

Description

Method for operating an elevator system

The invention relates to a method for operating an elevator system according to the precharacterizing clause of the independent patent claim.

EP 1 876 129 A1 describes a method for reducing the energy consumption of an elevator system. In this case, the elevator system is alternatively changed to an operation mode or to a stand-by mode. The highest energy consumption occurs in the operation mode, while the energy consumption in the stand-by mode is lower. Detection means are used to detect a use criterion of the elevator system, such as the presence of a passenger in an elevator car. Stand-by criteria, such as periods of time with a low volume of traffic, are also stipulated. As long as the stand-by criteria have not been met, the elevator system is left in the operation mode. As soon as a stand-by criterion has been met and the use criterion has not been met, the elevator system is changed to the stand-by mode.

US 6,857,506 B1 shows a method for operating an elevator group, an elevator-car-specific energy consumption file being produced in order to describe the energy consumption during a journey of the elevator car for different loads. Floor calls and elevator car calls are allocated to the elevator cars in such a manner that the energy consumption needed to handle all the calls is minimal.

One object of the present invention is to specify a method for operating an elevator system, in which energy consumption data are determined and are available for further use.

This object is achieved with a method having the features of the independent patent claim. According thereto, in the method, an **energy consumption** of at least one energy consumer of the elevator system and at least one **traffic situation** of the elevator system are detected. At least one **energy consumption value** is determined using the detected energy consumption and the detected traffic situation. This determined energy consumption value is output on at least one output means and is thus available for further use. At least one evaluation apparatus determines the energy consumption value, that is to say links the energy consumption and traffic situation. This has the advantage that an energy consumption value is situationally determined and output depending on the traffic. The energy consumption value informs of the energy consumption of an energy consumer, which makes it possible to operate the elevator system in an energy-conscious manner.

US 6,857,596 describes detection of the actual energy consumption for the energy consumption file to be created there. Depending on a respective departure and arrival or destination floor and also depending on a respective load, individual data items for the respective energy consumption are detected on the basis of the respective traffic situation (departure floor, destination floor, load). An energy consumption value which, as an individual number, makes a statement on the efficiency with which the elevator system is operated is not output in this case. If, for example, twelve passengers travel from the first floor, as the departure floor, to the tenth floor, as the destination floor, an energy consumption which takes into account the comparatively large load and the distance is taken as a basis according to US 6,857,596. The energy consumption value according to the invention takes into account the twelve conveyed passengers as a traffic situation, for example. Since each passenger could also travel alone, the energy consumption value determined is lower when simultaneously transporting a plurality of passengers than when transporting individual

passengers and thus expresses that the energy expended is used in a more efficient manner.

If the energy consumption value is indicated to the passengers conveyed in the elevator car, they can immediately discern that, for example, joint use of the elevator system saves energy. When the elevator system is used continuously, users will discern this on account of the indication on the at least one output means and are able to gear their usage behavior of the elevator system thereto. However, an indication of the mere energy consumption (the data item taken as a basis in US 6,857,596) does not make any sense in this scenario since - depending on the respective direction of travel and resultant motor or generator operation and counterweights or the like - the energy consumption for the individual journey with a plurality of passengers is usually higher than for an individual journey with only one passenger which is otherwise the same. An indication of the energy consumption could therefore unfavorably even result in journeys with a high (instantaneous) energy consumption being just avoided, which of course would have to increase the overall energy consumption, however.

Advantageous developments of the method are described in the dependent patent claims.

In order to **detect the energy consumption**, provision is made of at least one energy measuring apparatus which is preferably locally placed on the energy consumer. Additionally or alternatively, the respective active power is preferably detected as the actual energy consumption.

In order to **detect the traffic situation**, signals from the technical process, namely the elevator system, are evaluated. A sensor is suitable for obtaining such signals, which sensor communicates, for example, car-specific data, for example a load on an elevator car, to an evaluation apparatus and/or destination call controller and/or elevator controller.

In order to detect the traffic situation, a number of calls per unit of time is additionally or alternatively advantageously detected by a destination call controller and/or elevator controller as signals from the technical process. In order to
5 detect the traffic situation, it is likewise appropriate for the destination call controller and/or elevator controller to determine a number of passengers who have been conveyed by the elevator system in a unit of time in the building. It is also appropriate to take a number of passengers who have been
10 conveyed by the elevator system from call input floors to destination floors in a unit of time as a basis as the passenger flow in the building and thus as the traffic situation.

The detected energy consumption and/or the detected traffic situation is/are advantageously stored in at least one computer-
15 readable data memory, with the result that the stored data can be identified for subsequent use and can be retrieved from the data memory. The evaluation apparatus can then also determine the energy consumption value on the basis of retrieved data. In this case, an energy consumption and/or a traffic situation need
20 only be identified and can then be loaded, which makes renewed detection unnecessary. The same also accordingly applies to the energy consumption value.

In order to detect the energy consumption and/or in order to detect the traffic situation, the evaluation apparatus
25 advantageously simulates the energy consumption or traffic situation, with the result that a future energy consumption value can be determined using the simulated energy consumption and/or the simulated traffic situation even before the elevator system is installed.

30 In order to detect the traffic situation, signals are advantageously evaluated by different specialized apparatuses, thus resulting in a certain redundancy of the characteristic variables and making it possible to deliberately correct or confirm the detected traffic situation, which in turn results in

correct and confirmed determination of the energy consumption value. For example, in order to detect the traffic situation, signals which are communicated by the destination call controller and/or elevator controller to the evaluation apparatus are first of all processed. Even if the load on the elevator car is detected using a sensor, the signals communicated from there to the evaluation apparatus can be used to correct or confirm the detected traffic situation.

The determined energy consumption value can advantageously be determined for a wide variety of reference variables, for example as an energy consumption value for precisely one energy consumer or as an energy consumption value for precisely one energy consumer and for a particular unit of time. Other suitable reference variables are: the elevator system, the elevator system and a unit of time, the elevator system and a traffic situation, an elevator car, the elevator car and a unit of time. An individual passenger, a passenger and a unit of time or a passenger and a traffic situation can likewise be used as a reference variable, with the result that specified energy consumption values for transporting an individual passenger are available. It is accordingly also appropriate to take an energy consumption per call, per journey, per journey and unit of time, per journey and traffic situation or an energy consumption per area as a basis. Combinations of all of these reference variables are likewise possible, for example elevator system, unit of time and traffic situation or elevator car, unit of time and passenger and so on. As a result, a plurality of energy consumption values can be provided, to be precise both those which interest a building administrator who manages and operates the building having the elevator system and those which interest the passenger who is moved using the elevator system in the building.

An energy-saving mode of the elevator system is advantageously chosen or selected on the basis of at least one determined energy consumption value or a plurality of determined energy

consumption values. The at least one energy consumption value or one of the energy consumption values may result from the fact that no journey has been selected. A plurality of energy consumption values may result, for example, if different traffic situations are taken as a basis. A direct journey and a resultant first energy consumption value, for example, may be taken as a basis for a car or floor call. A second energy consumption value may be determined for a direct journey with a minimum waiting time. A third energy consumption value can be determined for a direct journey and an increased waiting time. Further energy consumption values can be determined for traffic situations if intermediate stops, for instance in order to allow further passengers to get in or out, or detours, in order to first of all allow other passengers to get in or out, are permitted for the journey. Yet further energy consumption values can be determined if it is permitted to enter or leave the elevator car at another floor instead of the starting floor or destination floor. The above examples can be supplemented - as described above and below - with further bases for determination and can be combined with one another. It is possible to choose and/or select one value from a plurality of indicated energy consumption values for the purpose of specifying the journey. If only one energy consumption value is indicated, this value can be chosen and/or selected.

In order to assist with choosing or selecting the energy-saving mode, at least one determined energy consumption value is output on an output means of a control center and/or call input apparatus. From a plurality of determined energy consumption values, it is possible to output a subset of the determined values, with the result that unfavorable values are not output, for example. Furthermore, a difference in different determined energy consumption values may be provided. An interested person, that is to say a building administrator in the control center or a passenger on the call input apparatus for example, can choose or select an energy-saving mode of the elevator system on the basis of the energy consumption value which has been output. The

term "**choose**" is understood as meaning a personal choice of an energy consumption value by the interested person. The term "**select**" is understood as meaning a stipulation of the energy consumption value to be actually used for the journey. In the simplest case, the choice of an energy consumption value is simultaneously also accompanied by a selection of this energy consumption value. In order to further assist with the choice or selection, not only the respective energy consumption value or each respective energy consumption value but also the underlying data, for example the traffic situation, are output, in particular in plain text. Plain text output of the traffic situation can draw a passenger's attention to the fact that, in the event of a floor call, the choice or selection of a first energy consumption value is associated with an increased waiting time and another energy consumption value is associated with an intermediate stop. The respectively interested person can make the choice or selection on this basis in an informed manner.

In addition to the choice on the call input apparatus, at least one energy consumption value can be chosen at another point, for example according to a specification or by the building administrator. Such a choice can be made automatically, for example by taking a predefined or predefinable criterion as a basis. A threshold value which must not be exceeded, for example,² is suitable as such a criterion. An energy consumption value is selected for the journey from a plurality of chosen energy consumption values according to at least one selection rule, in particular in an automatic manner. The selection is advantageously made on the basis of a hierarchical selection rule, with the result that a choice made by a building administrator is given a higher weighting than a choice made by a passenger, for example. Other aspects which can be taken into account with such a selection rule are that a choice made by a VIP passenger is given a higher weighting than a choice made by a non-VIP passenger, that a choice made by a disadvantaged passenger is given a higher weighting than a choice made by a non-disadvantaged passenger (selection fair to disadvantaged

persons), that an energy consumption value which is chosen most is selected or is given a higher weighting (democratic selection), that an energy consumption value chosen first is selected or is given a higher weighting (temporal selection),
5 that a chosen energy consumption value is randomly selected (random selection) and so on. A disadvantaged passenger is a physically and/or mentally handicapped person. However, a disadvantaged passenger may also be a passenger with bulky goods, with heavy luggage, with a patient transfer means, with
10 dangerous goods etc. If the applied selection rule is known to the passengers, it is also understood and accepted by the latter.

This has the advantage that, if different energy consumption values have been chosen for a journey, one of these energy
15 consumption values can be selected according to a defined selection rule or a combination of a plurality of selection rules, for example if a plurality of passengers are conveyed together in the same elevator car. In addition, a building administrator, for example, can stipulate that no low energy
20 consumption values are selected at peak times with a lot of traffic in the building because such a selection is associated with a loss of performance of the elevator system. Conversely, the building administrator can stipulate that only energy consumption values which are as low as possible can be selected
25 outside peak times when there is little traffic in the building, which saves energy. The evaluation apparatus, the destination call controller, the elevator controller, the or each call input apparatus or a control center is preferably suitable for making the automatic selection according to the or each selection rule.
30 This has the advantage that an energy consumption value can be selected in a flexible manner by different parts of the elevator system. If the elevator system has a destination call controller, it can not only allocate calls but can also select the energy consumption value.

In order to operate the elevator system using the selected energy consumption value, the latter is preferably communicated to at least one destination call controller and/or elevator controller, and at least one part of the elevator system is
5 operated by the destination call controller and/or elevator controller in at least one operating mode linked to the selected energy consumption value. This has the advantage that both the entire elevator system and individual parts of the latter can be operated with the selected energy consumption value.

10 The energy consumption value of the elevator system is preferably determined before the latter is installed. The elevator system is preferably installed on the basis of the determined energy consumption value. An energy consumption
15 guarantee certificate (certificate) is particularly preferably issued for an elevator system which has been installed or is to be installed, according to which certificate the actual energy consumption value of the elevator system is guaranteed not to exceed the determined energy consumption value after
20 installation has been concluded. During operation of the elevator system, actual energy consumption values can be continuously or cyclically compared with the energy consumption value according to the certificate. This has the advantage that an elevator system which deliberately saves energy is planned
25 and advertised and is then also installed. Compliance with the energy consumption value can also be checked and/or confirmed by issuing an energy consumption guarantee certificate.

In order to handle at least one call and/or at least one identification code, at least one destination call controller and/or elevator controller advantageously determine(s) at least
30 one journey of at least one elevator car. The or each journey is linked to at least one respective energy consumption value, for example by the evaluation apparatus. One energy consumption value is selected from the at least one linked energy consumption value on at least one call input apparatus, and a
35 call and/or identification code is/are handled by the

destination call controller and/or elevator controller using the journey linked to the selected energy consumption value. This has the advantage that a plurality of possible journeys or a journey with different energy consumption values is/are
5 determined for a call made by the passenger. The result is therefore a plurality of energy consumption values, and choosing and/or selecting one of the energy consumption values results in an energy-saving mode.

The invention also relates to an elevator system for carrying
10 out the abovementioned method, in which system the energy consumer is at least one elevator drive and/or a door drive and/or an elevator car lighting system, etc. This has the advantage that the energy consumption of a plurality of very different energy consumers of the elevator system can be
15 detected at the same time or alternately and can therefore be used for an objective decision regarding the energy-conscious operation of the elevator system.

At least one evaluation apparatus advantageously evaluates the detected energy consumption and the detected traffic situation
20 and determines the energy consumption value. The evaluation apparatus may be in the form of an independent apparatus or part of the following apparatuses: an energy measuring apparatus, a destination call controller, an elevator controller, a call input apparatus, a control center and so on. The evaluation
25 apparatus can therefore be placed in a flexible manner.

The energy measuring apparatus and the evaluation apparatus (also in the form of part of another apparatus) are or can be communicatively connected. A bus system, in particular in the form of a bidirectional bus, is suitable for communicative
30 connection. This has the advantage that the parts of the elevator system can interchange the information needed to determine the energy consumption value.

At least one output means is provided for the purpose of outputting the determined energy consumption value. A control center and/or a call input apparatus is/are suitable as the location for fitting the at least one output means. This has the advantage that the energy consumption value is output at the location of interest, that is to say in a control center in the case of the building administrator or on a call input apparatus in the case of the passenger. An interested person can use the energy consumption value which has been output to decide on the energy-conscious operation of the elevator system by choosing and/or selecting an energy consumption value.

The invention also relates to a computer program product which stores a computer program having program code instructions for implementing the invention and possibly the refinements of the latter. At least the following units are suitable for executing the computer program, which units have a processing unit in the form of a processor and a memory in a manner known per se for this purpose: energy measuring apparatus, evaluation apparatus, destination call controller, elevator controller, call input apparatus and control center.

Exemplary embodiments of the invention are explained in detail using the figures, in which, in some cases schematically:

- fig. 1 shows a first exemplary embodiment of part of an elevator system;
- fig. 2 shows a second exemplary embodiment of part of an elevator system;
- fig. 3 shows a first exemplary embodiment of part of a call input apparatus of the elevator system according to fig. 1 or 2;

fig. 4 shows a second exemplary embodiment of part of a call input apparatus of the elevator system according to fig. 1 or 2;

5 fig. 5 shows an exemplary embodiment of an energy consumption value of the elevator system according to fig. 1 or 2, which energy consumption value is output on an output means of a control center;

10 fig. 6 shows an exemplary embodiment of an energy consumption value of the elevator system according to fig. 1 or 2, which energy consumption value is output on an output means of the call input apparatus according to fig. 3; and

15 fig. 7 shows a flowchart having method steps of the method for operating the elevator system according to fig. 1 or 2 in an energy-saving manner.

20 Figs. 1 and 2 show two exemplary embodiments of part of an elevator system 1 in a building. On each floor S1-S3, a passenger can enter and/or leave the elevator car 17, 17' (with elevator car lighting system 10) via at least one elevator door 11, 11', 12, 12'. The elevator car 17, 17' is connected to at least one counterweight 18, 18' via at least one supporting means 19, 19' in at least one elevator shaft S4, S4'.

25 The current load on the elevator car 17, 17' is detected by at least one sensor 20. In order to detect the traffic situation, the sensor 20 provides sensor data as the signal from the technical process, namely the elevator system 1. A load mat, a light curtain, a motion detector, a camera, a drive torque measuring sensor etc. are suitable as the sensor 20. According to fig. 1, the sensor 20 is a load mat. According to fig. 2, the
30 sensor 20 is a motion detector. A load mat detects a weight of a passenger standing on it. In the case of a light curtain which is provided, for example, in the region of the threshold of the

elevator car 17, 17' and acts as a sensor 20, said light curtain is (partially) interrupted as soon as a passenger crosses the threshold when entering or leaving the elevator car 17, 17'. The presence (or absence) of a passenger or a plurality of
5 passengers in the elevator car 17, 17' can therefore be detected as the load.

An infrared sensor as the sensor 20 acquires, in a manner known per se, thermal images of the thermal radiation emitted by passengers, with the result that the presence or absence of
10 passengers in the elevator car 17, 17' can be detected as the load. Further embodiments of a sensor 20 are an ultrasonic sensor and a camera, in particular a digital camera. The use of a camera has the advantage of being able to use zoom lenses and/or movable holders, for example in the form of a motor-
15 operated stand. Such an orientation of a camera lens can be changed automatically or in a remotely controlled manner. The camera can be combined with a lighting device in order to ensure the function as a sensor 20 even in unfavorable lighting conditions.

A drive torque measuring sensor as the sensor 20 detects at
20 least one elastic deformation of at least one part of the elevator drive 8, 8', for example a brake lever. This elastic deformation can be converted into sensor data using at least one strain gage and at least one evaluation controller. In learning
25 journeys, elastic deformations of a more or less full elevator car 17, 17' are detected and are stored as reference data with an associated load. The load is thus indirectly detected.

Depending on the type of sensor 20, detected sensor data can be compared with stored reference data. The load associated with
30 those reference data which largely match the detected sensor data is then considered to be the current detected load on the elevator car 17, 17'.

The sensor 20 has at least one processor, at least one computer-readable data memory, at least one adapter for a bus system 15, 15' and/or at least one adapter for at least one radio field 16, 16' as well as an electrical power supply. At least one
5 communication computer program is loaded from the computer-readable data memory and is executed by the processor. The communication computer program controls communication between the sensor 20 and at least one evaluation apparatus 3 and/or destination call controller 4 and/or elevator controller 5, 5'.

10 At least one call input apparatus 6 is arranged close to a floor door 11, 11' and/or in an elevator car 17. The call input apparatus 6 makes it possible for a passenger to input a call. Fig. 3 shows a buttonless call input apparatus 6 in which a call is provided by touching at least one field 22, 22' on the
15 touchscreen 13. Fig. 4 shows a call input apparatus 6 having input buttons 23, 23'. The call can also be input in a contactless manner. In this respect, fig. 4 shows a call input apparatus 6 having a transmitting/receiving apparatus 24 for receiving identification codes in at least one radio field 16, 16', 26. Such an identification code is emitted by a mobile
20 device 25 worn by a passenger. The mobile device 25 is, for example, a Radio Frequency Identification Device (RFID) and/or a mobile telephone and/or a mobile computer.

At least one elevator controller 5, 5' has at least one
25 processor and at least one computer-readable data memory. At least one adapter for at least one signal line 14, 14' and/or at least one adapter for at least one bus system 15, 15' and/or at least one adapter for at least one radio field 16, 16' and an electrical power supply are arranged in at least one housing of
30 the elevator controller 5, 5'. According to fig. 2, the sensor 20 transmits sensor data to the elevator controller 5 in the bus system 15. Furthermore, the call input apparatus 6 according to fig. 2 transmits a call made by the passenger, in the form of a floor call and/or a car call, to the elevator controller 5 in
35 the bus system 15. A computer program executed by the processor

controls the elevator drive 8, 8' and the door drive 9, 9' and reads sensor data from the sensor 20. The computer program determines at least one call allocation for a floor call. The call allocation indicates, in principle, a journey to the call
5 input floor using an elevator car 17 with the shortest possible waiting time. For a floor call, an elevator car 17 is first of all moved to the floor of the call input apparatus 6. A car call to a destination floor is made on a call input apparatus 6 of the elevator car 17 only after the passenger has entered the
10 elevator car 17 and the elevator car 17 is moved to this destination floor.

At least one destination call controller 4 has a configuration which is, in principle, comparable to that of the elevator controller 5, 5' in terms of the processor, data memory, adapter
15 etc. According to fig. 1, the destination call controller 4 is an independent electronic unit in at least one separate housing, which unit is placed on the floor S3, for example. The destination call controller 4 may also be an electronic plug-in unit, for example in the form of a printed circuit board which
20 is arranged in the housing of a call input apparatus 6, 6' and/or an elevator controller 5, 5'. According to fig. 1, the sensor 20 transmits sensor data to the destination call controller 4 in the radio field 16. According to fig. 1, the call input apparatus 6 transmits a call made by the passenger,
25 in the form of a destination call, to the destination call controller 4 in the bus system 15. In the case of a destination call, a desired destination floor is already indicated when inputting the call, with the result that there is no longer any need for a car call. The destination call controller 4 thus
30 already knows the destination floor when the call is input and can therefore optimize not only the approach to the call input floor but also the approach to the destination floor. A computer program executed by the processor in the destination call controller 5 reads the transmitted sensor data and the
35 transmitted destination call. The computer program determines at least one most favorable call allocation for a destination call.

The most favorable call allocation indicates, in principle, a journey from a departure floor to an arrival floor using at least one elevator car 17, 17' with the shortest possible waiting time and/or the shortest possible time to the destination. The departure floor need not correspond to the call input floor. In addition, the arrival floor need not correspond to the destination floor desired by the passenger according to the destination call. The computer program can thus bundle passengers from a plurality of call input floors in a departure floor and/or can convey passengers who would like to arrive at different destination floors to an arrival floor. In this case, the passengers must then cover the floor difference between the call input floor and departure floor and/or destination floor and arrival floor by stairs and/or an escalator. When allocating the most favorable call allocation to the elevator car 17, 17', at least one start call signal and at least one destination call signal are generated and are transmitted to the adapter of the elevator controller 5, 5' of this elevator car 17, 17' via the signal line 14, 14'.

The destination call controller 4 and the elevator controller 5, 5' communicate in a bidirectional manner via a signal line 14, 14'. According to fig. 1, the destination call controller 4 is communicatively connected to an elevator controller 5, 5' via a respective signal line 14, 14'. The communication subscribers at the ends of the permanently activated signal lines 14, 14' can be uniquely identified.

The destination call controller 4 and/or the elevator controller 5, 5' detect(s) at least one traffic situation in the building. For this purpose, the destination call controller 4 and/or elevator controller 5, 5' detect(s) at least a number of calls per unit of time. Additionally or alternatively, it is possible to detect the following data: a number of passengers who have been conveyed by the elevator system 1 in a unit of time in the building; a difference in passengers on floors S1-S3 of the building who have been conveyed from call input floors to

destination floors by the elevator system 1 in a unit of time; a current number of passengers per floor S1-S3 of the entire building; and so on. The number of passengers per floor S1-S3 is detected using the calls which have been handled and/or from the load on the elevator car 17, 17' when handling the calls. If a plurality of passengers thus make calls on call input apparatuses 6 per unit of time, the passengers on the call input floors and/or departure floors then enter the elevator cars 17, 17' handling the calls and are moved to destination floors and/or arrival floors using the elevator cars 17, 17', the current traffic situation is tracked by virtue of the fact that the number of passengers on the call input floors and/or departure floors decreases by the number of passengers who have been moved and accordingly increases on the destination floors and/or arrival floors.

The load on the elevator car 17, 17', as detected by the sensor 20 when handling the calls, corrects or confirms the number of passengers who have been moved. If, for example, two passengers on the same call input floor make a destination call to the same destination floor in quick succession on a call input apparatus 6, an elevator car 17, 17' is moved to the call input floor for these two passengers. If, however, only one passenger now enters this elevator car 17, 17' and is moved to the destination floor using said car, this information is determined from the load on the elevator car 17, 17' (for example only an actual passenger weight of 80 kg is detected instead of twice the average passenger weight of 75 kg as expected). The destination call controller 4 and/or the elevator controller 5, 5' thus correct(s) and/or supplement(s) the number of calls communicated by the call input apparatus 6 on the basis of the load detected by the sensor 20 of the elevator car 17, 17' during the journey.

The current traffic situation reflects the passenger occupancy of the building in real time. A current traffic situation may also apply to areas of the building, particular floors of the building and individual calls. A current traffic situation may

thus also comprise an individual destination call if, for example at an off-peak time, there are only a few passengers in the building and each destination call is individually handled by an elevator car 17, 17'.

- 5 At least one energy measuring apparatus 2, 2', 2'' detects the energy consumption of at least one energy consumer of the elevator system 1. The energy measuring apparatus 2, 2', 2'' is locally placed on the energy consumer and, as an active power meter, detects the actual energy consumption of said consumer.
- 10 The energy measuring apparatus 2, 2', 2'' may have a processor, a computer-readable data memory, an adapter for a bus system 15, 15' and/or an adapter for at least one radio field 16, 16'. At least one communication computer program is loaded from the data memory and is executed using the processor. The communication
- 15 computer program controls communication between the energy measuring apparatus 2, 2', 2'' and at least one evaluation apparatus 3 and/or destination call controller 4 and/or elevator controller 5, 5' and/or call input apparatus 6 and/or control center 7. The energy measuring apparatus 2, 2', 2'' is, for
- 20 example, a measuring apparatus for electrical current, which apparatus is connected between the electrical power supply of the building and the energy consumer. The energy measuring apparatus 2, 2', 2'' then detects the electrical current flowing during operation of the respective energy consumer and the
- 25 electrical voltage and takes into account the phase angle between the current and voltage. According to figs. 1 and 2, a first energy measuring apparatus 2 is placed on the elevator drive 8, 8' and detects its energy consumption; a second energy measuring apparatus 2' and a third energy measuring apparatus
- 30 2'' are placed on the door drive 9, 9' and on the elevator car lighting system 10, respectively, and detect their respective energy consumption. Any known power meter or sensor is suitable as a measuring apparatus, for example a three-phase power meter for a three-phase elevator drive 8, 8', a single-phase power
- 35 sensor for a DC door drive and so on. Such devices, their functionality and connection requirements are known per se.

At least one evaluation apparatus 3 evaluates at least one detected energy consumption and at least one detected traffic situation. The evaluation apparatus 3 may be an independent apparatus or part of an energy measuring apparatus 2, 2', 2'' and/or a destination call controller 4 and/or an elevator controller 5, 5' and/or a call input apparatus 6 and/or a control center 7. The evaluation apparatus 3 may be an electronic plug-in unit, for example in the form of a printed circuit board which, according to fig. 2, is part of the destination call controller 4 or, according to fig. 2, is part of one of the energy measuring apparatuses 2, 2', 2''. In order to be able to be communicatively connected, the evaluation apparatus 3 comprises at least one adapter for a bus system 15, 15' and/or at least one adapter for a radio field 16, 16'. The evaluation apparatus 3 also comprises a processing unit in the form of a processor and at least one computer-readable data memory. At least one computer program is loaded from the data memory and is executed by the processing unit. The evaluation apparatus 3 links the detected energy consumption to the detected traffic situation. For this purpose, the energy measuring apparatus 2, 2', 2'' communicates the detected energy consumption to the evaluation apparatus 3, and the destination call controller 4 and/or the elevator controller 5, 5' communicate(s) the detected traffic situation to the evaluation apparatus 3. The computer program in the evaluation apparatus 3 determines at least one of the following energy consumption values 21 therefrom, for example:

- the energy consumption of the elevator system 1 per traffic situation,
- the energy consumption per elevator car 17, 17' and traffic situation,
- the energy consumption per passenger,
- the energy consumption per passenger and unit of time,
- the energy consumption per call,
- the energy consumption per journey,
- the energy consumption per journey and unit of time,
- the energy consumption per journey and traffic situation, and

- the energy consumption per area.

Furthermore, the determination of the following or further energy consumption values is also suitable, namely for example:

- the energy consumption per energy consumer,
- 5 - the energy consumption per energy consumer and unit of time,
- the energy consumption of the elevator system 1,
- the energy consumption of the elevator system 1 per unit of time,
- the energy consumption per elevator car 17, 17', and
- 10 - the energy consumption per elevator car 17, 17' and unit of time.

The unit of time can be selected as desired; typical units of time are minutes, quarter-hours, hours, days, weeks, months, years.

- 15 The respective energy consumption value 21 and/or the underlying data can be stored in a computer-readable data memory of the elevator system 1. It is thus possible to detect and store an energy consumption and a traffic situation once in advance. In this case, the energy consumption of an energy consumer need not
- 20 be detected again, for example; it is then sufficient to identify the stored energy consumption, for example by selecting the or each respective consumer, and to load it from the computer-readable data memory. Only the respectively determined energy consumption value 21 can be stored in exactly the same
- 25 manner. In this case, it is then sufficient to load an energy consumption value 21 from the computer-readable data memory for an identified energy consumption and an identified traffic situation.

- 30 It is also possible to detect and store an energy consumption in advance for standardized elevator systems 1 and/or standardized elevator system components. On account of the standardization, the energy consumption of these energy consumers is identical. In this case, it is sufficient to detect only the traffic situation and to identify a stored energy consumption value 21

for the detected traffic situation and to load said energy consumption value from the computer-readable data memory.

Furthermore, it is possible to currently detect only the energy consumption of the respective energy consumer for a previously known traffic situation. For example, the traffic situation in the building is always just below the capacity limit of the elevator system 1 at peak times such as mornings and evenings. For this traffic situation which is always repeated in substantially the same manner in a building, only the energy consumption of the energy consumers needs to be detected and the identified traffic situation can be loaded from the computer-readable data memory in order to determine the energy consumption value 21.

However, it is also possible to simulate the energy consumption of the energy consumer and/or the traffic situation by means of the evaluation apparatus 3. This is important, in particular, in the planning phase of an elevator system 1 where the elevator system 1 has not yet been installed but statements on the future energy consumption of the respectively included energy consumers are already needed for the energy-saving design of the elevator system. The evaluation apparatus 3 can then determine the energy consumption of an energy consumer ab initio, for example by simulating a power consumption of an elevator drive 8, 8' and/or a door drive 9, 9' and/or an elevator car lighting system 10, 10', as the energy consumption, and the traffic situation and determining an energy consumption value 21 therefrom. In this case, the evaluation apparatus 3 may be placed with a seller of an elevator system 1 who designs an energy-saving elevator system 1 on the basis of customer wishes. The respective energy consumers or individual energy consumers are then selected in such a manner that they are operated as close as possible to their respective nominal operating point during operation of the elevator system 1. The elevator system 1 is then installed with this energy consumption value 21 determined in advance when planning the elevator system 1. It is also possible to issue an

energy consumption guarantee certificate (certificate) for the elevator system 1 as early as when planning the elevator system 1, according to which certificate the energy consumption value 21 of the elevator system 1 does not exceed a guaranteed energy consumption value 21 after installation has been concluded. For example, the certificate for the elevator system 1 states that the energy consumption value 21 corresponds to an energy consumption label "A", "B", "C" etc. according to VDI4707. The certificate can also state that the energy consumption value 21 does not exceed a particular CO₂ emission. The accuracy with which the energy consumption value 21 is complied with may be +/-10%, advantageously +/-5%.

At least one control center 7 is communicatively connected to the elevator system 1 either via at least one bus system 15', as illustrated in fig. 1, or via at least one radio field 16', as illustrated in fig. 2. The control center 7 may be placed outside the building or in the building. Fig. 1 shows an arrangement which is remote from the building and in which the control center 7 is communicatively connected to a destination call controller 4 and to an elevator controller 5, 5' via a bus system 15'. Fig. 2 shows the control center 7 on one of the floors S3 of the building, the control center 7 being communicatively connected to an elevator controller 5 via a radio field 16'. The control center 7 may be operated by a building administrator. The control center 7 may be a computation unit such as a computer, a mobile telephone etc. At least one processor, at least one computer-readable data memory, at least one adapter for a bus system 15, 15' and/or at least one adapter for a radio field 16, 16', at least one output means, for example a screen 13', and an electrical power supply are arranged in at least one housing of the control center 7. A plurality of computer programs which operate independently of one another and/or together can be loaded into the processor of the control center 7. At least one computer program controls the adapter and/or the output means.

The energy measuring apparatus 2, 2', 2'', the evaluation apparatus 3, the destination call controller 4, the elevator controller 5, 5', the call input apparatus 6 and the control center 7 can communicate with one another in a bidirectional manner via at least one bus system 15, 15' or via a radio field 16, 16'. Any known bus system is suitable as the bus system 15, 15', for instance a Universal Serial Bus (USB), a Local Operating Network (LON), Modbus, Ethernet and so on. Known local radio networks such as Bluetooth (IEEE 802.15.1), ZigBee (IEEE 802.15.4) or Wi-Fi (IEEE 802.11) or known mobile radio networks such as the Global System for Mobile Communications (GSM), the General Packet Radio Service (GPRS), the Universal Mobile Telecommunications Service (UMTS), etc. can be used for communication in the radio field 16, 16'.

The bus system 15, 15' is illustrated by dotted lines in figs. 1 and 2. According to fig. 1, two call input apparatuses 6 for each floor S1-S3 are respectively communicatively connected to the destination call controller 4 via the bus system 15. Furthermore, according to fig. 1, the destination call controller 4 is communicatively connected to the control center 7 via a bus system 15'. According to fig. 2, one call input apparatus 6 for each floor S1-S3 is respectively communicatively connected to an elevator controller 5 via a bus system 15. Furthermore, according to fig. 2, a plurality of energy measuring apparatuses 2, 2', 2'' and the evaluation apparatus 3 are communicatively connected to the elevator controller 5 via the bus system 15. The radio field 16, 16' is illustrated by curved triple circular segments in figs. 1 and 2. According to fig. 1, a plurality of energy measuring apparatuses 2, 2', 2'' and the destination call controller 4 and the evaluation apparatus 3 are communicatively connected to one another via a radio field 16. Furthermore, according to fig. 2, the elevator controller 5 and the control center 7 are communicatively connected to one another via a radio field 16'. In addition to the types of networking mentioned, other wireless or wired types

of networking are just as possible as networking topologies or combinations other than those illustrated.

Fig. 5 shows an exemplary embodiment of an energy consumption value 21 of the elevator system 1, which energy consumption value is output on the output means of the control center 7. For example, according to fig. 5, a graph containing two different energy consumption values 21 of the elevator system 1 per unit of time is output on the screen 13' of the control center 7, and a building administrator can use at least one button 26 to choose between two operating modes of the elevator system 1 which are linked to the energy consumption values 21 and each result in a different energy consumption. By selecting an energy consumption value 21 of the elevator system 1, the elevator system 1 is operated by the destination call controller 4 and/or elevator controller 5, 5' with the selected energy consumption value 21. The building administrator can thus select between different energy consumption labels. For example, the building administrator decides to operate the elevator system 1 in an energy-saving manner with an energy consumption label "A" or decides to operate the elevator system 1 in a less energy-saving manner with an energy consumption label "B" or "C". During operation of the elevator system 1 with an energy consumption label "A", waiting times and/or times to the destination are greater but an energy consumption and/or a CO₂ emission is/are lower than in the case of operation with an energy consumption label "B" or "C". For example, the elevator cars 17, 17' approach only floors with even numbers and/or not all elevator cars 17, 17' move since one or more elevator cars 17, 17' are deliberately switched off for the purpose of saving energy.

The energy consumption value 21 can also be used for billing purposes. For example, a building administrator is issued with a bill for operating the elevator system 1 over a particular unit of time, which bill has been at least partially created on the basis of the energy consumption value 21 of the elevator system 1.

Fig. 6 shows an exemplary embodiment of an energy consumption value 21 of the elevator system 1, which energy consumption value is output on the output means of a call input apparatus 6. For example, according to fig. 6, three different energy consumption values of the elevator system 1 are output on a touchscreen 13 of a call input apparatus 6, for a call which has been input, for a journey for handling the call.

The reason for the different energy consumption values may be traffic situations which vary once and on which the determination of the respective energy consumption value was based, for example a direct journey, a direct journey with a waiting time, a journey with permitted intermediate stops and so on. A further or additional reason may be a different energy consumption. For example, an electric motor as the elevator drive 8, 8' is operated in an optimal and energy-optimized manner in the region of its so-called nominal operating point. However, operation outside the nominal operating point is readily possible, for example in the overload range, at least for a limited time. If operation in the region of the nominal operating point means a journey at normal speed, it is possible to increase the speed of the journey during operation in the permissible overload range. Both configurations result in a respectively different energy consumption of the elevator drive 8, 8' and accordingly in different energy consumption values which can be selected.

The passenger can use at least one field 23'' of the touchscreen 13 to choose between the, for example, three journeys linked to the energy consumption values 21, a different energy consumption resulting in each case. By selecting one of the energy consumption values 21, the call is handled by the destination call controller 4 and/or elevator controller 5, 5' using the journey linked to the selected energy consumption value 21. The passenger can thus select between different energy consumption labels. For example, the passenger decides on an energy-saving journey with an energy consumption label "A" or decides on a

less energy-saving journey with an energy consumption label "B" or "C".

Fig. 7 shows a flowchart having method steps of the method for operating the elevator system 1, in particular for energy-saving operation. In a method step A, at least one energy measuring apparatus 2, 2', 2'' detects the energy consumption of at least one energy consumer. In a method step B, at least one destination call controller 4 and/or elevator controller 5, 5' detect(s) at least one traffic situation of the elevator system 1. In a method step C, at least one evaluation apparatus 3 determines at least one energy consumption value 21 from a detected energy consumption and a detected traffic situation. In a method step D, the determined energy consumption value 21 is output on at least one output means. In a method step E, at least one energy-saving mode of the elevator system 1 is chosen and/or selected using the determined energy consumption value 21. In a method step F, the elevator system 1 is operated in a first selected energy-saving mode. Alternatively, in a method step F, the elevator system 1 is operated in another selected energy-saving mode using the determined energy consumption value 21.

Patent claims

1. A method for operating an elevator system (1),
wherein an energy consumption of at least one energy consumer
of the elevator system (1) is detected,
5 wherein at least one traffic situation of the elevator system
(1) is detected,
wherein at least one energy consumption value (21) is
determined using the detected energy consumption and the
detected traffic situation, and
10 wherein the determined energy consumption value (21) is
output on at least one output means.
2. The method as claimed in claim 1, wherein, in order to
determine the at least one traffic situation, at least one
load on at least one elevator car (17, 17') is detected by at
15 least one sensor (20) and is communicated, as sensor data, to
at least one evaluation apparatus (3) and/or destination call
controller (4) and/or elevator controller (5, 5').
3. The method as claimed in either of claims 1 and 2,
wherein, in order to determine the traffic situation,
20 at least one destination call controller (4) and/or
elevator controller (5, 5') detect(s) either
 - at least a number of calls per unit of time and/or
 - at least a number of passengers who have been
conveyed by the elevator system (1) in a unit of time in the
25 building, and/or
 - at least a difference in passengers on floors (S1-
S3) of the building who have been conveyed by the elevator
system (1) from call input floors to destination floors in a
unit of time,
 - 30 andthe destination call controller (4) and/or elevator

controller (5, 5') determine(s) the traffic situation of the elevator system (1) from the number of calls per unit of time or from the number of conveyed passengers or from the difference in passengers on floors (S1-S3).

- 5 4. The method as claimed in one of the preceding claims,
 wherein the determined energy consumption and/or the
 determined traffic situation is/are stored in at least one
 computer-readable data memory,
 wherein a stored determined energy consumption and/or a
10 stored determined traffic situation is/are identified and
 loaded from the computer-readable data memory, and
 wherein the loaded and/or determined energy consumption and
 the loaded and/or determined traffic situation are evaluated
 by at least one evaluation apparatus (3) and the energy
15 consumption value (21) is determined.
5. The method as claimed in one of the preceding claims,
 wherein at least one evaluation apparatus (3) simulates the
 energy consumption of the at least one energy consumer and/or
 the at least one traffic situation of the elevator system
20 (1), and
 wherein at least one energy consumption value (21) is
 determined using the simulated energy consumption and the
 simulated traffic situation.
6. The method as claimed in one of the preceding claims,
25 wherein at least one sensor (20) detects sensor data which
 code at least one load on at least one elevator car (17,
 17'), and
 wherein the determined traffic situation is corrected or
 confirmed by the load on the elevator car (17, 17'), which
30 load is detected as sensor data.
7. The method as claimed in one of the preceding claims,
 wherein at least one energy consumption value (21) for
 operating the elevator system (1) in an energy-saving manner

is selected on the basis of a plurality of energy consumption values (21) which have been determined and, in particular, have been output on an output means of a control center (7) and/or an output means of a call input apparatus (6), and the
5 elevator system (1) is operated with the selected energy consumption value (21).

8. The method as claimed in claim 7,
wherein the selected energy consumption value (21) is
communicated to at least one destination call controller (4)
10 and/or elevator controller (5, 5'), and
wherein at least one part of the elevator system (1) is
operated by the destination call controller (4) and/or
elevator controller (5, 5') in at least one operating mode
linked to the selected energy consumption value (21).

15 9. The method as claimed in claim 7,
wherein at least one call is input and/or at least one
identification code is received on at least one call input
apparatus (6),
wherein at least one destination call controller (4) and/or
20 elevator controller (5, 5') determine(s) at least one journey
of at least one elevator car (17, 17') in order to handle the
call and/or identification code,
wherein at least one evaluation apparatus (3) determines at
least one energy consumption value (21) for the journey,
25 wherein the journey is linked to the at least one energy
consumption value (21),
wherein the journey and the energy consumption value (21) are
output on the call input apparatus (6),
wherein an energy consumption value (21) is selected for a
30 journey, and
wherein the destination call controller (4) and/or elevator
controller (5, 5') handle(s) the call or identification code
with the journey linked to the selected energy consumption
value (21).

10. The method as claimed in claim 9,
wherein the call input apparatus (6) communicates the input
call and/or received identification code to at least one
destination call controller (4) and/or elevator controller
5 (5, 5'),
wherein the determined journey is communicated to at least
one evaluation apparatus (3),
wherein the journey and the energy consumption value (21) are
communicated to the call input apparatus (6), and
10 wherein the call input apparatus (6) communicates an energy
consumption value (21) selected for a journey to the
destination call controller (4) and/or elevator controller
(5, 5').
11. The method as claimed in one of the preceding claims,
15 wherein the energy consumption value (21) of the elevator
system (1) is determined before the elevator system (1) is
installed, and the elevator system (1) is installed with the
determined energy consumption value (21).
12. The method as claimed in claim 11,
20 wherein at least one energy consumption guarantee certificate
is issued for the energy consumption value (21) determined
for the elevator system (1) before the latter is installed,
according to which certificate the actual energy consumption
value (21) of the elevator system (1) is guaranteed not to
25 exceed the determined energy consumption value (21) after
installation has been concluded.
13. The method as claimed in claim 12,
wherein an actual energy consumption value (21) of the
elevator system (1), formed by detecting at least one energy
consumption of the elevator system (1) and at least one
30 traffic situation of the elevator system (1) and determining
at least one actual energy consumption value (21), is
compared with the determined energy consumption value (21)

according to the energy consumption guarantee certificate in order to check and/or confirm it.

14. An elevator system for carrying out the method as claimed in one of the preceding claims,
5 having at least one evaluation apparatus (3), in particular an evaluation apparatus (3) included in an energy measuring apparatus (2, 2', 2'') and/or destination call controller (4) and/or elevator controller (5, 5') and/or call input
10 apparatus (6) and/or control center (7),
wherein the at least one evaluation apparatus (3) evaluates the detected energy consumption of an energy consumer and the detected traffic situation of the elevator system (1) and determines the energy consumption value (21).
15. The elevator system as claimed in claim 14,
15 wherein at least one control center (7) and/or at least one call input apparatus (6) comprise(s) the output means intended to output the determined energy consumption value (21).