. 9 with notations;
- Figs. 11A to 11C show different illustrations of call allocations and new calls in the case of the lift installation of Fig. 2, wherein Fig. 11A shows a start situation by way of example, Fig. 11B a new call in the case of the situation shown in Fig. 11A and Fig. 11C a call allocation, which would be obtained by a conventional control;
- Fig. 12 shows a part of the flow chart of fig. 9 with notations for illustration of how the control algorithm shown in Fig. 9 would perform the call allocation;
- Fig. 13 shows an illustration of the final situation of the call allocation as is obtained by the algorithm shown in Fig. 9 starting out from the situation according to Fig. 11A;

- Figs. 14 to 17 show further illustrations of call allocation situations in the lift installation according to Fig. 2 for clarification of the function of the control algorithm according to Fig. 9;
- Figs. 18 and 19 show, by way of example, illustrations of a call allocation without a free lift cage, for the purpose of explanation of a problematic situation;
- Figs. 20 and 21 show call allocations corresponding to Figs. 18 and 19 for the purpose of illustration of a solution to this problem;
- Figs. 22 to 24 show flow charts for an algorithm for solution of the problem illustrated in Figs. 18 and 19; and
- Figs. 25 to 27 show illustrations of different call situations, by way of example, for explanation of the function of the algorithm according to Figs. 22 to 24.

1. General observations

1.1 Introduction to the problem of zonal control

A zonal control in buildings or the like (ships would also be conceivable) is used in order to separate different groups of lift passengers from one another. The zonal control is a safety feature which is used in buildings or the like where passenger groups have to be separated from one another.

If there are, for example, two groups of passengers, namely a group 1 and a group 2, then in a zonally controlled building a passenger belonging to group 1 may not travel together with a passenger belonging to group 2.

In a zonally controlled building or the like every destination call is assigned to a zone. In order to separate passenger groups, a lift which is busy may not accept any call assigned to a zone different from the zone which the lift is just serving. It may be assumed, for example, that a lift A serves a call for a zone 1. It may be further assumed that at this instant a passenger belonging to the group 2 registers a call. Due to the zonal separation

the passenger from the group 2 may travel only in his or her zone 2, whilst the passenger from 1 may travel only in his or her zone 1. Accordingly this new call from the passenger belonging to group 2 cannot be assigned to the lift A.

In the case of the lift installation present here as well as in the case of the control method fundamental here to such a lift installation it shall be made possible to undertake a favourable control method with use of such a zonal control. The individual user groups respectively assigned to a zone shall be effectively separated from one another so that no person from a first user group can travel by a lift serving a second zone.

The individual user groups can be assigned to the individual zones by known person identification measures. For this purpose the lift installation can have different person identification devices. Examples are key switches, code buttons, electronic keys, chip cards, finger sensors, etc. Virtually any technology known in the sector of locking technology, such as, for example, in the case of doors, gates or motor vehicles, is usable. For example, a person belonging to a specific user group can register a call for a travel order with a destination storey in his or her zone only with use of a personal mechanical or electronic key or with input of his or her personal code. In the case of the corresponding control method there is thus preferably carried out, with the call input, a person identification in order to assign the call to a specific zone.

1.2 Change of zones

In a zonally controlled building either each lift can serve actual calls or it has no orders. If the lift does not have any travel orders, it is "free". In free state a lift can accept a call from any zone.

If a lift serves calls within one zone, the lift cannot change the zone until it is free.

An example with two zones is indicated in Fig. 1.

In that case the meanings are:

$R \rightarrow Z1$	a call assigned to the zone 1
Z1	zone 1
Knj	the lift has no orders
fr	the lift is free
$R \rightarrow Z2$	a call is assigned to the zone 2
Z2	zone 2

Fig. 1 illustrates the above case.

2. Favourite cage algorithms

In order to solve assignment problems in buildings with heterogeneous lift layouts or heterogeneous lift structures, so-called favourite cage algorithms are used here.

For illustration of the problem and the solution presented here, a lift structure, by way of example, and some zones associated therewith are described in the following in the way that they can actually occur in specific buildings. All examples submitted with regard thereto are based on the zones and structures which have been presented. After an introduction the algorithm proposed in accordance with the example of embodiment is explained together with some examples.

2.1 Lift structure

An example of a heterogeneous lift structure (lift layout) is reproduced in Fig. 2. The lift installation schematically illustrated there comprises six lifts with lift cages A, B, C, D, E and F. The main entrance ME is indicated by a dashed line. The lifts with the cages A, B, C and D go from the main entrance ME only upwards. In the example presented here the lifts with the cages E and F also serve basement floors lying below the main entrance ME. Thus, only the lift cages E and F serve all storeys of the building. The following examples refer to this lift structure by way of example, as is presented in Fig. 2.

2.2 Zones

The building illustrated here is a building in which a zonal control is desired as a safety feature. For this purpose it may be assumed that the building is a bank building which

additionally has public areas - for example a storey in which eating facilities are provided - and living areas. In Figs. 3 to 5 the zones resulting therefrom and respectively to which individual user groups of the lift installation are assigned are indicated in each instance by a grey bar.

2.2.1 Zone 1: Visitors

In the example present here the first user group shall concern visitors. The visitors shall, in the example illustrated here, have access to the main entrance and to a visitor storey. The visitor storey can be, for example, the storey with publicly accessible eating facilities or the visitor rooms of the bank. Zone 1 is illustrated by the reference numeral Z1 in Fig. 3. There, a grey bar is at the main entrance ME and a grey bar is in the visitor storey.

The two further user groups for the example building are residents and bank staff.

The visitors have the following storeys in common with the residents: main entrance ME and visitor storey. The visitors have only the storey "main entrance" in common with the bank employees.

As apparent from Fig. 3, in the example illustrated here all lifts A to F serve the storeys of the visitors and thus the zone Z1.

2.2.2 Zone 2: Residents

Residents of a building shall obviously have access to those storeys on which their dwellings are located. Usually in the sub-floor of a building there are also regions which shall be accessible to a resident, such as basement areas or a residents underground garage.

In Fig. 4 a zone 2 by way of example - denoted by reference numeral Z2 - is indicated for a resident. The storeys for residents are, in the illustrated example, the main entrance, all storeys from the visitor storey and thereabove and some storeys below the main entrance.

The residents have the storey "main entrance" ME and the visitor storey in common with the visitors. The residents have only the storey "main entrance" ME in common with the bank employees.

2.2.3 Zone 3: Bank staff

In the example illustrated in Fig. 5 the storeys for the bank employees are all storeys from the main entrance ME up to the visitor storey (wherein the visitor storey is not included therewith) and some storeys below the main entrance ME. The zone 3 resulting therefrom is characterised in Fig. 5 by Z3. The bank employees accordingly have only the storey "main entrance" ME in common with the visitors and the residents.

2.3 Definitions

Some expressions are explained for better understanding of the favourite cage algorithms:

2.3.1 Favourite zone

A zone is a "favourite zone" if it contains storeys which are not reachable by every lift cage. In the above examples the zones "residents" Z2 and "bank staff" Z3 are favourite zones.

2.3.2 Favourite cage (favourite lift)

A lift cage is a "favourite cage" if it can serve all storeys of at least one favourite zone. In the above examples the lift cages E and F are favourite cages.

2.3.3 Favourite call

A call assigned to a travel order is a favourite call if it is assigned to a favourite zone. This can be established, for example, by known person identification measures as explained above. If a passenger is identified as a resident by a corresponding key or code, then he or she can register a travel order to a destination storey within the zone Z2. The corresponding call is then assigned to the zone Z2. In the case of the example illustrated

here the visitor does not necessarily have to have a person identification. The bank employees in turn need a key or the like for input of a call assigned to the zone Z3.

2.3.4 Number of unassigned favourite zones

The number of those favourite zones which are not assigned at the time or in fact to any lift or a lift cage is termed number of non-assigned favourite cages. An example of that is reproduced in Fig. 6.

In that case the lift cages A, B, C and F are free (this state is indicated in the drawings by the reference symbol fr). The lifts D and E are busy with travel orders. The lift D serves a travel order of a visitor and thus is assigned to the zone Z1. The lift E serves a travel order of a resident and is thus assigned to the zone Z2.

In this example the number of non-assigned favourite zones is one. The zone Z3 is a favourite zone, but it is not assigned to any lift cage.

2.3.5 Number of non-assigned non-favourite zones

All zones which are not favourite zones are here termed non-favourite zones. The number of non-favourite zones which is actually or at the time not assigned to any lift is termed number of non-assigned non-favourite zones. In the example of Fig. 4 the number of non-assigned non-favourite zones is zero. The sole non-favourite zone in our example is the zone Z1. One lift cage, namely the lift cage D, is assigned to the zone Z1.

2.3.6 Sufficient favourite cages available

The condition "sufficient favourite cages available" is to be fulfilled when the number of free favourite cages is greater than or equal to the number of non-assigned favourite zones.

This condition or this expression is advantageous when a decision has to be taken whether or not a call is to be assigned to a free lift cage.

In the example of Fig. 7 the lift cages A to C are free. The lift cage D is assigned to the zone Z1 and the lift cages E and F are assigned to the zone Z2. In this example insufficient lift cages are available! The two favourite cages E and F are busy. A favourite cage is no longer left for the favourite zone Z3.

2.3.7 Sufficient non-favourite cages available

The condition "sufficient non-favourite cages available" is fulfilled when the number of free non-favourite cages is greater than or equal to the number of non-assigned non-favourite zones.

This expression is advantageous when a decision has to be taken whether or not a new call shall be placed in a free lift cage.

2.4 Why an algorithm?

If a call is input by a user, the call is immediately assigned to a zone. According to known assignment algorithms - see for this purpose, for example, EP 0 301 178 B1 - the lift control then selects the best lift cage which can serve this call. This can be undertaken, for example, in dependence on a costs minimisation or on algorithms for the quickest possible filling and/or for shortening of waiting times. For the selection of the best lift cage there are at that instant only a few restrictions: the lift cage must be able to serve not only the starting storey, but also the destination storey, the zone state of the lift cage must be "free" or the zone assigned at that time to the lift cage must correspond with the zone assigned to the call.

What can take place in that case is illustrated in Figs. 8A to 8C.

In Fig. 8A there is illustrated, by way of example, the starting state. This state corresponds with the state of Fig. 6, i.e. the lift cage D is assigned to the zone Z1 and the lift cage E to the zone Z2, whilst the remaining lift cages are free. In this state there is a new call nRZ2 in zone Z2, as illustrated in Fig. 8B. This new call nRZ2 is the requirement of a travel order between a residential storey and a basement floor accessible for residents.

The lift control selects, for example, the lift cage F as best lift cage.

The then-resulting allocation situation is reproduced in Fig. 8C. The state corresponds with that of Fig. 7, wherein the newly allocated call is underlined in grey.

Without a special algorithm the following situation can now arise:

It may be assumed that a new call nRZ3 is now indicated by a bank employee, who would like to go between the main entrance and the basement floor accessible only for bank staff. This new call belongs to the zone Z3 and contains one of the basement floors.

As Fig. 8E shows, there is no available lift cage for this purpose. The free lift cages A to C cannot serve the basement floor and the two favourite cages E and F, which could serve the basement floor, are assigned to another zone Z2 and therefore may not be assigned to the zone Z3.

The bank employee therefore has to wait until one of the two lift cages E and F is free again. Since also new destination calls from the zone Z2 could always be input again here, this wait can in certain circumstances last for a very long time.

For solution of such a problem an "allocation to a free cage" algorithm is proposed. This analyses the situation and shifts the lift allocation of the call belonging to the zone Z2 to the lift cage E and not to the lift cage F.

After the algorithm has been performed, the call can be definitively assigned and information can be given to the user to indicate to him or her the allocated cage for his call.

2.5 The "assignment to a free cage" algorithm

The "assignment to a free cage" algorithm is reproduced in Fig. 9 in the form of a flow chart. The flow chart is, with consideration of the following legends, self-explanatory:

R = f	Call is a favourite call. Here it is investigated whether or not the call is a favourite call.
gfK	Sufficient favourite cages available? This condition is investigated on the basis of the above definition. In that case the interrogation is (also) carried out in such a manner that it is investigated whether <u>after</u> an allocation of the new call to a free favourite cage sufficient favourite cages are then still available.
tbfK	Take the best favourite cage. The selection from the number of free favourite cages is carried out according to the criteria also used with customary control algorithms.
afKsZ	Other favourite cages travel in the same zone. Here it is investigated whether there is already a favourite cage which is assigned to the same zone to which the new call belongs.
gnFK	Sufficient non-favourite cages available? With the interrogation it is preferably also investigated whether after allocation of the new call to a free non-favourite cage sufficient non-favourite cages are then still available.
R → nfK	Call can be shifted to a non-favourite cage.
anfKsZ	Other non-favourite cages travel in the same zone.
tbfKsZ	Take the best favourite cage travelling in this zone.
tbnkF	Take the best non-favourite cage.
R → nfKsZ	Call can be shifted to a non-favourite cage travelling in this zone.
tbnfKsZ	Take the best non-favourite cage travelling in this zone.
nc	No change.

2.5.1 What would the algorithm do in the example of Figs. 8A to 8E?

For this purpose reference is made to the decision branch, which is illustrated in Fig. 10, from the algorithm of Fig. 9. At 100 the condition "the call is a favourite call" has been found to be "true": The call illustrated in Fig. 8B belongs to the favourite zone Z2 and is thus a favourite call.

If the call - as happens in our example by the upstream customary control algorithm - were to be placed on the lift cage F, sufficient lift cages for a call in the favourite zone Z3 would no longer be available. The condition "sufficient favourite cages available" gfk is thus not fulfilled, as is reproduced by the reference numeral 102.

On the other hand, the favourite cage E already travels in the zone Z2. The condition "other favourite cages travel in the same zone" afKsZ is thus fulfilled, as is recognisable by the reference numeral 104.

There are still three free non-favourite cages. The condition "sufficient non-favourite cages available" gnfk is thus fulfilled. However, the new call nRZ2 of Fig. 8B cannot be allocated to any non-favourite cage, since none of the non-favourite cages A to D can serve the basement floor contained in the new call nRZ2, which leads to the decision reproduced at 106.

Thus, the algorithm leads to the statement tbfKsZ, i.e. the best non-favourite cage travelling in this zone must be taken, as indicated at the reference numeral 108. This is the correct decision, because now the new call nRZ2 is allocated to the lift cage E and thus a favourite cage F is kept free for the favourite zone Z3. The new call nRZ3 of Fig. 8D can be allocated without undue waiting times.

2.5.2 A further example

Fig. 11A represents a further situation which can happen. In the case of Fig. 11A the lifts of the cages A, B, D and E are out of operation, which is reproduced by the reference symbol oos (out of service). The lift cage C is assigned to the zone Z2 and the lift cage F is free fr. It may now be assumed, as illustrated in Fig. 11B, that a new call NRZ2 is input

in the zone Z2, which demands a travel order between the main entrance ME and an upper residential storey. Such an order, by way of example, can also not be dealt with by a non-favourite cage A to B. Conventional lift controls would assign such a new call NRZ2 to, for example, the lift cage F, since it recognises this as best lift cage.

Without an algorithm there would thus be the situation illustrated in Fig. 11C, according to which the lift cages C and F are both assigned to the zone Z2 and the remaining lift cages are out of operation oos.

There is then the problem that a possible new call to be assigned to the zone Z3 (see, for example, the call nRZ3 from Fig. 8D) cannot be assigned particularly when this call can be served only by a favourite cage.

In Fig. 12 it is reproduced what the algorithm illustrated in Fig. 9 would do in this case.

As indicated at 110, the algorithm has decided that the call is assigned to the zone Z2 and is thus a favourite call. The decision 112 is based on the fact that only one favourite cage is left, but there are two favourite zones. If the call were to be assigned to the lift cage F, sufficient favourite cages would then no longer be available. This leads to the decision 112.

At 114 it is to be noted that in the situation illustrated in Fig. 11A no cage is left for the non-favourite Z1, since only a single non-favourite cage C travels in the zone Z2 and all other non-favourite cages are unavailable. This leads to the decision that insufficient non-favourite cages are available.

The non-favourite cage C travels in zone Z2. There are thus still other non-favourite cages travelling in the same zone, as is indicated at 116.

Since the new call NRZ2 concerns only the storey main entrance ME and storeys lying thereabove, the call can be allocated to a non-favourite cage travelling in the same zone. The non-favourite cage C travelling in the same zone can serve all storeys in upward direction from the entrance. The corresponding decision is reproduced at 118.

Thus the algorithm leads at 120 to the instruction ZbnfKsZ to take the best non-favourite cage travelling in the same zone. This is, in the example of Fig. 11A, the cage C!

The corresponding allocation undertaken on the basis of the algorithm is reproduced in Fig. 13. The algorithm shifts the call allocation of the call NRZ2 from the lift cage F selected by upstream lift algorithms to the lift cage C. The algorithm has kept free the lift cage F for further calls belonging to the zone Z3. A call belonging to the zone Z3 can thus be served in every case.

Note: If, however, a new call cannot be moved to the zone Z2 or lift cage C, the algorithm would lead to the decision "no change" nc. The call would not be shifted at all. Then, according to the otherwise known algorithms, the lift cage F would be allocated to the call.

2.5.3 Example 1

Reference will be made to Fig. 14. As apparent therefrom, there is again the lift layout according to the foregoing examples (Figs. 2 to 5) with six lifts A to F. There are two favourite cages of the lift group, which are denoted by E and F. There are the following defined zones:

Zone Z1	non-favourite zone
Zone Z2	favourite zone for the cages E, F
Zone Z3	favourite zone for the cages E, F.

The cage E may be assigned to the zone Z2. The cage F may be free. For a new call allocated to the zone Z1, a costs calculation algorithm would select, for example, cage F for this call. If the cage F were to be allocated to the zone Z1, however, no cage would be left for the zone Z3.

The algorithm of Fig. 9 prevents this problem. As readily inferrable from the flow chart of Fig. 9, the algorithm decides in this example that the best non-favourite cage, which already travels in this zone Z1, is to be taken for this new call for zone Z1.

2.5.4 Example 2

Here reference is made to Fig. 15. As evident therefrom, there is again the lift layout according to the foregoing examples (Figs. 2 to 5) with six lifts A to F. There are two lift cages of the lift group, which are denoted by E and F. There are the following defined zones:

Zone Z1	non-favourite zone
Zone Z2	favourite zone for the cages E, F
Zone Z3	favourite zone for the cages E, F.

In this example it may be assumed that the cage A is to be allocated to the zone Z1 and the cage E to the zone Z2. The remaining cages may be free fr.

If now the cage F were to be allocated to the zone Z1, no favourite cage would be left for the zone Z3. In order to avoid this problem, the algorithm decides - as readily inferrable from the flow chart of Fig. 9 - that the best non-favourite cage must be taken for this new call.

2.5.5 Example 3

The example 3 is illustrated in Fig. 16. There is here again six lifts, but three non-favourite cages A to C and three favourite cages D to F. As defined zones there may be assumed:

Zone Z1	non-favourite zone
Zone Z2	non-favourite zone
Zone Z3	favourite zone for the cages D to F
Zone Z4	favourite zone for the cages D to F.

In the case of the example according to Fig. 16 the cages A and B are assigned to the zone Z1 and the cages D and E to the zone Z3. The cages C and F may be free. There is now a new call assigned to the zone Z3. A pure costs calculation algorithm would assign this new call to, for example, the lift cage C.

If, however, the lift cage were to be assigned to the zone Z3, no lift cage would remain for the zone Z2.

The decision of the algorithm can - as also in the case of the above Examples 1 and 2 - be readily obtained from the flow chart of Fig. 9. As evident therefrom, the algorithm avoids the above-mentioned problem. The algorithm decides that the best favourite cage, which already travels in zone Z3, must be taken for this new call assigned to the zone Z3. The algorithm may not take the cage F, because then a cage would no longer be left for zone Z4.

2.5.6 Example 4

Reference is made to Fig. 17 for the Example 4. Here a lift layout as in Fig. 16 may be assumed. Accordingly, there are three favourite cages in a lift group, which are denoted by D, E and F. Two of them may be assigned to the zone Z2. Overall the following zones may be defined here:

Zone Z1	non-favourite zone
Zone Z2	favourite zone for the cages D to F
Zone Z3	favourite zone for the cages D to F.

The lift cages C and F may be free. For a new call assigned to the zone Z2 a costs calculation algorithm would select, for example, cage F for this call.

If, however, the cage F were to be assigned to the zone Z2, no favourite cage would be left for zone Z3.

It is readily evident from the flow chart of Fig. 9 what the algorithm presented here does in this case. It *attempts* to place this call on the cage C if this is possible, so as to keep a favourite cage free for zone Z3. If this is not possible, the best favourite cage, which travels in the zone Z2, *must* take the call.

2.6 The "missing cage for zone" algorithm

Reference may now be made to a situation as illustrated in Fig. 18. Here again a lift structure, by way of example, as evident from Fig. 2 is assumed. The subdivision of the individual storeys of the building provided therewith takes place as explained above with respect to Figs. 3 to 5. In the case of the illustrated situation the cages A, B, D and F serve the zone Z3. The cage C is assigned to the zone Z1 and the cage E is assigned to the zone Z2. Only a single cage travels in the zone Z1. All other cages travel in other zones. No cage is free.

It may now be further inferred, as illustrated in Fig. 19, that the lift cage travelling in zone Z1 is unavailable. This is indicated by the reference symbol oos for "out of operation". In other words, the zone Z1 is "lost". From now on, all persons who want to register a call assigned to the zone Z1 can no longer be served.

At this instant an algorithm, which is termed "missing cage for zone", begins to work:

The mode of operation is illustrated in Figs. 20 and 21. As is evident from Fig. 20, this algorithm determines from all travelling (i.e. non-free) cages a specific cage which will no longer receive calls. This cage - in the example, cage D - is blocked against new calls. A cage in such a state is here termed "jumper cage" SK.

As illustrated in Fig. 21, a jumper cage, as soon as it has processed all existing calls, is free and can then process calls for the zone which has become lost. In the final situation illustrated at the right in Fig. 21 the cage D can now be used for the zone Z1. The "missing cage for the zone" algorithm in this situation again stops working.

If more than one zone becomes "lost" in the above-described manner, this algorithm selects for each lost zone a jumper cage which then jumps into the free state after processing its orders from the allocated zone.

Two lists are maintained by the "missing cage for zone" algorithm: These are on the one hand a list for all favourite cages (favourite jumper cages) blocked against new orders and on the other hand a list for all non-favourite cages (non-favourite jumper cages) blocked against new orders.

An example of a "missing cage for zone" algorithm is illustrated in Figs. 22, 23 and 24, wherein Fig. 22 illustrates the main part of the algorithm, Fig. 23 the process of maintaining of the list of non-favourite jumper cages and Fig. 24 the process of maintaining the list of favourite jumper cages.

The flow charts reproduced in Figs. 22 to 24 are self-explanatory with consideration of the legends set out below.

The "missing cage for zone" algorithm illustrated therein is called up each time before a call is definitively assigned to a cage.

Legends for the flow charts of Figs. 22 to 23:

LSnfK	Maintaining the list of non-favourite jumper cages;
LSfK	Maintaining the list of favourite jumper cages;
K e LSnfK	Cage is in the list of non-favourite jumper cages;
K e LSfK	Cage is in the list of favourite jumper cages;
nc	No change;
tbuKsZ	Take the best non-jumper cage travelling in this zone (in other words, the algorithm blocks the jumper cages against a new call allocation);
mnfZ	Missing non-favourite zones;
rLSnfK	Reset the list of non-favourite jumper cages (the list of those non-favourite cages, which are blocked for new call allocations, is set to zero);
K = fr	Cage is free;
K = nf	Cage is non-favourite cage;

#mnfz >

#SnfK The number of missing non-favourite zones is greater than the number of non-favourite jumper cages;

KsZ > 1 More than one cage travels in this zone;

K → LSnfK Add cage to the list of non-favourite jumper cages;

na No action;

mfZ Missing favourite zones;

rLSfK Reset the list of favourite jumper cages (the list of those cages blocked for a new call allocation is set to zero);

K = f Cage is favourite cage;

#mfz >

#SfK The number of missing favourite zones is greater than the number of favourite jumper cages; and

K → LSfK Add cage to the list of favourite jumper cages.

2.6.1 Example

Reference may be made to Fig. 25, which shows a starting situation by way of example. In that case the lift structure and the zone division may again be assumed to be such as explained in Figs. 2 to 5. There are accordingly the following defined zones:

Zone Z1	non-favourite zone
Zone Z2	favourite zone for the cages E, F
Zone Z3	favourite zone for the cages E, F.

The allocation of the individual lift cages A to F to these zones is apparent from Fig. 25.

The cage C is now suddenly unavailable, which is indicated in Figs. 26 and 27 by "UA" (unavailable). In the case of the situation in Fig. 26 resulting therefrom future and waiting passengers, who are assigned to the zone Z1, can no longer be transported.

Now a new call is input. The call may be assigned to the zone Z3. A costs calculation algorithm would decide, for example, that the lift cage D is the best for this call.

It is readily apparent from the flow charts 22 to 24 what the "missing cage for zone" algorithm would do in this case. This algorithm assigns the call not to a cage D, but selects the cage D as jumper cage. The call is now assigned to the best of those other cages which already travel in zone Z3.

Later, as illustrated in Fig. 27, the cage D is free fr. The cage D is now free for an assignment to the zone Z1.

It is to be noted that the cage D is now in fact kept free by the above-explained "assignment to free cage" algorithm.

CLAIMS

1. Method of controlling a lift installation with several lift cages (A-F) in a building, the storeys of which are subdivided into several zones (Z1, Z2, Z3), wherein travel orders of a zone are allocated to the lift cages, characterised in that as long as a lift cage executes a travel order for a zone no travel order for another zone is allocated to this lift cage, that in consequence of a call (nRZ2, NRZ2) for a travel order the number of free lift cages (fr) is compared with the number of still unallocated or still unserved zones and that the travel order forming the call is allocated to a lift cage in dependence on the comparison result.

2. Method according to claim 1, characterised in that a new call (nRZ2, NRZ2), which is assigned to a zone (Z2) already served by at least one of the lift cages (A-F), is allocated to a free lift cage (fr) only when the number of free lift cages (fr) is greater than or equal to the number of zones (Z3) then not served by the lift installation.

3. Method according to claim 2, characterised in that in the case that the number of free lift cages (fr) is smaller than the number of the zones (Z3) not served by the lift installation the new call is allocated to a lift cage which already travels in the same zone.

4. Method according to any one of the preceding claims, characterised in that in the case that

- a) at least one of the storeys cannot be served by all lift cages of the lift installation and
- b) the zones comprise at least one favourite zone (Z1, Z2) which is defined by the fact that at least one storey not able to be served by all lift cages (A-F) belongs to it,

the allocation of a new call is carried out in dependence on whether or not it is assigned to a favourite zone.

5. Method according to claim 4, characterised in that in the case that the conditions a) and b) and additionally

- c) the lift installation has at least one favourite cage (E, F) which is defined by the fact that it can serve all storeys of at least one favourite zone (Z2, Z3),

are fulfilled, when a call assigned to a favourite zone occurs the number of free favourite cages (E, F) is compared with the number of still unallocated favourite zones or favourite zones still not served by the lift installation and the allocation of the call is carried out in dependence on the comparison result and/or that when a call not assigned to a favourite zone occurs the number of free non-favourite cages (A-D) is compared with the number of still unallocated non-favourite zones (Z1) or non-favourite zones (Z1) still not served by the lift installation and the allocation of the call is carried out in dependence on the comparison result.

6. Method according to claim 5, characterised in that a new call (nRZ2, NRZ2) assigned to a favourite zone is allocated to a free favourite cage (E, F) only when the number of free favourite cages is greater than or equal to the number of favourite zones (Z2, Z3) not then served by the lift installation and/or that a new call not assigned to a favourite zone is allocated to a free non-favourite cage (A-D) only when the number of free non-favourite cages is greater than or equal to the number of the non-favourite zones (Z1) not currently served by the lift installation.

7. Method according to any one of the preceding claims, characterised in that in the case that the number of the free lift cages (fr) is smaller than the zones not currently served by the lift installation and a zone (Z3) is served by two or more lift cages one (D) of these lift cages serving the same zone (Z3) is blocked against further allocations until it is free and thus an allocation is accessible to one of the unserved zones.

8. Method according to claim 7, characterised in that in the case of a lift installation in which the total number of zones (Z1, Z2, Z3) is smaller than or equal to the number of lift cages (A-F) one of the lift cages which serves the same zone as another one of the lift cages is blocked per unserved zone against new allocations.

9. Method according to any one of the preceding claims, characterised in that the subdivision of the storeys into several zones (Z1, Z2, Z3) is dependent on or performed by the access authorisation of passengers to the storeys.

10. Control device for a lift installation by a control method according to one of claims 1 to 9.