

(19)



(11)

EP 2 539 266 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
18.09.2019 Bulletin 2019/38

(51) Int Cl.:
B66B 9/02 (2006.01) B66B 1/30 (2006.01)

(21) Application number: **11747796.8**

(86) International application number:
PCT/SE2011/050213

(22) Date of filing: **24.02.2011**

(87) International publication number:
WO 2011/105959 (01.09.2011 Gazette 2011/35)

(54) **POWER SUPPLY SYSTEM FOR RACK AND PINION LIFTS AND METHOD FOR POWERING THESE**
STROMVERSORGUNGSSYSTEM FÜR ZAHNSTANGEN UND ANTRIEBSVERFAHREN DAFÜR
SYSTÈME D'ALIMENTATION EN ÉNERGIE POUR ÉLÉVATEURS À PIGNON ET CRÉMAILLÈRE
ET PROCÉDÉ D'ALIMENTATION EN ÉNERGIE DE CES ÉLÉVATEURS

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR

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(43) Date of publication of application:
02.01.2013 Bulletin 2013/01

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Description

[0001] The present invention concerns a power supply system for rack and pinion lifts according to the introduction to claim 1. The present invention concerns also a method for the power supply for rack and pinion lifts according to the introduction to claim 12. The invention includes also the use of a power supply system according to claim 1, as specified in claim 20. The power that is required to drive transport means, such as lifts, for persons or goods between floors in buildings varies, depending on a number of factors such as, for example, the instantaneous load on the lift, its speed, the direction of travel and in which part of the transport cycle the lift is currently operating. It is important that the power requirement be reduced as far as possible not only to reduce the installation and operating costs of the lift, but also to reduce the dimensions and space required for the power supply system of the lift.

[0002] A rack and pinion lift as known from JP 2003238051 comprises in general a load carrier such as a lift car that can be driven along a track by means of electric motors and cogged wheels, which track is normally in the form of a mast provided with a cogged rod. The electric motors that are referred to are normally of three-phase type with a rated voltage of 380-500 V and a frequency of 50 or 60 Hz. The motors offers soft starting and stopping by the use of frequency control. The electric motor for a rack and pinion lift is supported immediately by the lift car, as is also the control and operating unit for controlling the lift. This means that the rack and pinion lifts differ from conventional lifts in that the lift car carries its own drive unit and the associated control and operating unit for the control of the electric motor. As a consequence of this, the distance between the power supply system and the drive machinery of the lift will vary as the lift car moves upwards and downwards along the mast. An electrical power line, such as electrical conductors surrounded by insulating material, passes from a unit at ground level up to the lift car for power supply to the electric motors. The electrical power line is arranged, with the aid of a cable trolley or similar guided along the mast, to follow with an adapted length the lift car upwards and downwards along the mast, suspended under the lift car. It should be understood that, as the lift car carries its own drive unit supply, the electrical power line must be extended and shortened as the lift car moves along the mast.

[0003] The lifts are, on the other hand, becoming evermore higher and it has proved to be the case that the weight of the electrical power line, for lift heights up to 400-500 m and in certain cases even higher, becomes so great that it influences the loading capacity of the lift. The extension of the electrical power line as the lift car moves along the mast creates also difficulties with housing the complete cable length, in particular, when the power cable is to supply powerful motors with the current they require. In particular, in the case in which lifts spec

and claims clean copy.docx are to move between floors in very high buildings, the length, stiffness and dead-weight of the electrical power line constitute problems, whereby the relatively heavy-duty electrical power line that accompanies the lift car becomes difficult to control and to carry. It should be understood that the limited possibilities of the rack and pinion lift to balance the potential energy of the lift car with a counterweight leads to a demand for not only powerful electric motors but also electrical power lines with a relatively large cross-sectional area in order to be able to supply the current required by the drive motors of the lift.

[0004] The greatest instantaneous force is required at the instant of starting, i.e. during the initial part of the transport cycle when the lift car is accelerated. The power requirement falls when the lift car has reached a constant speed. The potential energy of the lift car of a conventional lift provided with a counterweight is balanced by a counterweight during motion. Rack and pinion lifts normally lack this possibility and the potential energy must be continuously overcome by the power supply system, which, of course, places heavy demands on this system. The energy or force that is generated when the lift car moves with the said constant speed downwards and is braked (retarded) is normally caused to be dissipated as heat in separate resistances (braking resistances) or it is fed back into the mains power network by the use of what is known as "generative braking" and network return. In a comparison with a conventional lift provided with a counterweight, a rack and pinion lift produces in a corresponding manner when the lift car moves downwards considerably more energy than a conventional lift provided with a counterweight.

[0005] It is not unusual that rack and pinion lifts are used during the construction of buildings at locations that lack electrical power supply and the infrastructure of power stations, and this means that alternative sources of energy such as diesel-powered units are used as main power generators. It should be understood that it would be desirable from a number of points of view to be able to reduce not only the size but also the cost of the equipment used to generate power. It can also be mentioned in addition to this that the length of the mast that is used in the currently used type of rack and pinion lift is formed from a number of sections that can be stacked and mounted on each other, in order to be able to vary the length of the mast. A consequence of this is, of course, that also the electrical power line is given a length that is adapted such that it can accompany the lift car along the complete height of the mast. It can be mentioned in this context that rack and pinion lifts are normally intended to be used for non-permanent use within the building industry, i.e. the lift is demounted when the building construction has been completed.

[0006] It should be understood that the limited possibilities of the rack and pinion lifts to balance the potential energy of the lift car through its lack of a counterweight leads to a requirement for very powerful electric motors

and associated electrical equipment such as electrical power lines with relatively large cross-sectional areas in order to be able to deliver the current required by the drive motors of the lift, in particular with respect to the instant of starting, or the "acceleration phase". When the lift car is driven to a certain level up the mast, its potential energy increases according to the equation: ($E_{\text{pot}} = mgh$; where m = mass, h = height and g = acceleration due to gravity). In the absence of a counterweight, the potential energy of a lift car that has been lifted to a certain height has increased considerably, whereby the lift has been supplied with large amounts of energy through the power supply system. It should be realised that the energy that has been supplied is collected at the lift car as potential energy, when the lift car is in its elevated position.

[0007] In addition to the said high elevations of the lift, it is, of course, also a problem that the lift motors drive the lift at full power only during certain periods, while the power supply system of the lift must be dimensioned based on the highest most critical power that is normally required only during short periods of the operation, in particular during the instant of starting and also during motion of the lift upwards along the mast. The greatest instantaneous force is, however, required at the instant of starting, i.e. during the initial part of the transport cycle when the lift car is accelerated. The power requirement falls considerably when the lift car has reached a constant speed. Changes in potential energy of the lift car of a conventional lift provided with a counterweight are balanced during motion by a counterweight. Rack and pinion lifts normally lack this possibility and the potential energy must be continuously overcome by the power supply system, which, of course, places considerable demands on this system. Enormous amounts of energy are generated when a rack and pinion lift car moves downwards along the mast during braking (retardation). The potential energy that is in this way released by the lift car is normally converted to heat energy in separate resistances (braking resistances) or it is fed back into the mains power network by a process known as "regenerative braking". It should be realised that a rack and pinion lift produces a considerably greater amount of energy during its motion downwards than conventional lifts provided with counterweights produce, due to the absence of a counterweight. Previous attempts to equip rack and pinion lifts with counterweights have been less than successful, mainly as a result of complicated designs and the extra work that the counterweight arrangement introduces during the tasks of mounting and demounting the lift.

[0008] Since the power supply system and the associated electrical plant must be dimensioned to cope with the highest output power that is required during short periods, while the appearance of the standard load places considerably lower requirements for the capacity of the power plant, overload protection, the conductor system and other equipment in the consumer circuit will not be used fully with respect to the capacity of the equipment. As a consequence of this, the investment costs for

the power supply system will be significant and more extensive than necessary and they will be inefficient from the point of view of costs.

[0009] Examples are shown in Figures 1, 1a and 2 of prior art technology whereby for reasons of clarity the same reference numbers are used as those shown in the subsequent Figures 3-6 but with an increase by addition of the figure 100 in order to make clear that it is a case of the same or similar items that are described in the invention.

[0010] Figures 1 and 1a show how three-phase alternating current is fed to a transformer 116 in a main power generator 120 that is part of the public mains power network 115, in order to be transformed down to a suitable level of voltage. Through an AC bus 113 and a three-phase electrical power line 113', a three-phase electric motor 103, 104 supported by a first and a second lift car 101, 102 is supplied with electrical energy. The lift cars 101, 102 are rack and pinion cars and they can be driven along a mast 105 through the interaction between a cogged wheel 111 driven by the relevant electric motor 103, 104 and a cogged rod 112 arranged on the mast. The selected speed during raising and lowering is controlled through appropriate frequency conversion of the electric motor 103, 104. When a lift car 101, 102 moves downwards along the mast 105 during braking, an inverted flow of AC alternating current is generated in the electric motor 103, 104. The inverted AC current flow during the "generator braking" is led back to the main power network 120.

[0011] Figure 2 shows an example in which a diesel-powered unit 125 intended to be used as a source of power is a component of the main power generator 120. The diesel-powered unit 125 is mechanically coupled to an AC power generator 126. The AC alternating current that is produced by the power generator 126 supplies the electric motors 103, 104 of the relevant lift car with AC alternating current through an electrical power line 113' and from this point the system is the same as that described in Figure 1. When one of the lift cars 101, 102 moves downwards along the mast 105, an inverted flow of AC alternating current is generated in the motor.

[0012] A first principal aim of the present invention is to achieve a more efficient power supply system for rack and pinion lifts not least with the aim of reducing energy consumption and the rated power requirement for the generator system. A second aim is to achieve a system that facilitates the housing and the weight from the electrical power line that supplies the electric motors with power and extends from the unit at ground level to the lift car. A third aim of the invention is to achieve a power supply system for rack and pinion lifts that is simple to use together with a freely chosen type of main power generator, that can regain and store a considerable amount of energy through generative braking when the lift car moves downwards which can be used later, and in particular during the instant of starting, i.e. during the initial part of the transport cycle when the lift car is accel-

erated. A further aim of the invention is to achieve a method that allows a more efficient power supply of rack and pinion lifts and that the requirements placed on the generator system that is used can be reduced.

[0013] These aims of the invention are achieved through a power supply system that demonstrates the distinctive features and characteristics that are stated in claim 1, a method that demonstrates the distinctive features and characteristics that are stated in claim 12 and the use of a DC bus as power cable for the power supply of rack and pinion lifts as specified in claim 20.

[0014] Among the advantages of using a DC bus as a component of a power cable for the power supply of the drive machinery from the ground level can be mentioned that it makes it possible to transport power with lower resistance losses and dielectric losses than those experienced using alternating current at corresponding powers. The advantages become particularly large if the driving current in this case is constituted by a high-voltage DC current. A typical DC transmission cable includes conductors and an insulating layer. An AC voltage also gives rise to capacitance losses, which can be avoided with a DC direct current as the driving current. As a result of the use of a DC bus as power cable can be mentioned that the dimensions of the cable can be kept low, and this reduces not only the weight of the cable but also the problems of housing the complete length of the power cable when supplying powerful electric motors with driving current. A further advantage of using a DC bus architecture with a positive and a negative side is that it makes it possible to connect different types of electrical equipment in parallel directly to the power supply system in a freely chosen manner, such as an energy storage system, alternative power-generating main power networks, and a braking resistance directly to the mains power network.

[0015] The electrical drive motors 3, 4 of the lift cars 1, 2 may in one design be selected from a group consisting of frequency-controlled motors, AC current motors, and DC current motors.

[0016] The power-generating main network 12 may, in an alternative design, comprise a source of power 15, 25 selected from any one of the following: diesel engines, turbine engines, Stirling engines, Otto engines, fuel cells, solar cells, AC electrical networks, wind turbines, and combinations of these.

[0017] The control unit may, in an alternative design, be selected from any one of the following: an analogue unit, a programmable logic controller (PLC), and a computer.

[0018] An embodiment of the invention will be described below in more detail with reference to the attached drawings, of which:

Figure 1 shows schematically a block diagram of a prior art power supply system, connected to the mains power network, for rack and pinion lifts arranged in pairs that can be driven along a common

mast, known as a "double car",

Figure 1a shows a view from the front and in greater detail of the drive unit that is a component of a rack and pinion lift of the type shown in Figure 1,

Figure 2 shows schematically a block diagram of the power supply system according to Figure 1 but now in a design with a generator unit powered by a diesel engine, also known as a "generator system",

Figure 3 shows schematically a block diagram of a power supply system according to the invention that is connected to a mains power network for the power supply of rack and pinion lifts that are arranged in pairs and that can be driven along a common mast (known as a "double car"),

Figure 4 shows schematically a block diagram of the power supply system according to Figure 3 but now in a design with a generator unit powered by a diesel engine, also known as a "generator system",

Figure 5 shows in a schematic form a block diagram of a power supply system according to Figure 3, but with an energy storage system in the form of a supercondensor,

Figure 6 shows in a schematic form a block diagram of a power supply system according to Figure 3, but with an energy storage system in the form of a battery,

Figure 7 shows schematically in the form of a graph the energy requirement of a prior art rack and pinion lift at various stages A-F of a transport cycle, and

Figure 8 shows schematically in the form of a graph equivalent to Figure 7 the energy requirement during the use of a power supply system according to the present invention.

[0019] With reference to Figures 3-6, there is shown schematically a lift system comprising two rack and pinion lifts 1 and 2 for the transport of persons or goods, whereby each lift comprises a load carrier in the form of a lift car that can be driven, by means of an electric motor 3, 4 supported by this lift car and a transmission with a shaft that can be rotated and that interacts with a cogged wheel, along a track in the form of a mast 5 provided with a cogged rod (see Figure 1a). Each lift car 1, 2 supports a converter 6, 7 for the conversion of DC to AC adapted for driving the electric motor. It is appropriate that the said relevant electric motor be of three-phase type, having, for example, a rated voltage of 380-500 V and a frequency of 50 or 60 Hz. The present power supply system is shown in Figures 3-5 incorporated as a component of the two prior art designs that are shown in Figures 1, 1a and 2.

[0020] An energy storage system denoted generally by the reference number 10 is a component of the power supply system, which, with an energy store 11 located at ground level, can absorb and store energy that is produced through regenerative operation when one of the lift cars 1, 2 is retarded during motion downwards along the mast 5, i.e. when the potential energy is reduced and

converted to electrical energy in the electric motor. When one of the lift cars 1, 2 moves upwards along the mast 5 through the influence of the power supply with the AC drive motor 3 or 4, respectively, that is supported by the lift car, the electric motor is supplied with the energy stored in the energy store 11 in order to achieve an increase in the potential energy of the lift car. In addition to stored energy in the energy store 11, any further energy that is required is taken, either from a principal power network that generates power and that is denoted generally by the reference number 12, which may, for example, be constituted by an electrical power network located at ground level or from the diesel-powered unit and the associated power generator shown in Figure 2. Electrical power is supplied to the electric motors 3, 4 during the motion of the lift cars 1, 2 upwards along the mast 5, whereby the potential energy of the lift cars increases, and electrical power is produced through regenerative braking of the electric motor during the motion of the lift cars 1, 2 downwards along the mast, whereby the potential energy is reduced. Electrical energy that has been obtained through regenerative operation during the braking motion of the lift cars 1, 2 downwards along the mast 5 is recycled and collected in the energy store 11 located at ground level. The term "ground level" is here used to denote generally the lowest level located along a track on which a lift car is normally located or the lower level from which electrical power is led up to the drive machinery of the lift car.

[0021] The energy storage system 10 is shown in Figures 3 and 4 surrounded by a dash-dot line and connected in parallel to a DC bus with a positive side 13 and a negative side 13'. The principal power network 12 that produces power is also connected to the positive and negative sides 13, 13' of the DC bus. The said principal power network 12 that produces power includes generally a mains power network 15 from which three-phase alternating current is fed to a transformer 16, to be transformed down to a suitable level of voltage. The alternating current is converted to a DC direct voltage by a converter 16 that is connected to the DC bus 13, 13' mentioned above. The three-phase AC drive motors 3, 4 of the relevant lift cars 1, 2 are connected to the DC bus 13, 13' through converters 6, 7 and through a DC power cable or transmission cable 14 that extends between the said converters and the DC bus. It would be possible, as an alternative, that the DC power cable or transmission cable 14 be constituted by a current rail or similar attached to the mast 5 and running along it. As Figure 1 makes clear, it can be selected that the drive motors 3, 4 obtain current either from the energy storage system 10 or from the principal power network 12 that produces power, or as a combination of power from the said two power supplies.

[0022] The power to and from the relevant units that are connected to the DC bus 13, 13' are controlled and monitored by means of a control system 34, for example a programmable logic controller, a PLC, or a computer

that is placed in connection with the relevant converters 6, 7, 17, 20 by channels 35, 36, 37, 38] in the form of, for example, a radio link 35 or wired connection. The power system described and shown here contains also a dynamic brake resistance 18 that can be connected by means of a switch 19 such that energy that has been produced by generative braking will be returned to the DC bus when one of the lifts 1, 2 moves downwards along the mast 5 and its potential energy is reduced, and it can then be selected whether this energy is to be led either to the braking resistance in order to be dissipated as heat or to the energy storage system 10 to be stored and used later. It would be appropriate for monitoring and surveillance of the voltage levels of the DC bus that it should be possible to arrange to what is known as a "buck-boost" circuit or similar between the DC bus 13, 13' and the energy storage system 10.

[0023] The energy storage system 10 comprises a converter 20, a three-phase induction motor 21 and an energy storage 11 in the form of a flywheel 22. The induction motor 22 may be constituted by, for example, a traction motor, i.e. a three-phase synchronous motor with permanent magnets. When one of the lift cars 1, 2 moves downwards through the influence of the associated electric motor 3, 4, energy is stored in the flywheel 22, and this takes place as a consequence of the electric motor 3, 4 that is supported by the lift car 1, 2 being reversed and functioning in this case as a generator. The AC alternating current that is generated from the lift motor is thereby converted to DC direct current through the converter 6, 7, which direct current is led after passage through the DC bus to the energy storage system 10, which receives and stores the potential energy that has been received as kinetic energy in the flywheel 22 that is used in the energy store 11, through the flywheel being accelerated by means of the motor 21. The kinetic energy in the flywheel 22 can, when power is needed, be converted subsequently to electrical energy, which can be used by one of the two lifts 1 and 2.

[0024] It should be realised that for lift applications of the type that are described here whereby rack and pinion lifts are arranged in pairs such that they can be driven along a common mast, known as "double-car" applications, the advantage is obtained that the regenerative braking energy (the collected potential energy at an elevated position) that is recycled when the drive motors of one lift 1 when it moves downwards can be stored in the energy storage system 10, to be used by the drive motors of the second lift car 2 when it moves upwards. In this way the lift cars in a double-car application of the type described here will function in approximately the same way as the counterweight in conventional lifts, where the collected and recycled potential energy from one lift car 1 is used during the acceleration and driving upwards along the mast of the second lift car 2, and vice versa. The potential energy levels of the two lift cars 1, 2 can in this way be balanced through mutual energy transfer. This is very interesting, in particular during the acceler-

ation phase, since it means that the main network 12 that produces power must supply only a limited part of the current that normally would be required during the critical acceleration phase of the lift car (see also Figures 7 and 8). The advantage that the main power unit 12 needs to deliver only a fraction of the energy that is normally required during the acceleration phase means that it is possible to reduce significantly the dimensions of the external power system.

[0025] Figure 4 shows the principal power network 12 that produces power in an alternative design where a diesel-powered unit 25 is used as a source of power. The diesel-powered unit 25 is mechanically coupled to an AC power generator 26. The AC alternating current that is supplied by the power generator 26 is converted to DC direct current by means of a converter 27 and is led into the DC bus through the positive 13 side and the negative side 13'.

[0026] Figure 5 shows the energy storage system 10 in an alternative design comprising an energy store 11 in the form of a supercondensor 27 in which the potential energy that is obtained during the motion downwards of one of the lift cars 1, 2 along the mast 5 and generative braking can be stored. In addition to the said supercondensor 27, a diode 28 and a charge switch 29 are present in a first branch whereby the branch is connected in parallel across the positive side 13 and the negative side 13' of the DC bus. Further, a second branch is present with a switch 30 that causes when closed the supercondensor 27 to be discharged. The diode 28 allows current to pass only in a direction that leads to charging of the supercondensor 27, whereby discharge cannot take place through the said first branch, which contains the diode 28. When the first branch is closed, the voltage of the supercondensor 27 increases such that it eventually exceeds the voltage across a condensor 31 that is component of the DC bus. Since the voltage across the supercondensor 27 is higher than the voltage across the condensor 31 of the DC bus, the supercondensor can be connected for the delivery of power to one of the drive motors 3, 4 of the lifts 1, 2 through the relevant converter 6, 7, which takes place in practice through the second branch being closed by means of the switch 30.

[0027] Figure 6 shows the energy storage system 10 in an alternative design comprising an energy store 11 in the form of a battery 32 that is controlled by means of a switch 33 for the storage of energy and the delivery of the said energy in the form of a DC direct current.

[0028] With reference to Figure 7, there is shown schematically in the form of a graph the energy requirement for a rack and pinion lift at various stages A-F of a transport cycle whereby block A corresponds to the electricity consumed during acceleration of the lift car 1, 2 to a predetermined speed in a direction of motion upwards along the mast 5. Block B corresponds to the power consumption when the lift car 1, 2 increases its potential energy through moving at a constant speed upwards along the mast. Block C corresponds to the energy consumption

during retardation and stop of the lift car 1, 2. Block D represents the inverse power or the return of potential energy for storage during acceleration downwards of the lift car 1, 2. Block E represents inverse energy consumption during motion at constant speed downwards and block F represents the inverse energy during retardation and stop of the lift car 1, 2 during downwards motion.

[0029] Figure 8 shows graphically the power consumption that can be achieved according to the principles of the present invention whereby the power consumption is illustrated as constant with time in the hatched block and is obtained through stored potential energy from regenerative motor operation being recycled as power that is superimposed on the power that is consumed in Figure 7. The graph is intended to give an example of how residual power that is recycled and stored in the energy storage system 10 that has been obtained during braking of the lift car during its motion downwards and that is stored as transferred potential energy in, for example as kinetic energy of the flywheel 22 of the energy storage system, can be returned at times during the transport cycle of the lifts 1, 2 when the power that is required is at its greatest, for example, at the instant of starting when the lift car is accelerated. It should be furthermore understood that the collected energy in the power supply system can be regarded as a constant, as is stated by the general laws of thermodynamics, whereby the only energy that is consumed is the energy that is lost due to the appearance of mechanical and electrical losses.

[0030] The invention is not limited to that which has been described above and shown in the drawings: it can be changed and modified in several different ways within the scope of the attached patent claims.

Claims

1. A power supply system for a lift of the type in which drive machinery is supported by a load carrier (1, 2) and drives by means of a cogged wheel (111) and cogged rod (112) the load carrier along a track on a mast (5) in first and second directions, and an electric motor (3, 4) that is a component of the drive machinery of the load carrier is supplied with power from a unit at ground level, comprising;

- a) an electrically operated electric motor (3, 4) that is a component of the drive machinery arranged to drive the load carrier (1, 2) in first and second directions along the mast (5) and to generate electrical energy through regenerative operation of the electric motor during the driving of the load carrier in a second, opposing, direction,
- b) an energy storage system (10) that is a component of the unit at ground level and that includes an energy store (11) for the storage of energy,
- c) a principal power network (12) arranged at

ground level, from which electrical energy can be withdrawn,

characterised in that it comprises;

d) a power transfer DC-bus (13, 13'), and a DC-power line (14) to follow with an adapted length the load carrier upwards and downwards along the mast to transfer electrical energy between the drive machinery of the load carrier (1, 2), the energy storage system (10) and the principal power network (12) that produces power, wherein each of said storage system (10) and said principal power network (12) is connected in parallel to the DC-bus,

e) a control and monitoring system (17) for the monitoring and control of the flows of electrical energy between the electric motor (3, 4) of the load carrier, the energy store (11) at ground level and the principal power network (12).

2. The power supply system according to claim 1, wherein the electrical DC power line (14) is arranged to be suspended at the load carrier (1, 2) for the transfer of power between the electric motors of the load carrier (1, 2), the energy storage system (10) and the principal power network (12) that produces power.

3. The power supply system according to claim 2, whereby the electrical power line (14) includes a DC transmission cable with conductors and insulating layer.

4. The power supply system according to any one of claims 1-3, whereby the electric motor (3, 4) comprises one of the following: frequency-controlled motors, AC alternating current motors and DC direct current motors.

5. The power supply system according to claim 3 or 4, whereby the electric motor (3, 4) is of AC inductive three-phase type with an associated converter (6, 7) suspended in the same way at the load carrier (1, 2) for the conversion of the direct current delivered from the DC bus.

6. The power supply system according to any one of claims 3-5, comprising a dynamically operating brake resistance (18) that can be connected between the positive (13) and negative (13') connections of the DC bus by means of a switch (19), whereby electrical energy produced during regenerative operation can be caused to be dissipated as heat in the brake resistance.

7. The power supply system according to any one of claims 3-6, whereby the DC-bus transfers the DC direct current that is produced during regenerative operation to the energy storage system (10) in order

to increase the energy that is stored in the energy store (11) when the load carrier (1, 2) reduces its potential energy by motion downwards along the track (5).

8. The power supply system according to any one of claims 1-7, whereby the principal power network (12) comprises a source of power (15, 25) selected as one of the following from a group: diesel-powered engines, fuel cells, solar cells, AC electrical networks, wind turbines and combinations of these.

9. The power supply system according to any one of claims 1-8, whereby the energy storage system (10) comprises an energy store (11) selected as one of the following from a group: a battery (32), a super-condensor (27), a flywheel (22) and combinations of these.

10. The power supply system according to any one of claims 1-9, whereby the control and monitoring system (17) comprises a control unit selected as one of the following from a group: an analogue unit, a programmable logic controller and a computer.

11. A lift of the type in which load carriers (1, 2) are constituted by a system with what is known as "double cars" that can be driven along tracks that run parallel to each other on a common mast (5) comprising a power supply system according to any one of claims 1-10, wherein energy that is obtained from one of the drive motors (3) of the load carrier (1) during regenerative braking is stored in the energy store (11) and is returned and used by the drive motor (4) of the second load carrier (2) when it is accelerated in the upwards direction along the track.

12. A method for the power supply of lifts of the type in which drive machinery is supported by a load carrier (1, 2) and drives by means of a cogged wheel (111) and cogged rod (112) the load carrier along a track on a mast (5) in first and second directions, and an electric motor (3, 4) that is a component of the drive machinery of the load carrier is supplied with power from a unit at ground level, comprising the following operational steps:

a) that a load carrier (1, 2) is arranged,

b) that the drive machinery of the load carrier (1, 2) is assigned an electric motor (3, 4) that allows the load carrier to be driven in first and second directions along the mast (5) and to produce electrical energy through regenerative operation of the electric motor during driving of the load carrier in the said second direction downwards,

c) that a principal power network (12) for the supply of electrical energy is arranged at a

ground level,

d) that an energy storage system (10) comprising an energy store (11) for the storage of energy is arranged at a ground level,

characterised in the following operational steps;

e) that a DC-bus (13, 13) and a DC power line (14) to follow with an adapted length the load carrier upwards and downwards along the mast it is arranged for the transfer of electrical energy between the electric motor (3, 4) that is supported by the load carrier (1, 2), the energy store (11) arranged at ground level and the principal power network (12) located at ground level, wherein each of said storage system (10) and said principal power network (12) is connected in parallel to the DC-bus,

f) that a control and monitoring system (17) is arranged for the monitoring and control of the flows of electrical energy between the electric motor (3, 4) of the load carrier, the energy store (11) at ground level and the principal power network (12) that produces power,

g) that the operation of the load carrier (1, 2) is arranged to supply through regenerative operation potential energy during driving downwards along the mast (5) and that the electrical energy obtained in this manner is led by the bus to the energy store (11) to be stored, and

h) that the load carrier (1, 2) is arranged to increase its potential energy during acceleration or motion upwards along the mast (5) through the influence of electrical energy that has been obtained from the energy store (11).

13. The method according to claim 12 whereby electrical energy is transferred as a DC direct current between the electric motor (3, 4) and the energy store (11) arranged at ground level.

14. The method according to claim 12, whereby the DC direct current is transferred over a DC power cable or transmission cable (14) arranged suspended at the load carrier (1, 2) and extending downwards, or alternatively by means of a current rail attached to the mast (5) and running along it.

15. The method according to any one of claims 13-14, whereby as electric motor (3, 4) there is selected an inductive AC electric motor driven by alternating current and that the lift car (1, 2) is arranged supporting a converter (6, 7) for the conversion of DC direct current to AC alternating current adapted for the operation of the AC electric motor.

16. The method according to any one of claims 12-15, whereby the lift is arranged as a double car with load carriers running in pairs on a common mast (5) and

that the electrical energy that is obtained during regenerative braking from the drive motor (3) of one of the load carriers (1) when the load carrier moves downwards is stored in the energy system (10) and is returned and used by the drive motor (4) of the second of the load carriers (2) when this load carrier is accelerated in an upwards direction along the mast.

17. The method according to any one of claims 12-16, whereby the energy store (11) is selected as one of the following from a group: a battery (32), a supercondensator (27), a flywheel (22) and combinations of these.

18. The method according to any one of claims 12-17, whereby the principal power network (12) is selected as one of the following from a group: diesel engines, turbine engines, Stirling engines, Otto engines, fuel cells, solar cells, AC electrical networks, wind turbines and combinations of these.

19. The method according to any one of claims 12-18, whereby the control and monitoring system (17) is selected as one of the following from a group: an analogue unit, a programmable logic controller and a computer.

20. The use of a power supply system according to claim 1 with a combination of a DC bus and a DC transmission cable (14) for the transfer of power to the electric motor (3, 4) of a load carrier (1, 2) of the type that is specified in the introduction to claim 1.

Patentansprüche

1. Stromversorgungssystem für einen Aufzug des Typs, bei dem Antriebsmaschinen von einem Lastträger (1, 2) getragen werden und mittels eines Zahnrades (111) und einer Zahnstange (112) den Lastträger entlang einer Spur auf einem Mast (5) in einer ersten und zweiten Richtung antreiben, und ein Elektromotor (3, 4), welcher ein Bestandteil der Antriebsmaschinen des Lastträgers ist, mit Strom von einer bodennahen Einheit versorgt wird, umfassend;
einen elektrisch betriebenen Elektromotor (3, 4), welcher ein Bestandteil der Antriebsmaschinen ist, die dazu ausgelegt sind, den Lastträger (1, 2) in einer ersten und zweiten Richtung des Mastes (5) anzutreiben, und elektrische Energie durch regenerativen Betrieb des Elektromotors während des Antreibens des Lastträgers in einer zweiten, entgegengesetzten Richtung zu erzeugen,
ein Energiespeichersystem (10), das ein Bestandteil der bodennahen Einheit ist, und das einen Energiespeicher (11) zum Speichern von Energie enthält,

- ein in Bodennähe angeordnetes Hauptstromnetz (12), aus dem elektrische Energie entnehmbar ist, **dadurch gekennzeichnet, dass** es umfasst; ein Stromübertragungs-gleichstrombus (13, 13') und eine Gleichstromleitung (14), um mit einer angepassten Länge dem Lastträger aufwärts und abwärts entlang des Mastes zu folgen, um zwischen den Antriebsmaschinen des Lastträgers (1, 2), dem Energiespeichersystem (10) und dem den Strom herstellenden Hauptstromnetz (12) elektrische Energie zu übertragen, wobei jedes des Speichersystems (10) und des Hauptstromnetzes (12) mit dem Gleichstrombus parallel geschaltet ist, ein Steuerungs- und Überwachungssystem (17) zur Überwachung und Steuerung der Ströme elektrischer Energie zwischen dem Elektromotor (3, 4) des Lastträgers, dem Energiespeicher (11) in Bodennähe und dem Hauptstromnetz (12).
2. Stromversorgungssystem nach Anspruch 1, wobei die elektrische Gleichstromleitung (14) aufgehängt am Lastträger (1, 2) angeordnet ist, um Strom zwischen den Elektromotoren des Lastträgers (1, 2), dem Energiespeichersystem (10) und dem den Strom herstellenden Hauptstromnetz (12) zu übertragen.
 3. Stromversorgungssystem nach Anspruch 2, wobei die elektrische Stromleitung (14) ein Gleichstromübertragungskabel mit Leitern und Dämmschicht enthält.
 4. Stromversorgungssystem nach einem der Ansprüche 1 bis 3, wobei der Elektromotor (3, 4) einen der Folgenden umfasst: frequenzgeregelte Motoren, Wechselstrommotoren und Gleichstrommotoren.
 5. Stromversorgungssystem nach Anspruch 3 oder 4, wobei der Elektromotor (3, 4) vom Wechselstrom-Dreiphasentyp mit einem verknüpften Umwandler (6, 7) ist, der auf gleiche Weise am Lastträger (1, 2) aufgehängt ist, um den vom Gleichstrombus gelieferten Gleichstrom umzuwandeln.
 6. Stromversorgungssystem nach einem der Ansprüche 3 bis 5, umfassend einen dynamisch betriebenen Bremswiderstand (18), der zwischen den positiven (13) und negativen (13') Verbindungen des Gleichstrombusses mittels eines Schalters (19) verbindbar ist, wobei während des regenerativen Betriebs erzeugte elektrische Energie als Wärme im Bremswiderstand abführbar ist.
 7. Stromversorgungssystem nach einem der Ansprüche 3 bis 6, wobei der Gleichstrombus den während des regenerativen Betriebs erzeugten Gleichstrom an das Energiespeichersystem (10) überträgt, um die im Energiespeicher (11) gespeicherte Energie zu erhöhen, wenn der Lastträger (1, 2) seine potenzielle Energie durch Abwärtsbewegung entlang der Spur (5) reduziert.
 8. Stromversorgungssystem nach einem der Ansprüche 1 bis 7, wobei das Hauptstromnetz (12) eine Stromquelle (15, 25) umfasst, die als eine der Folgenden aus einer Gruppe: dieselbetriebene Motoren, Brennstoffzellen, Solarzellen, elektrische Wechselstromnetze, Windturbinen und Kombinationen von diesen ausgewählt ist.
 9. Stromversorgungssystem nach einem der Ansprüche 1 bis 8, wobei das Energiespeichersystem (10) einen Energiespeicher (11) umfasst, der als einer der Folgenden aus einer Gruppe: eine Batterie (32), ein Superkondensator (27), ein Schwungrad (22) und Kombinationen von diesen, ausgewählt ist.
 10. Stromversorgungssystem nach einem der Ansprüche 1 bis 9, wobei das Steuerungs- und Überwachungssystem (17) eine Steuereinheit umfasst, die als eine der Folgenden aus einer Gruppe: eine analoge Einheit, eine programmierbare Logiksteuerung und ein Computer, ausgewählt ist.
 11. Aufzug des Typs, bei dem Lastträger (1, 2) durch ein System gebildet sind, das als "Doppelwagen" bekannt ist, die entlang von auf einem gemeinsamen Mast (5) parallel zueinander verlaufenden Spuren antreibbar sind, umfassend ein Stromversorgungssystem nach einem der Ansprüche 1 bis 10, wobei während des regenerativen Bremsens von einem der Antriebsmotoren (3) des Lastträgers (1) erhaltene Energie im Energiespeicher (11) gespeichert wird und zurückgeführt und vom Antriebsmotor (4) des zweiten Lastträgers (2) genutzt wird, wenn dieser in der Aufwärtsbewegung entlang der Spur beschleunigt wird.
 12. Verfahren zur Stromversorgung von Aufzügen des Typs, bei dem Antriebsmaschinen von einem Lastträger (1, 2) getragen werden und mittels eines Zahnrades (111) und einer Zahnstange (112) den Lastträger entlang einer Spur auf einem Mast (5) in einer ersten und zweiten Richtung antreiben, und ein Elektromotor (3, 4), welcher ein Bestandteil der Antriebsmaschinen des Lastträgers ist, mit Strom von einer bodennahen Einheit versorgt wird, umfassend die folgenden Betriebsschritte:
 - a) dass ein Lastträger (1, 2) angeordnet wird,
 - b) dass die Antriebsmaschinen des Lastträgers (1, 2) einem Elektromotor (3, 4) zugeordnet werden, welcher den Antrieb des Lastträgers in erster und zweiter Richtung entlang des Mastes (5) und die Erzeugung elektrischer Energie durch regenerativen Betrieb des Elektromotors wäh-

- rend des Antreibens des Lastträgers in der zweiten Abwärtsrichtung erlaubt,
- c) dass ein Hauptstromnetz (12) zur Versorgung der elektrischen Energie auf einer Bodennähe angeordnet wird,
- d) dass ein Energiespeichersystem (10), das einen Energiespeicher (11) zur Speicherung von Energie umfasst, in einer Bodennähe angeordnet wird,
- gekennzeichnet durch** die folgenden Betriebs-schritte;
- e) dass ein Gleichstrombus (13, 13) und eine Gleichstromleitung (14), um mit einer angepassten Länge dem Lastträger aufwärts und abwärts entlang des Mastes zu folgen, angeordnet sind, um zwischen dem vom Lastträger (1, 2) getragenen Elektromotor (3, 4), dem bodennah angeordneten Energiespeicher (11) und dem bodennah angeordneten Hauptstromnetz (12) elektrische Energie zu übertragen, wobei jedes des Speichersystems (10) und des Hauptstromnetzes (12) mit dem Gleichstrombus parallel geschaltet ist,
- f) dass ein Steuerungs- und Überwachungssystem (17) zur Überwachung und Steuerung der Ströme elektrischer Energie zwischen dem Elektromotor (3, 4) des Lastträgers, dem Energiespeicher (11) in Bodennähe und dem den Strom herstellenden Hauptstromnetz (12) ausgelegt ist,
- g) dass der Betrieb des Lastträgers (1, 2) zur Versorgung potenzieller Energie durch regenerativen Betrieb während des Abwärtsfahrens entlang des Mastes (5) ausgelegt ist, und dass die auf diese Weise erhaltene elektrische Energie vom Bus zum Energiespeicher (11) geleitet wird, um gespeichert zu werden, und
- h) dass der Lastträger (1, 2) ausgelegt ist, um seine potenzielle Energie während der Beschleunigung oder Bewegung aufwärts entlang des Mastes (5) durch den Einfluss elektrischer Energie, die aus dem Energiespeicher (11) erhalten wurde, zu erhöhen,
13. Verfahren nach Anspruch 12, wobei elektrische Energie als ein Gleichstrom zwischen dem Elektromotor (3, 4) und dem in Bodennähe angeordneten Energiespeicher (11) übertragen wird.
14. Verfahren nach Anspruch 12, wobei der Gleichstrom über ein Gleichstromkabel oder Übertragungskabel (14), das aufgehängt am Lastträger (1, 2) angeordnet ist und sich nach unten erstreckt, oder alternativ mittels einer an einem Mast (5) befestigten und daran entlang verlaufenden Stromschiene übertragen wird.
15. Verfahren nach einem der Ansprüche 13 bis 14, wobei als Elektromotor (3, 4) ein durch Wechselstrom angetriebener induktiver Wechselstromelektromotor ausgewählt wird, und dass die Aufzugskabine (1, 2) so angeordnet ist, dass sie einen Umwandler (6, 7) zur Umwandlung des Gleichstroms in Wechselstrom unterstützt, der für den Betrieb des Wechselstromelektromotors angepasst ist.
16. Verfahren nach einem der Ansprüche 12 bis 15, wobei der Aufzug als ein Doppelwagen mit Lastträgern angeordnet ist, die auf einem Mast (5) paarweise verlaufen, und dass die während des regenerativen Bremsens vom Antriebsmotor (3) eines der Lastträger (1) erhaltene elektrische Energie beim Herunterbewegen des Lastträgers im Energiesystems (10) gespeichert wird und zurückgeführt und vom Antriebsmotor (4) des zweiten der Lastträger (2) genutzt wird, wenn dieser Lastträger in einer Aufwärtsrichtung entlang des Mastes beschleunigt wird.
17. Verfahren nach einem der Ansprüche 12 bis 16, wobei der Energiespeicher (11) als einer der Folgenden aus einer Gruppe: eine Batterie (32), ein Superkondensator (27), ein Schwungrad (22) und Kombinationen von diesen, ausgewählt wird.
18. Verfahren nach einem der Ansprüche 12 bis 17, wobei das Hauptstromnetz (12) als eines der Folgenden aus einer Gruppe: Dieselmotoren, Turbinenmotoren, Stirlingmotoren, Ottomotoren, Brennstoffzellen, Solarzellen, elektrische Wechselstromnetze, Windturbinen und Kombinationen von diesen, ausgewählt wird.
19. Verfahren nach einem der Ansprüche 12 bis 18, wobei das Steuerungs- und Überwachungssystem (17) als eines der Folgenden aus einer Gruppe: eine analoge Einheit, eine programmierbare Logiksteuerung und ein Computer, ausgewählt wird.
20. Verwendung eines Stromversorgungssystems nach Anspruch 1 mit einer Kombination eines Gleichstrombusses und eines Gleichstromübertragungskabels (14) zur Übertragung von Strom an den Motor (3, 4) eines Lastträgers (1, 2) des Typs, der durch die kennzeichnenden Merkmale des Anspruchs 1 angegeben ist.

Revendications

1. Système d'alimentation en énergie pour un ascenseur du type dans lequel la machinerie d'entraînement est soutenue par un transporteur de charge (1, 2) et entraîne au moyen d'une roue dentée (111) et d'une tige dentée (112) le transporteur de charge le long d'une voie sur un mât (5) dans des première et deuxième directions, et un moteur électrique (3, 4)

- qui fait partie de la machinerie d'entraînement du transporteur de charge est alimenté en puissance par une unité située au niveau du sol, comprenant ; un moteur électrique actionné électriquement (3, 4) qui fait partie de la machinerie d'entraînement et est agencé pour entraîner le transporteur de charge (1, 2) dans des première et deuxième directions le long du mât (5) et pour générer de l'énergie électrique par l'intermédiaire d'une opération de régénération du moteur électrique pendant l'entraînement du transporteur de charge dans une deuxième direction opposée, un système de stockage d'énergie (10) qui est un composant de l'unité au niveau du sol et qui comprend un stockage d'énergie (11) pour le stockage d'énergie, un réseau électrique principal (12) disposé au niveau du sol, à partir duquel l'énergie électrique peut être retirée,
- caractérisé en ce qu'il comprend ;**
- un bus à courant continu de transfert d'énergie (13, 13') et une ligne à courant continu d'alimentation électrique (14) pour suivre d'une longueur adaptée le transporteur de charge vers le haut et vers le bas le long du mât pour transférer de l'énergie électrique entre la machinerie d'entraînement du transporteur de charge (1, 2), le système de stockage d'énergie (10) et le réseau électrique principal (12) produisant de l'énergie, chacun dudit système de stockage (10) et dudit réseau électrique principal (12) étant connectés en parallèle au bus à courant continu, un système de commande et de surveillance (17) pour la surveillance et la commande des flux d'énergie électrique entre le moteur électrique (3, 4) du transporteur de charge, le stockage d'énergie (11) au niveau du sol et du réseau électrique principal (12).
2. Système d'alimentation en énergie selon la revendication 1, dans lequel la ligne à courant continu d'alimentation électrique (14) est agencée pour être suspendue au niveau du transporteur de charge (1, 2) pour le transfert de puissance entre les moteurs électriques du transporteur de charge (1, 2), le système de stockage d'énergie (10) et le réseau électrique principal (12) produisant de la puissance.
 3. Système d'alimentation en énergie selon la revendication 2, dans lequel la ligne d'alimentation électrique (14) comprend un câble de transmission à courant continu avec des conducteurs et une couche isolante.
 4. Système d'alimentation en énergie selon l'une quelconque des revendications 1 à 3, dans lequel le moteur électrique (3, 4) comprend l'un des moteurs suivants : moteurs à fréquence contrôlée, moteurs à courant alternatif et moteurs à courant continu.
 5. Système d'alimentation en énergie selon la revendication 3 ou 4, dans lequel le moteur électrique (3, 4) est du type triphasé inductif alternatif avec un convertisseur associé (6, 7) suspendu de la même manière au transporteur de charge (1, 2) pour la conversion du courant continu délivré par le bus à courant continu.
 6. Système d'alimentation en énergie selon l'une quelconque des revendications 3 à 5, comprenant une résistance de freinage à fonctionnement dynamique (18) pouvant être connectée entre les connexions positive (13) et négative (13') du bus à courant continu au moyen d'un commutateur (19), l'énergie électrique produite pendant l'opération de régénération pouvant être dissipée sous forme de chaleur dans la résistance de freinage.
 7. Système d'alimentation en énergie selon l'une quelconque des revendications 3 à 6, dans lequel le bus à courant continu transfère le courant continu produit pendant l'opération de régénération au système de stockage d'énergie (10) afin d'augmenter l'énergie stockée dans le stockage d'énergie (11) lorsque le transporteur de charge (1, 2) réduit son énergie potentielle par un mouvement descendant le long de la voie (5).
 8. Système d'alimentation en énergie selon l'une quelconque des revendications 1 à 7, dans lequel le réseau électrique principal (12) comprend une source de puissance (15, 25) sélectionnée parmi l'un des éléments suivants dans un groupe : moteurs diesel, piles à combustible, cellules solaires, réseaux électriques à courant alternatif, éoliennes et leurs combinaisons.
 9. Système d'alimentation en énergie selon l'une quelconque des revendications 1 à 8, dans lequel le système de stockage d'énergie (10) comprend un stockage d'énergie (11) sélectionné parmi l'un des éléments suivants dans un groupe : une batterie (32), un super-condensateur (27), un volant (22) et des combinaisons de ceux-ci.
 10. Système d'alimentation en énergie selon l'une quelconque des revendications 1 à 9, dans lequel le système de commande et de surveillance (17) comprend une unité de commande sélectionnée parmi l'un des éléments suivants dans un groupe : une unité analogique, un contrôleur logique programmable et un ordinateur.
 11. Ascenseur du type dans lequel lesdits transporteurs de charge (1, 2) sont constitués par un système avec ce que l'on appelle des "doubles wagons" pouvant être entraînés le long de voies s'étendant en parallèle l'une de l'autre sur un mât commun (5) compre-

nant un système d'alimentation en énergie selon l'une quelconque des revendications 1 à 10, dans lequel de l'énergie provenant de l'un des moteurs d'entraînement (3) du transporteur de charge (1) pendant le freinage régénérateur est stockée dans le stockage d'énergie (11) et est renvoyée et utilisée par le moteur d'entraînement (4) du deuxième transporteur de charge (2) lorsqu'il est accéléré vers le haut le long de la voie.

12. Procédé d'alimentation en énergie d'ascenseurs du type dans lequel la machinerie d'entraînement est soutenue par un support de charge (1, 2) et entraîne au moyen d'une roue dentée (111) et d'une tige dentée (112) le transporteur de charge le long d'une voie sur un mât (5) dans des première et deuxième directions, et un moteur électrique (3, 4) qui fait partie de la machinerie d'entraînement du transporteur de charge est alimenté en énergie par une unité située au niveau du sol, comprenant des étapes de fonctionnement suivantes ;

a) où un transporteur de charge (1, 2) est agencé,

b) où la machinerie d'entraînement du transporteur de charge (1, 2) est pourvue d'un moteur électrique (3, 4) qui permet au transporteur de charge d'être entraîné dans des première et deuxième directions le long du mât (5) et de produire de l'énergie électrique par l'intermédiaire d'une opération de régénération du moteur électrique pendant l'entraînement du transporteur de charge dans ladite deuxième direction vers le bas,

c) où un réseau d'alimentation principal (12) pour l'alimentation en énergie électrique est agencé à un niveau du sol,

d) où un système de stockage d'énergie (10) comprenant un stockage d'énergie (11) pour le stockage d'énergie est agencé au niveau du sol, **caractérisé par** les étapes de fonctionnement suivantes ;

e) où un bus à courant continu (13, 13') et une ligne à courant continu (14) pour suivre d'une longueur adaptée le transporteur de charge vers le haut et vers le bas le long du mât sont agencés pour transférer de l'énergie électrique entre le moteur électrique (3, 4) qui est supporté par le transporteur de charge (1, 2), le stockage d'énergie (11) disposé au niveau du sol et le réseau d'alimentation principal (12) situé au niveau du sol, chacun dudit système de stockage (10) et dudit réseau électrique principal (12) étant connectés en parallèle au bus à courant continu,

f) où un système de commande et de surveillance (17) est agencé pour la surveillance et la commande des flux d'énergie électrique entre le mo-

teur électrique (3, 4) du transporteur de charge, le stockage d'énergie (11) au niveau du sol et du réseau électrique principal (12) produisant de la puissance,

g) où le fonctionnement du transporteur de charge (1, 2) est agencé pour fournir, lors de l'opération de régénération, l'énergie potentielle lors de la descente le long du mât (5) et que l'énergie électrique ainsi obtenue est acheminée par le bus jusqu'au stockage d'énergie (11) à stocker, et

h) où le transporteur de charge (1, 2) est agencé pour augmenter son énergie potentielle pendant une accélération ou un mouvement vers le haut le long du mât (5) par l'influence de l'énergie électrique qui a été obtenue depuis le stockage d'énergie (11).

13. Procédé selon la revendication 12, dans lequel de l'énergie électrique est transférée sous la forme d'un courant continu entre le moteur électrique (3, 4) et le stockage d'énergie (11) agencé au niveau du sol.

14. Procédé selon la revendication 12, dans lequel le courant continu est transféré sur un câble d'alimentation en courant continu ou un câble de transmission (14) suspendu au niveau du transporteur de charge (1, 2) et s'étendant vers le bas ou alternativement au moyen d'un rail de courant fixé au mât (5) et s'étendant le long de celui-ci.

15. Procédé selon l'une quelconque des revendications 13 à 14, dans lequel, en tant que moteur électrique (3, 4), est sélectionné un moteur électrique à courant alternatif inductif entraîné par un courant alternatif et en ce que la cabine d'ascenseur (1, 2) est agencée pour supporter un convertisseur (6, 7) pour la conversion du courant continu en courant alternatif adapté au fonctionnement du moteur électrique à courant alternatif.

16. Procédé selon l'une quelconque des revendications 12 à 15, dans lequel l'ascenseur est agencé en tant que double wagon avec des transporteurs de charges s'étendant par paires sur un mât commun (5), et en ce que l'énergie électrique obtenue lors du freinage régénérateur du moteur d'entraînement (3) de l'un des transporteurs de charge (1) lorsque celui-ci descend, est stockée dans le système d'énergie (10) et est renvoyée et utilisée par le moteur d'entraînement (4) du deuxième des transporteurs de charge (2) lorsque ce transporteur de charge est accéléré vers le haut et le long du mât.

17. Procédé selon l'une quelconque des revendications 12 à 16, dans lequel le stockage d'énergie (11) est sélectionné parmi l'un des éléments suivants dans un groupe : une batterie (32), un super-condensa-

teur (27), un volant (22) et des combinaisons de ceux-ci.

18. Procédé selon l'une quelconque des revendications 12 à 17, dans lequel le réseau électrique principal (12) est sélectionné parmi l'un des éléments suivants dans un groupe : moteurs diesel, moteurs à turbine, moteurs Stirling, moteurs Otto, piles à combustible, cellules solaires, réseaux électriques à courant alternatif, éoliennes et leurs combinaisons. 5 10
19. Procédé selon l'une quelconque des revendications 12 à 18, dans lequel le système de commande et de surveillance (17) est sélectionné parmi l'un des éléments suivants dans un groupe: une unité analogique, un contrôleur logique programmable et un ordinateur. 15
20. Utilisation d'un système d'alimentation en énergie selon la revendication 1 avec une combinaison d'un bus à courant continu et d'un câble de transmission à courant continu (14) pour le transfert de puissance au moteur électrique (3, 4) d'un transporteur de charge (1, 2) du type spécifié dans l'introduction de revendication 1. 20 25

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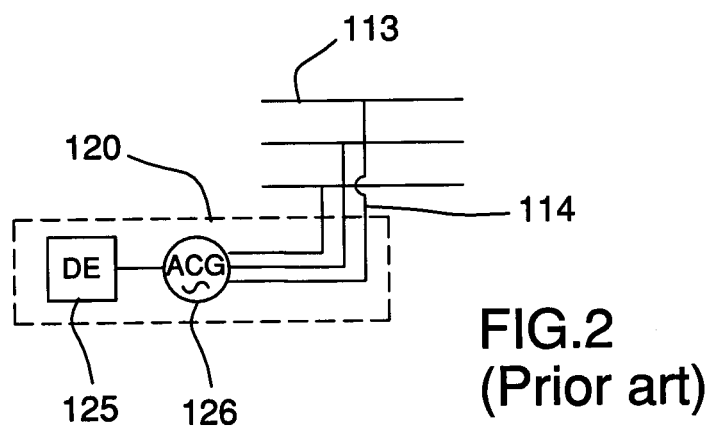
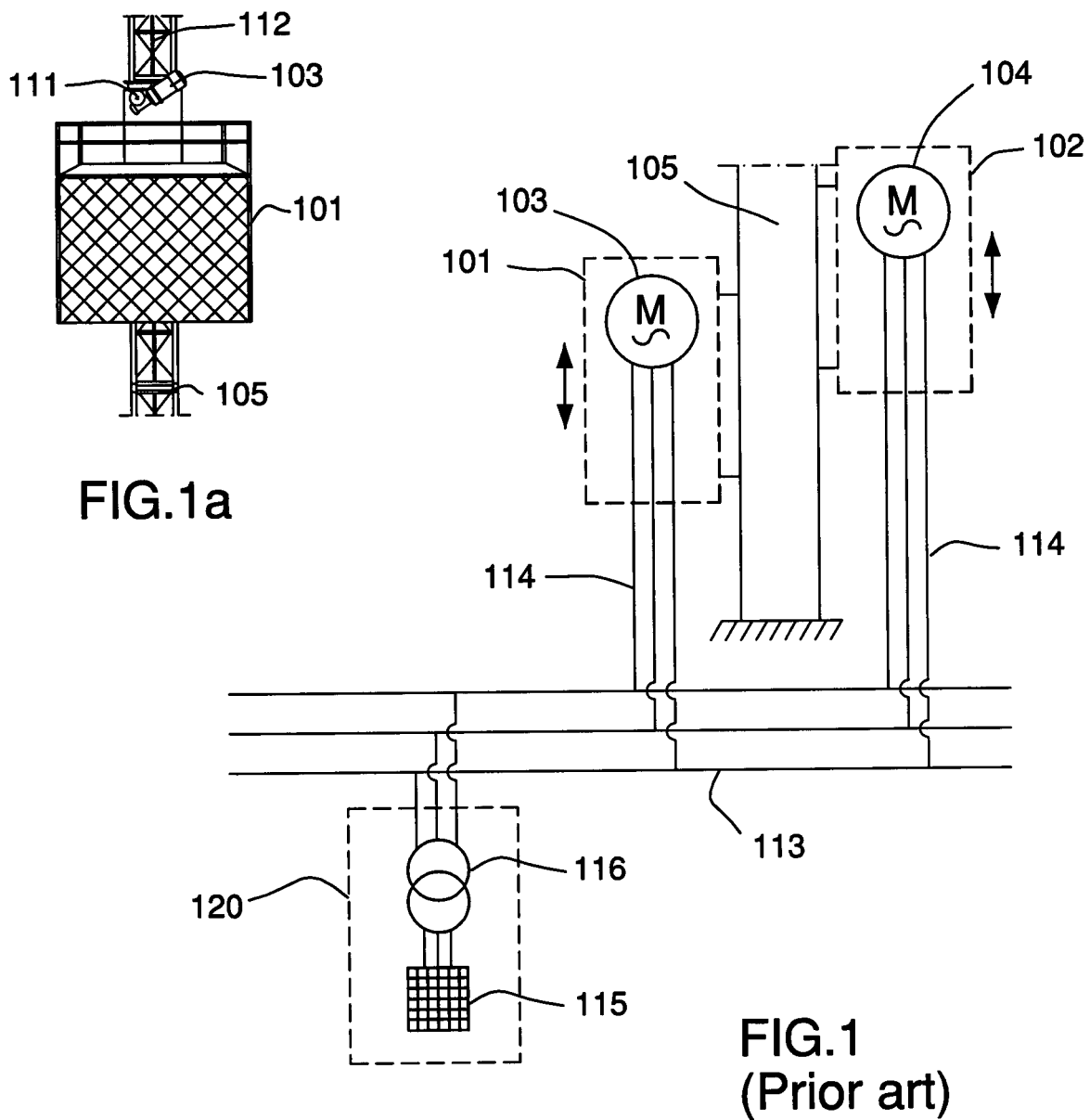
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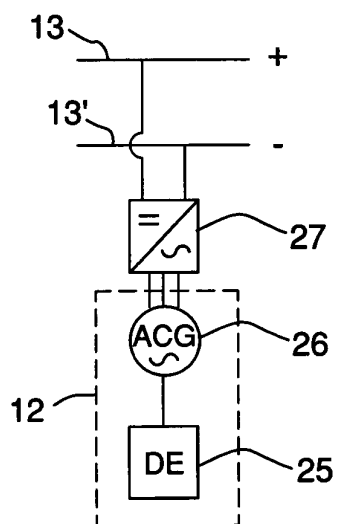
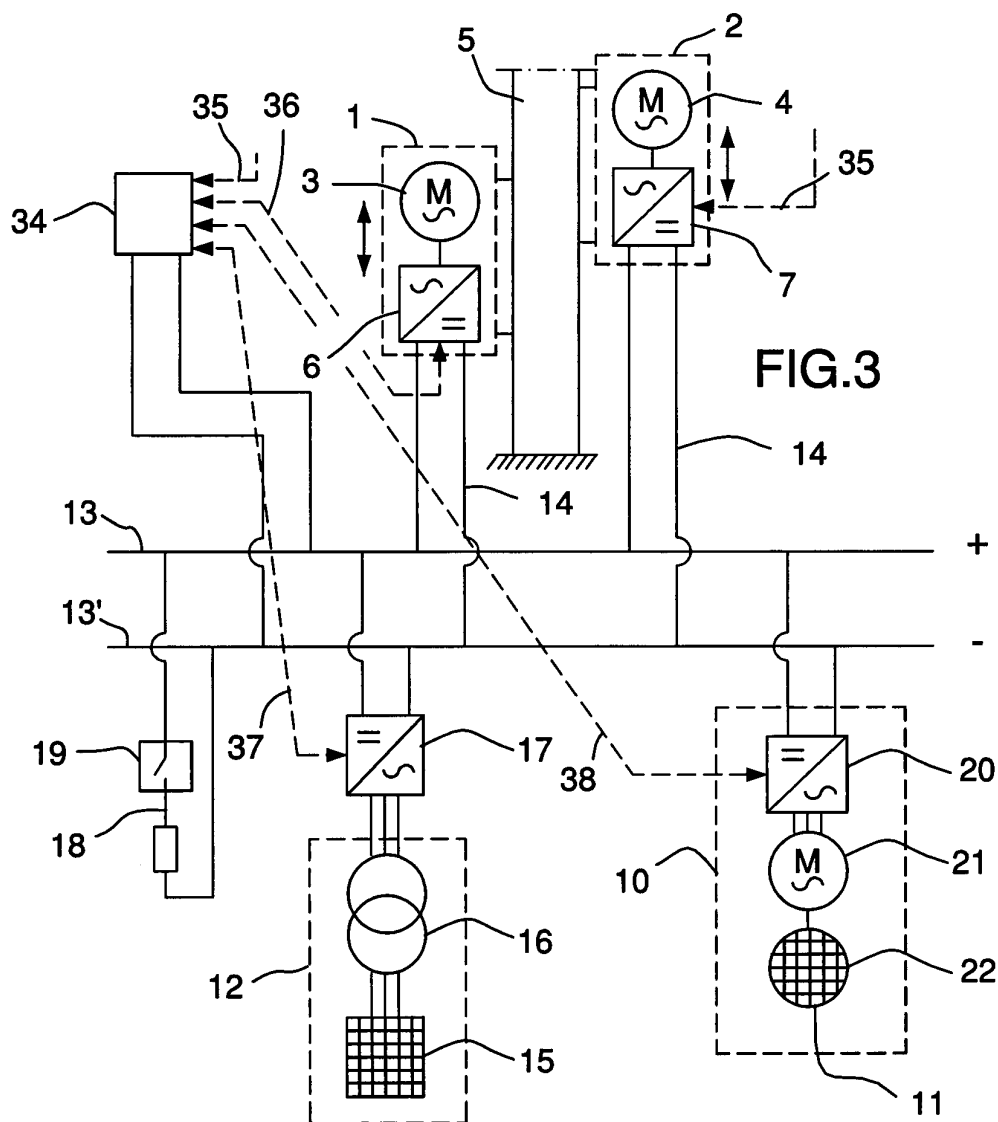


FIG.4

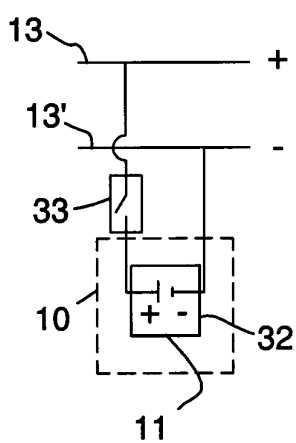


FIG.6

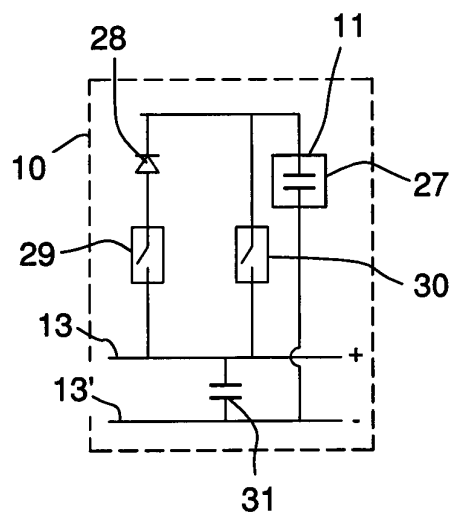


FIG.5

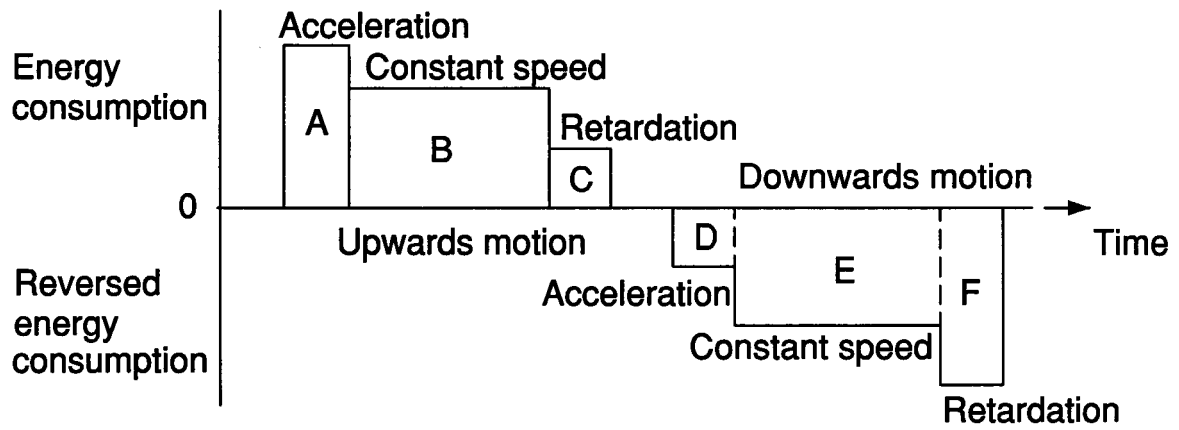


FIG.7

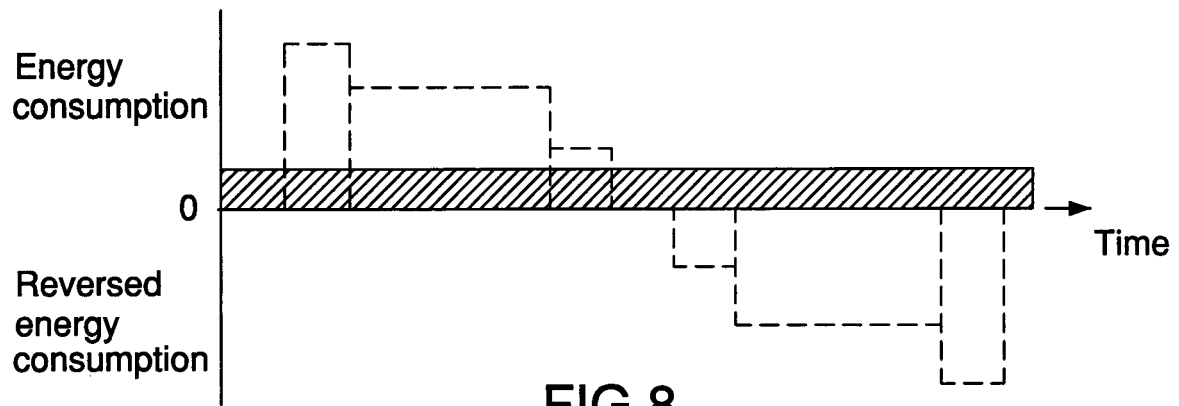


FIG.8

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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