

Description

Energy-efficient lift installation

The invention relates to a method of operating a lift installation, which comprises a control unit and at least one lift cage, in a building with a plurality of storeys.

EP 1876129A1 describes a method for reducing the energy consumption of a lift installation. In that case the lift installation is alternatively brought into an operating mode or a standby mode. The highest energy consumption occurs in the operating mode, whilst the energy consumption in the standby mode is lower. A use criterion of the lift installation, such as the presence of a passenger in a lift cage, is detected by detecting means. In addition, standby criteria, such as periods of time with low traffic incidence, are also ascertained. As long as the standby criteria are not fulfilled, the lift installation is left in the operating mode. As soon as the standby criteria are fulfilled and the use criterion is not fulfilled, the lift installation is brought into the standby mode.

Possibilities for reducing energy consumption of lift installations are discussed by José Alberto Roig, Ana Lorente, Agustin Chiminelli and José Núñez in the article "Bewertung der Umweltverträglichkeit von Aufzügen im Laufe ihrer Nutzungsdauer" in issue 3/2010 of Lift Reports. In that case there is description of, inter alia, methods for measuring or ascertaining the energy consumption or energy consumption values of lift installations.

In the Abstract of the closing report "Energieverbrauch und Einsparpotenziale bei Aufzügen" of Jürg Nipkow of the Swiss Agency for Energy-Efficiency S.A.F.E. (downloadable under www.electricity-research.ch) with the publication number 250057 the author describes the results of a research project concluded at the end of 2005. Various possibilities of energy savings with lifts are discussed.

WO 2010/086290 A1 describes a method for energy-saving operation of a lift installation, wherein the energy consumption of at least one energy consumer of the lift installation is detected, at least one traffic situation of the lift installation is detected, at least one energy consumption value is ascertained for the detected energy consumption and the detected traffic situation and the ascertained energy consumption value is output on at least one output means.

Hitherto it was sought to reduce the energy consumption of a lift installation by new or improved components of a lift installation, which leads to higher costs for the operator of a lift installation. A further possibility for reducing the energy consumption of lift installations consists in bringing the lift installation in the case of non-use into a waiting mode (standby mode). This means that, for example, superfluous lighting, displays, control units or other lift components are temporarily switched off. If a travel request occurs, the lift installation awakes and executes the lift journey, but without taking into consideration the energy consumption of the lift journey. The waiting mode in the case of lift installations can have the disadvantage that the time period between waiting mode and operating readiness of the lift installation can be comparatively lengthy.

It is an object of the invention to propose a further possibility for a cost-effective and efficient reduction in the energy consumption of a lift installation.

The invention is fulfilled by way of the features of the independent patent claims. Developments are indicated in the dependent claims.

The core of the invention resides in the fact that there is determination, by a control unit of a lift installation in a building with a plurality of storeys, of a respective energy consumption value of the lift installation for the journey from a current stopping storey of a lift cage of the lift installation to at least one respective input destination storey and at least one respective input travel request storey. In that case, a journey is undertaken by the lift cage to that destination or travel request storey for which the at least one energy consumption value of the lift installation is minimal.

The lift cage is moved between the storeys of the plurality. A respective lift control unit for input of a travel request is arranged on at least two storeys. Obviously, a lift control unit could also be arranged on each storey.

The method proposes that the control unit receives a travel request from a lift control unit arranged on the at least two storeys. A destination storey is defined either by the input into the lift control unit or by an input into a control unit, which communicates the input to the control unit, in the lift cage and the input is executed by the control unit. The control unit thus receives a statement with respect to a destination storey. The at least one input

travel request is executed by the control unit by means of a collect operating mode.

By collect operating mode there is understood in general that the lift or the lift cage during a lift journey from a starting storey to a destination storey includes intermediate stops so that further passengers can board or disembark. This mode is in contrast to the so-termed taxi operation in lift installations in which the lift or the lift cage is moved from the starting storey to the destination storey without an intermediate stop.

According to the invention the travel direction of the lift cage is changed by the control unit in dependence on the ascertained energy consumption values. Thus, the lift cage could, for example, be moved a storey deeper before it continues its upward travel. The lift cage is thus moved during a collect journey in the collect operating mode not upwardly only or downwardly only, but moved both downwardly and upwardly depending on ascertained energy consumption values. The travel pattern or travel plot in the collect operating mode thus has a zigzag course, i.e. the lift cage thus does not travel continuously in upward direction or in downward direction.

The energy consumption values of the lift installation can be determined or ascertained in dependence on, for example, the load in the lift cage, the travel direction of the lift cage, etc.

A sequence of the destination and travel request storeys to which journeys are to be undertaken can be ascertained on the basis of the energy consumption values determined by the control unit. In that case, the sequence can be determined in such a manner that the total energy consumption of the lift installation for the destination and travel request storeys to which journeys are to be undertaken, thus the collect travel which is to be performed in the collect operating mode, is minimal. Moreover, it is also conceivable that the energy consumption values are ascertained by a central unit in a service centre and passed on to the control unit of the lift installation for further processing, for example for determination of the sequence of the stops, which are to be performed, with respect to the input destinations and the travel requests. A travel diagram for the collect journey to be undertaken is thereby defined and executed by the control unit. This travel diagram can, for example, be stored in a memory unit connected with the control unit. The sequence of the destination and travel request storeys to which journeys are to be undertaken can obviously change during performance of a collect journey. This is the case when, for

example, apart from the already registered destinations and travel requests a further travel request is input at a lift control unit on a storey.

According to the invention a storey, to which a journey is to be undertaken, can be ascertained in dependence on - additionally to the energy consumption value - a rule. The most diverse parameters, conditions, procedures, intervals, etc., are conceivable as the rule. Obviously also several rules can be defined and, for example, combined together. A maximum time for a lift journey from a starting storey to a destination storey of a passenger, the so-called service time, can, for example, be determined as the rule. However, the waiting time of a passenger at a starting or travel request storey can also be determined. In addition, for example, the number of travel direction changes, the times when a travel direction change is not to be undertaken, the maximum load of the lift cage, a maximum number of storeys travelled to, the time of duty, a number of storeys already travelled to, etc., can be used as the rule.

An advantage is to be seen in the fact that the energy consumption of a lift installation can be reduced merely by controlling or co-ordinating the lift journeys to be executed.

A further advantage consists in that the method can be used even with existing lift installations, since no constructional measures with respect to the components of a lift installation have to be undertaken. Merely the control unit might have to be modified.

The invention is explained in more detail on the basis of an exemplifying embodiment illustrated in the figures, in which:

Fig. 1 shows an exemplifying lift installation which can be operated in accordance with the method,

Fig. 2 shows an example of a known travel diagram,

Fig. 3 shows an example of a travel diagram according to the method described here and

Fig. 4 shows a further example of a travel diagram according to the method described here.

Figure 1 shows an example according to the invention of a lift installation for performance of the method according to the description in Figures 3 and 4. In this example use is made of a lift with a counterweight G. A hydraulic lift, a lift without a counterweight, etc., can obviously also be used. A lift cage AK with a counterweight G and a drive M is disposed in a shaft S in a building with a plurality of storeys F, namely storeys 0 to 4th. The lift cage AK has a control unit BE for the input of a destination storey Z. In this example each storey F has a lift control unit ABE, these units being connected in wired manner or non-wired manner with a control unit SE by way of a suitable communications network. The control unit BE in the lift cage AK is also connected with the control unit SE by way of a communications network, be it by way of an own or the same communications network as the lift control unit ABE.

Figure 2 shows an example of a known travel diagram with a collect travel in a collect operating mode. The storeys F to which journeys are undertaken are recorded as a function of time t in the travel diagram. The lift journey or the collect journey in this example begins at the ground floor F, i.e. the 0 storey, at the time t on the basis of a travel request R1 input at a lift control unit ABE and passed on to a control unit SE and is to end at the 5th storey, i.e. the destination storey Z1. Due to a further travel request R2 at the 3rd storey the control unit SE causes an intermediate stop of the lift cage AK at this travel request storey F. The request made at the 3rd storey shall similarly end at the 5th storey. Yet a further travel request R3 from a lift control unit ABE disposed on the 2nd storey is registered. Since this travel request storey, i.e. 2nd storey, is located below the current stopping storey, this travel request R3 is initially disregarded by the control unit SE and a journey to the destination storey Z1 of the two other travel requests R1, R2, i.e. to the 5th storey, is undertaken by the lift cage AK. Having arrived there, the passengers disembark from the lift cage AK.

The travel request R3 until now disregarded by the control unit SE is now processed. For this purpose the lift cage AK travels in empty state to the travel request storey, i.e. the 2nd storey, so that it can bring the passengers requiring the journey to the 6th storey, i.e. to the destination storey Z2 of this travel request R3.

It is to be noted that the input of a destination storey Z can take place either by way of the lift control unit ABE or by way of a control unit BE in the lift cage AK.

The travel request R1, R2, R3 input into the lift control unit ABE and the input destination storey Z1, Z2, wherein this input of the destination storey Z1, Z2 is carried out either in the lift control unit ABE or in a control unit BE in a lift cage AK, are communicated to the control unit SE of the lift installation so that the control unit SE can process and execute the request and the input of the destination storey.

Figure 3 shows an example of a travel diagram according to the invention. The collect journey again starts at the time t at the ground floor, i.e. the 0 storey, with a travel request R1 which was input into a lift control unit ABE and communicated to the control unit SE. The lift cage AK again makes an intermediate stop at the 3rd storey due to a further travel request R2. Yet a further travel request R3, which is input in a lift control unit ABE at the 2nd storey, is again registered by the control unit SE.

This time, however, the control unit SE now determines at least one respective energy consumption value of the lift installation for the journey from the current stopping storey, for example the 3rd storey, of the lift cage AK to the respective travel request storey R3, in this example the 2nd storey, and to the respective destination storeys Z1, Z2, in this example the 5th and 6th storeys.

A journey is now undertaken to that destination or travel request storey Z1, Z2, R3 for which the at least one energy consumption value of the lift installation is minimal. In this example the energy consumption value of the lift installation for a journey to the 2nd storey is minimal. A travel direction change thus takes place before the collect journey in upward direction to the destination storeys Z1, Z2, i.e. to the 5th and 6th storeys, is continued. Through the execution of the travel request R3 on the 2nd storey and the change in travel direction, which is connected therewith, the energy consumption of the lift installation can be minimised in simple and efficient manner.

The energy consumption values can in that case be determined in dependence on the load in the lift cage AK, the travel direction of the lift cage AK, etc. Use can be made, as load, not only of the current load existing in the lift cage AK, but also the estimated additional load due to the boarding of passengers at a travel request storey R1, R2, R3.

Determination of the energy consumption values can be carried out by different methods, such as, for example, described in the Lift Report Article "Bewertung der

Umweltverträglichkeit von Aufzügen im Laufe ihrer Nutzungsdauer" 03/2010. Thus, for example, the energy consumption for a representative journey can be determined. In that case individual energy consumption values such as, for example, for an upward journey to the highest stopping point, a downward journey to the lower stopping point and the respective door operation (opening and closing), can be calculated. The energy consumption of other journeys can then be determined on the basis of the individual energy consumption values. With inclusion of a traffic pattern of the lift installation the overall energy of a lift installation can be determined. In addition, the energy consumption of a lift installation can be determined on the basis of consumption measurements for every possible journey or on the basis of simplified energy models.

It is conceivable that a sequence of the destination and travel request storeys Z1, Z2, R1, R2, R3 to which journeys are to be made is determined by the control unit SE on the basis of the ascertained energy consumption values. In that case the sequence of the destination and travel request storeys Z1, Z2, R1, R2, R3 to which journeys are to be undertaken can be determined in such a manner that the total energy consumption of the lift installation is minimal or reduced. The sequence can be stored in the form of a list, table, etc., in a memory unit, which is not shown in the figures. The memory unit is in that case connected with the control unit SE and then either integrated in the control unit or separate therefrom (SE). The determined sequence can either be determined statically on an occasion prior to the collect journey and correspondingly executed by the control unit SE or it can be dynamically changed during operation of the lift installation.

It is also conceivable that a central unit, for example in a service centre, determines the energy consumption values of the lift installation and communicates them to the control unit SE for further processing or for execution.

In addition to the energy consumption values the destination and/or travel request storeys Z1, Z2, R1, R2, R3 to which journeys are to be undertaken can be determined by the control unit SE in dependence on a rule. In principle, all parameters, conditions, intervals, etc., which can ensure efficient lift operation can be used as the rule. Thus, for example, a value or an interval for a service time can be determined. By service time there is meant the time for execution of a requested lift journey from the travel request storey R1, R2, R3 to the destination storey Z1, Z2. This in general increases when journeys are to be made by the lift cage AK to additional travel request storeys. In addition, the minimum and/or

maximum waiting time of a passenger on a travel request storey could be defined in accordance with a rule. The number of maximum travel direction changes, conditions when no change in travel direction is undertaken, etc., could, for example, be indicated as rules with respect to the travel direction change. Thus, times of day, for example the main traffic times in a building, in which no travel direction change by the lift installation is to be undertaken could be indicated as a condition. A further condition could, for example, regulate priority journeys. In addition, minimum and/or maximum load values in the lift cage AK could be used as the rule. Thus, for example, the load in the lift cage AK could be regulated in such a manner that the energy consumption of the lift installation due to load management can be reduced. A further example for a rule can be that the minimum and/or maximum number of destination and/or travel request storeys Z1, Z2, R1, R2, R3 to which journeys are to be undertaken within a collect journey is determined.

Figure 4 shows a further example of a travel diagram according to the invention. In this example the lift cage AK changes the travel direction from the 3rd storey to the 4th storey due to more favourable or minimal energy consumption values so that it (AK) can execute a travel request R3. The passengers are thereafter brought in the lift cage AK to their destination storeys Z1, Z2 at the 1st storey and ground floor. The method is otherwise used as is described in Figure 3.

Patent claims

1. Method of operating a lift installation, which comprises at least one control unit (SE), in a building with a plurality of storeys in a collect operating mode, wherein at least one travel request (R1, R2, R3) and at least one statement with respect to a destination storey (Z1, Z2) are received by the control unit (SE), characterised in that a respective energy consumption value of the lift installation for a journey from a current stopping storey (F, Z1, Z2, R1, R2, R3) of a lift cage (AK) of the lift installation to the respective at least one input destination storey (Z1, Z2) and to the respective at least one input travel request storey (R1, R2, R3) is ascertained by the control unit (SE), that a minimal energy consumption value for a lift journey is determined from the ascertained energy consumption values and that a journey is undertaken to that destination storey (Z1, Z2) or travel request storey (R1, R2, R3) with the minimal energy consumption value.
2. Method according to claim 1, characterised in that a travel direction of the lift cage (AK) is changed by the control unit (SE) in dependence on the ascertained energy consumption values.
3. Method according to one of the preceding claims, characterised in that the energy consumption values are determined in dependence on a load in the lift cage (AK) and/or a travel direction of the lift cage (AK).
4. Method according to any one of the preceding claims, characterised in that a sequence of destination storeys (Z1, Z2) and travel request storeys (R1, R2, R3) to which journeys are to be undertaken is ascertained on the basis of the energy consumption values ascertained by the control unit (SE).
5. Method according to claim 4, characterised in that the sequence of destination storeys (Z1, Z2) and travel request storeys (R1, R2, R3) to which journeys are to be undertaken is determined in such a manner that the total energy consumption of the lift installation is minimal.
6. Method according to any one of the preceding claims, characterised in that a destination storey (Z1, Z2) or travel request storey (R1, R2, R3) to which a journey is to be undertaken is ascertained by the control unit (SE) in dependence on, additionally to the

energy consumption values, a rule.

7. Method according to claim 6, characterised in that a statement with respect to a service time, a waiting time, a travel direction change, a load value for the lift cage (AK), a number of destination storeys (Z1, Z2) or travel request storeys (R1, R2, R3) to which journeys have already been undertaken and/or a time of day is or are used as the rule.

8. Lift installation with a control unit (SE) and at least one lift cage (AK) in a building with a plurality of storeys (F), wherein the lift cage (AK) is vertically movable between the storeys (F) of the plurality, wherein a lift control unit (ABE) is arranged on at least two storeys (F), wherein the control unit (SE) receives a travel request (R1, R2, R3), which is input into the lift control unit (ABE), from at least one lift control unit (ABE), wherein a destination storey (Z1, Z2) is defined either by an input into the lift control unit (ABE) or by an input into a control unit (BE), which communicates the input to the control unit (SE), in the lift cage (AK) and wherein the control unit (SE) executes the at least one input travel destination (Z1, Z2) and the at least one input travel request (R1, R2, R3) by means of a collect operating mode, characterised in that the control unit (SE) ascertains on each occasion at least one energy consumption value of the lift installation for the journey from a current stopping storey (F, Z1, Z2, R1, R2, R3) of the lift cage (AK) to the respective at least one input destination storey (Z1, Z2) and respective at least one input travel request storey (R1, R2, R3) and that the control unit (SE) selects, that destination storey (Z1, Z2) or travel request storey (R1, R2, R3) - for the undertaking of a journey thereto - for which the at least one energy consumption value of the lift installation is minimal.