

Elevator installation having a double deck

The invention relates to an elevator installation having at least one elevator car carrier that can accommodate two or more elevator cars. In particular, the invention relates to the field of
5 elevator installations that take the form of so-called double-deck elevator installations.

JP 2001-322771 A1 discloses a double-deck elevator. This known elevator includes a car frame, in which two cars are arranged one above the other. Here, the upper car is supported against the car frame by way of a resilient body. The lower car is supported against a base by
10 way of a resilient body. The base is in turn supported against the car frame by way of hydraulic oil cylinders. Here, the weight of the lower car is measured. The oil pressure for the hydraulic oil cylinders is controlled in dependence on the weight of the lower car.

The double-deck elevator known from JP 2001-322771 A1 has the disadvantage that the
15 stroke of the hydraulic oil cylinders is limited and so a possible adjustment travel for the lower car is limited. Although in theory a relatively large adjustment travel for the lower car may be achieved if the stroke of the oil cylinders is correspondingly long, in practice reasons of static equilibrium and safety exclude this possibility. In particular, sufficient safety must be guaranteed while the car frame is in motion as well. In particular if there is an emergency
20 stop, major forces may act on the oil cylinders during this, and this has to be taken into account in the construction.

The object of the invention is to provide an elevator installation that enables improved operation. In particular, it is an object of the invention to provide an elevator installation that
25 enables a high degree of safety in operation and has a broad range of application.

The object is achieved by an elevator installation according to the invention having the features of claim 1. The measures stated in the subclaims make advantageous further developments of the elevator installation specified in claim 1 possible.

30

The object is achieved by an elevator installation having at least one elevator car carrier, which may be moved in a movement space provided for movement of the elevator car carrier, a first elevator car that is arranged on the elevator car carrier, and at least one second elevator

car that is arranged on the elevator car carrier. At least one hydraulic adjustment element is provided for the first elevator car and serves to adjust the first elevator car in relation to the elevator car carrier. Moreover, at least one hydraulic adjustment element is provided for the second elevator car and serves to adjust the second elevator car in relation to the elevator car carrier. Here, a stroke of the hydraulic adjustment element for the first elevator car for adjusting the first elevator car in a first direction of adjustment is converted into a stroke of the hydraulic adjustment element for the second elevator car for adjusting the second elevator car in an opposing direction of adjustment.

The elevator car carrier of the elevator installation may for example be arranged in an elevator shaft. In that case, the movement space that is provided for movement of the elevator car carrier is limited by the elevator shaft. Here, a drive motor unit may be provided that serves to actuate the elevator car carrier. As a result of this, the elevator car carrier may be moved along the provided path of movement. The elevator car carrier may be suspended from a traction means that is connected to the elevator car carrier. Here, the traction means may be suitably guided by way of a traction sheave of the drive motor unit. In addition to the function of transmitting the force or moment of the drive motor unit to the elevator car carrier, a traction means of this kind may also have the function of carrying the elevator car carrier. The term "actuation of the elevator car carrier" should be understood in particular to mean raising or lowering in the elevator shaft or the movement space that is provided for movement of the elevator car carrier. The elevator car carrier may be guided on one or more guide rails.

It is advantageous if a possible stroke of the hydraulic adjustment element for the first elevator car for adjusting the first elevator car is of approximately the same size as a possible stroke of the hydraulic adjustment element for the second elevator car for adjusting the second elevator car. As a result of this, a possible adjustment travel that is of approximately the same size may be achieved for both elevator cars. This means in particular that an identical layout of the components for the first elevator car and the second elevator car becomes possible. Here, comparable forces act on the hydraulic adjustment element of the first elevator car and the hydraulic adjustment element of the second elevator car, as a result of which optimized construction is produced. This allows low-cost manufacture to be possible.

It is also advantageous if a direction of adjustment for the first elevator car, in which the first elevator car may be adjusted by the hydraulic adjustment element for the first elevator car, and a direction of adjustment for the second elevator car, in which the second elevator car may be adjusted by the hydraulic adjustment element for the second elevator car, are parallel
5 to a direction of movement of the elevator car carrier in which the elevator car carrier may be moved through the movement space. As the elevator car carrier accelerates and decelerates, forces which are also parallel to the direction of movement are exerted on the elevator car. This produces advantageous loading of the hydraulic adjustment elements for the elevator cars in their directions of adjustment. This makes a robust construction possible.

10 It is advantageous if, in the event of adjustment of the first elevator car in relation to the elevator car carrier, the hydraulic adjustment element for the first elevator car is adjusted synchronously with the hydraulic adjustment element for the second elevator car in a direction of adjustment of the first elevator car and in a direction of adjustment of the second
15 elevator car. This means that when the first elevator car and the second elevator car are adjusted in relation to the elevator car carrier an advantageous weight distribution is always achieved within the elevator car carrier.

20 It is advantageous if a hydraulic connection is provided between the hydraulic adjustment element for the first elevator car and the hydraulic adjustment element for the second elevator car. A pump is arranged in the hydraulic connection, wherein the pump for lowering the first elevator car and for raising the second elevator car in relation to the elevator car carrier conveys from the hydraulic adjustment element for the first elevator car to the hydraulic adjustment element for the first elevator car.

25 Depending on the load on the first or second elevator car and the direction of adjustment of the first or second elevator car, the output to be supplied by the pump varies in order to convey a pressurized fluid from the hydraulic adjustment element of the first elevator car to the adjustment element of the second elevator car.

30 For example when there is a relatively high load on the first elevator car, a higher hydraulic pressure prevails in the hydraulic adjustment element of the first elevator car than in the hydraulic adjustment element of the second elevator car. The resulting load thus acts on the

hydraulic adjustment element of the first elevator car, with the result that the pressurized fluid tends to be expelled from the hydraulic adjustment element of the first elevator car. To lower the first elevator car, the pump need supply only a small output. If the resulting load becomes greater, the pump need only produce what is actually a throttled output in order to lower the first elevator car in a controlled manner. During this the second elevator car is raised accordingly. To raise the first elevator car in opposition to the resulting load, by contrast, the pump must supply a relatively large output. During this the second elevator car is lowered accordingly.

It is also advantageous if a blocking valve is arranged in the hydraulic connection. Here, the pump conveys from the hydraulic adjustment element for the first elevator car to the hydraulic adjustment element for the first elevator car by way of the open blocking valve. In a rest position, by contrast, in which the first elevator car and the second elevator car are at rest in relation to the elevator car carrier, the blocking valve blocks the hydraulic connection. Thus, reliable fixing of the first and second elevator cars in relation to the elevator car carrier may be achieved in the rest position.

In particular, even if operation of the pump fails, the blocking valve may be blocked off. In so doing, an undesirable counter-movement of the first and second elevator cars is prevented.

This ensures a high degree of safety in operation.

It is also advantageous if the hydraulic adjustment element for the first elevator car is arranged below the first elevator car on a transverse support of the elevator car carrier, and the hydraulic adjustment element for the second elevator car is arranged above the second elevator car on a transverse support of the elevator car carrier. If the first elevator car is arranged below the second elevator car, this gives the advantage that the intermediate space between the first and the second elevator car remains free of adjustment elements and a small car spacing may be set between the first and the second elevator car. This makes it possible to use the elevator installation in buildings having a relatively low height between landings.

Preferred exemplary embodiments of the invention are explained in more detail in the description that follows, with reference to the attached drawings, in which:

Fig. 1 shows an elevator installation in a schematic illustration corresponding to an exemplary embodiment of the invention.

Fig. 1 shows an elevator installation 1 having at least one elevator car carrier 2. The elevator car carrier 2 may be moved in a movement space 3 provided for movement of the elevator car carrier 2. For example, the movement space 3 may be provided in an elevator shaft of a building. In that case, the movement space 3 is limited by such an elevator shaft. Here, a plurality of landings 4, 5 may be provided in the building. The landings 4, 5 are arranged next to the movement space 3. Here, the landings 4, 5 represent examples of stopping points 4, 5. The landings 4, 5 are illustrated here by way of example. In practice, a significantly larger number of landings or stopping points may be provided.

The elevator car carrier 2 is suspended from a traction means 8. The traction means 8 runs around at least one traction sheave 9 of a drive motor unit 10. Depending on the direction of rotation at that time of the traction sheave 9 that is driven by the drive motor unit 10, the elevator car carrier 2 is moved through the movement space 3, upward in a direction 11 or downward in a direction 12. In this way, the elevator car carrier 2 may be moved through the movement space 3 in the directions of movement 11, 12.

The elevator car carrier 2 serves to receive a first elevator car 15 and a second elevator car 16. In this exemplary embodiment, the elevator car carrier 2 receives the two elevator cars 15, 16.

In this exemplary embodiment, the first elevator car 15 is arranged below the second elevator car 16 in the elevator car carrier 2. Provided between the two elevator cars 15, 16 is a transverse support 17 of the elevator car carrier 2. Further provided, below the first elevator car 15, is a further transverse support 18 of the elevator car carrier 2. Further provided, above the second elevator car 16, is a transverse support 19 of the elevator car carrier 2. The traction means 8 may for example be secured to the transverse support 19 of the elevator car carrier 2.

Between the first elevator car 15 and the transverse support 18 there are arranged hydraulic adjustment elements 20, 21. The hydraulic adjustment elements 20, 21 are in this case connected on the one hand to the transverse support 18 and on the other hand to a floor plate

22 of the first elevator car 15. The hydraulic adjustment elements 20, 21 serve to raise the first elevator car 15 in a direction of adjustment 23. Moreover, the first elevator car 15 may be lowered in a direction of adjustment 24 by appropriate triggering of the adjustment elements 20, 21. In this way, it is possible to adjust the first elevator car 15 in the directions
5 of adjustment 23, 24. The directions of adjustment 23, 24 are oriented in opposition to one another. Moreover, the directions of adjustment 23, 24 are oriented parallel to the directions of movement 11, 12 of the elevator car carrier 2.

The direction of adjustment 23 points vertically upward while the direction of adjustment 24
10 points vertically downward.

The hydraulic adjustment elements 20, 21 are constructed as hydraulic oil cylinders. Here, the hydraulic adjustment elements 20, 21 have bushings having cylindrical bores in which pistons 27, 28 are guided. Furthermore, the bushings define cylindrical spaces. The
15 cylindrical spaces are filled with a hydraulic pressurized fluid, in particular a hydraulic oil.

Preferably, the oil cylinders of the adjustment elements 20, 21 are constructed such that a respective piston face of a piston 27, 28 divides a respective cylindrical space in two, namely into an upper region 25, 26 and a lower region 29, 30 of the cylindrical space. Here, at least
20 the lower region 29, 30 is filled with pressurized fluid. Preferably, the upper region 25, 26 is also filled with pressurized fluid. Here, the two upper regions 25, 26 of the cylindrical spaces are connected to one another by way of a connection line 51 and the two lower regions 29, 30 of the cylindrical spaces are connected to one another by way of a connection line 31.

25 The lower region 29, 30 of a cylindrical space represents a working region in which the pressure of the pressurized fluid is built up for adjustment of the first elevator car 15. For this reason, the pressure in a lower region 29, 30 of a cylindrical space is relatively high, namely in the region of 100 or several hundred bar. The upper region 25, 26 of a cylindrical space, by contrast, serves to damp an abrupt stroke movement, such as may occur for example in the
30 event of arrest. For this reason, the pressure in an upper region 25, 26 of a cylindrical space is relatively low, around 1 to 2 bar.

Moreover, hydraulic adjustment elements 32, 33 are provided for the second elevator car 16. The hydraulic adjustment elements 32, 33 are arranged between the transverse support 19 and the second elevator car 16. The hydraulic adjustment elements 32, 33 are in this case connected on the one hand to the transverse support 19 and on the other hand to a ceiling
5 plate 34 of the second elevator car 16.

The hydraulic adjustment elements 32, 33 are also constructed as hydraulic oil cylinders. Here, the hydraulic adjustment elements 32, 33 have bushings. The bushings, in turn, have cylindrical bores in which pistons 37, 38 are guided. Furthermore, the bushings define
10 cylindrical spaces. The cylindrical spaces are filled with a hydraulic pressurized fluid, in particular a hydraulic oil. The adjustment elements 32, 33 and their oil cylinders preferably operate in the same way as those of the adjustment elements 20, 21.

Thus, in this case too a respective piston face of a piston 37, 38 divides a respective
15 cylindrical space in two, namely into an upper region 35, 36 and a lower region 39, 40 of the cylindrical space. Here, at least the lower region 39, 40 is filled with pressurized fluid. Preferably, the upper region 35, 36 is also filled with pressurized fluid. Here, the two upper regions 35, 36 of the cylindrical spaces are connected to one another by way of a connection line 71 and the two lower regions 39, 40 of the cylindrical spaces are connected to one
20 another by way of a connection line 41. A lower region 39, 40 and an upper region 35, 36 of a cylindrical space are also under high and low pressure respectively.

The second elevator car 16 may be adjusted upward in a direction of adjustment 61 and downward in a direction of adjustment 62. The directions of adjustment 61, 62 are in this case
25 oriented parallel to the directions of movement 11, 12 of the elevator car carrier 2.

Formed between the hydraulic adjustment elements 20, 21 and the hydraulic adjustment elements 32, 33 by way of a hydraulic line 42 is a hydraulic connection 42. Here, at least the lower regions 29, 30, 39, 40 of the cylindrical spaces and the hydraulic adjustment elements
30 20, 21, 32, 33 are connected. Depending on the switch position of a switched valve unit 43, a connection is released or blocked between the lower regions 29, 30 of the hydraulic adjustment elements 20, 21 and the lower regions 39, 40 of the hydraulic adjustment elements 32, 33 by way of the hydraulic connection 42.

For this purpose, the switched valve unit 43 has a blocking valve 50 and a switching solenoid 49. By means of the switching solenoid 49, the blocking valve 50 may be switched such that it releases or blocks the hydraulic connection 42. When the elevator cars 15, 16 are adjusted in the directions of adjustment 23, 62 and 24, 61 respectively, the blocking valve 50 releases the hydraulic connection 42. In a rest position of the two elevator cars 15, 16, by contrast, the blocking valve 50 blocks the hydraulic connection 42. The switching solenoid is constructed to fail to safety. Thus, the switching solenoid 49 only releases the blocking valve 50 if a switching current is applied. In the event of a power failure, by contrast, the switching solenoid 49 blocks the switching valve 50. For this purpose, the switching solenoid 49 is in operative contact with a restoring spring which returns the switching solenoid 49 in the direction in which it blocks the blocking valve 50.

Furthermore, a pump 48 is arranged in the hydraulic connection 42 between the working regions 29, 30, 39, 40 of the hydraulic adjustment elements 20, 21 and the hydraulic adjustment elements 32, 33. Here, for the purpose of raising and lowering the first elevator car 15 and raising and lowering the second elevator car 16 in relation to the elevator car carrier 2, the pump 48 conveys pressurized fluid out of the working regions 29, 30 of the hydraulic adjustment elements 21, 22 for the first elevator car 15 into the working regions 39, 40 of the hydraulic adjustment elements 20, 21 for the second elevator car 16 or vice versa.

The pump 48 is constructed such that, depending on the desired direction of adjustment of the elevator cars 15, 16, it either conveys pressurized fluid out of the working regions 29, 30 of the hydraulic adjustment elements 20, 21 and into the working regions 39, 40 of the hydraulic adjustment elements 32, 33 or conveys pressurized fluid in the opposing direction, namely out of the working regions 39, 40 of the hydraulic adjustment elements 32, 33 and into the working regions 29, 30 of the hydraulic adjustment elements 20, 21. The pump 48 thus has two directions of conveying. In the case of certain loads on the first and second elevator cars 15, 16, the pump 48 may also be used as a throttling element.

For this purpose, the pump 48 is connected to a speed-regulated motor 47 by way of a drive shaft. The torque transmitted by the motor 47 to the pump 48 for adjustment of the first or second elevator car 15, 16 depends largely on the acceleration of the elevator cars 15, 16 and the load in conjunction with the direction of adjustment of the first or second elevator car 15,

16. The load results from a difference between the loading that is at that time on the first and the second elevator cars 15, 16.

5 The gravitational force of the first elevator car 15 and where appropriate the loading on the first elevator car 15 bear on the hydraulic adjustment elements 20, 21. Accordingly, the gravitational force of the second elevator car 16 and where appropriate the loading on the second elevator car 16 bear on the hydraulic adjustment elements 32, 33.

10 If for example the loading on the first elevator car 15 is greater than that on the second elevator car 16, a pressure p_1 of the pressurized fluid in the working regions 29, 30 of the hydraulic adjustment elements 20, 21 is greater than a pressure p_2 of the pressurized fluid in the working regions 39, 40 of the hydraulic adjustment elements 32, 33.

15 In this situation, the motor 47 must overcome a greater or smaller load, depending on the direction of conveying of the pump 48. If pressurized fluid is conveyed into the adjustment unit 20, 21 having the higher pressure p_1 , the motor has to produce a greater torque than if pressurized fluid is conveyed into the adjustment unit 32, 33 having the smaller pressure p_2 . If there is a relatively large difference in loading between the first and the second elevator car 15, 16, with a correspondingly large difference in pressure, the pump 48 may also be used as
20 a throttling element to limit the throughput of pressurized fluid out of the working regions 29, 30 of the hydraulic adjustment elements 20, 21 and into the working regions 39, 40 of the hydraulic adjustment elements 32, 33.

25 Depending on the loading on the first and second elevator cars 15, 16, another distribution of pressure is possible, in which for example the pressure p_2 is greater than the pressure p_1 . This results in correspondingly different preconditions for producing a torque for the motor 47.

30 For example, when the first elevator car 15 is being lowered, on the one hand the pistons 27, 28 of the hydraulic adjustment elements 20, 21 move in the direction of adjustment 24. On the other hand, the pistons 37, 38 of the hydraulic adjustment elements 32, 33 move in the direction of adjustment 61. Because the pressurized fluid expelled from the working regions 29, 30 of the hydraulic adjustment elements 20, 21 flows into the working regions 39, 40 of the hydraulic adjustment elements 32, 33, a synchronous movement is achieved between on

the one hand the hydraulic adjustment elements 20, 21 and on the other hand the hydraulic adjustment elements 32, 33 in the directions of adjustment 24 and 61 respectively. Here, the hydraulic adjustment elements 20, 21 and the hydraulic adjustment elements 32, 33 are constructed such that they are matched to one another. When the second elevator car 16 is lowered, movement of the pistons 27, 28, 37, 38 and the direction of flow of the pressurized fluid are reversed.

In a rest position of the elevator cars 15, 16, the connection between the hydraulic adjustment elements 32, 33 and the hydraulic adjustment elements 20, 21 by way of the hydraulic line 42 is blocked. As a result, there is no exchange of pressurized fluid between on the one hand the working regions of the hydraulic adjustment elements 32, 33 and on the other hand the working regions of the hydraulic adjustment elements 20, 21. As a result, on the one hand adjustment of the pistons 27, 28 of the hydraulic adjustment elements 20, 21 is blocked and thus prevented. On the other hand, adjustment of the pistons 37, 38 of the hydraulic adjustment elements 32, 33 is blocked and thus prevented. The pressurized fluid is in particular an incompressible pressurized fluid. This means that reliable fixing of the position of the first and second elevator cars 15, 16 in relation to the elevator car carrier 2 is made possible.

Adjustment of the elevator cars 15, 16 is controlled by a control unit 46. For this purpose, the control unit 46 has available information from a first position measuring unit 72, a second position measuring unit 73, at least one first load measuring unit 78, 79 and at least one second load measuring unit 80, 81. The first positioning unit 72 and the first load measuring unit 78, 79 are associated with the first elevator car 15. The second positioning unit 73 and the second load measuring unit 80, 81 are associated with the second elevator car 16. Thus, the control unit 46 knows the positions of the first and the second elevator cars 15, 16 in relation to the elevator car carrier 2, and also knows the loading at that time on the first and second elevator cars 15, 16. Moreover, the control unit 46 communicates with an elevator control and has available information on which landing will be approached next and the car spacing 77 which has to be set between the elevator cars 15, 16 for this landing.

By means of this information, the control unit 46 sets a torque for the motor 47 in order to set the car spacing 77 between the elevator cars 15, 16 in good time, for a given loading. By way

of the position measuring units 72, 73, the control unit 46 has available the current positions of the elevator cars 15, 16 during adjustment, and cuts the motor 47 once the predetermined car spacing 77 has been achieved. Moreover, the control unit 46 triggers the switching solenoid 49 such that the blocking valve 50 releases the hydraulic connection 42 during
5 adjustment of the car spacing 77 and blocks the hydraulic connection 42 once the predetermined car spacing 77 has been achieved.

Furthermore, the hydraulic connection 42 supplies additional pressurized fluid from an auxiliary pump 44. Here, the auxiliary pump 44 conveys pressurized fluid from an oil
10 reservoir 45 to the hydraulic connection 42. This additional supply of pressurized fluid is performed in order to top up oil losses. For this purpose, the auxiliary pump 44 is triggered by the control unit 46. Normally, with a synchronous adjustment in opposing directions of the elevator cars 15, 16, subtracting the position values of the first position measuring unit 72 and the second position measuring unit 73 will give a constant value. With continuing oil loss,
15 this value will vary within a broad range. The control unit 46 identifies the fact that a predetermined critical variance in this value has been exceeded and instructs the auxiliary pump 44 to convey pressurized fluid until the oil loss has been compensated.

Furthermore, the upper regions 25, 26 of the hydraulic adjustment elements 20, 21 and the
20 upper regions 35, 36 of the hydraulic adjustment elements 32, 33 are connected by way of a hydraulic connection 52. Here, depending on the adjustment movement of the first and second elevator cars 15, 16, pressurized fluid flows out of the upper regions 25, 26 of the adjustment elements 20, 21 and into the upper regions 35, 36 of the adjustment elements 32, 33 and vice versa. Since the pistons 27, 28 make the volume of the upper regions 25, 26 of
25 the adjustment elements 20, 21 smaller, the volume of the upper regions 35, 36 becomes larger with a given stroke of the elevator cars 15, 16 and with the same diameter of the upper regions 25, 26, 35, 36. For this reason, the hydraulic connection 52 is connected to a pressure accumulator 54. As the pressurized fluid flows out of the upper regions 35, 36 of the hydraulic adjustment elements 32, 33 and into the upper regions 25, 26 of the hydraulic
30 adjustment elements 20, 21, the pressure accumulator 54 temporarily stores excess pressurized fluid from the upper regions 35, 36. When the pressurized fluid flows in the opposing direction the pressure accumulator 54 returns stored pressurized fluid to the hydraulic connection 52.

As an alternative, an additional pressure accumulator 54 may be dispensed with if the diameter of the upper regions 25, 26 of the adjustment elements 20, 21 are constructed to be correspondingly larger.

- 5 Preferably, the pressure accumulator 54 is coupled to the hydraulic connection 52 by way of a throttle valve 53. The throttle valve 53 limits the flow rate of the pressurized fluid into the pressure accumulator 54 and out of the pressure accumulator 54, such that if there is a jolting stroke of the elevator cars 15, 16, as for example if the elevator car carrier 2 is subject to an arrest, there is always enough pressurized fluid left in the upper regions 25, 26, 35, 36 to
10 achieve sufficient damping of the jolting stroke.

Because, for the same reasons, there is a difference in volume between the working regions 29, 30 of the hydraulic adjustment elements 20, 21 and the working regions 39, 40 of the hydraulic adjustment elements 32, 33, the hydraulic connection 42 is preferably connected to
15 a further pressure accumulator and a further throttle valve. As above, as an alternative to this, an additional pressure accumulator with a throttle valve may be dispensed with if the diameters of the working regions 39, 40 of the adjustment elements 32, 33 are constructed to be correspondingly larger.

- 20 The first elevator car 15 has an alighting level 75. The second elevator car 16 has an alighting level 76. The alighting levels 75, 76 may for example be determined by the floors in the elevator cars 15, 16. A car spacing 77 is determined between the alighting level 75 of the first elevator car 15 and the alighting level 76 of the second elevator car 16. Once the two elevator cars 15, 16 have each stopped in relation to the elevator car carrier 2, which is the
25 case in the switching positions 50 of the switched valve unit 43, the car spacing 77 remains constant even when the elevator car carrier 2 is moving through the movement space 3. The car spacing 77 can be varied by adjusting the first elevator car 15 and the second elevator car 16.

- 30 The landing spacing between the landings 4, 5 depends on the architectonic conditions of the building or similar. Here, the spacing between two successive landings may vary within a building. For example, there may be provided in the building in some cases intermediate floors for receiving an air conditioning system. Moreover, the landing spacing for a basement

may be different from a landing spacing for the upper floors. Further, an entrance hall may also call for a greater landing height.

The elevator installation 1 advantageously makes it possible to adapt the car spacing 77 to the landing spacing of the landings 4, 5 to be approached. Thus, there may be a variation in the car spacing 77 within the building. This creates greater architectonic freedom.

The fact that the two elevator cars 15, 16 may in particular be moved toward one another or away from one another creates a number of advantages. By adjusting the first elevator car 15 in the direction of adjustment 23 and the second elevator car 16 in the direction of adjustment 62, the elevator cars 15, 16 are moved toward one another and the car spacing 77 is made shorter. Because both elevator cars 15, 16 are adjusted, the car spacing 77 changes at the sum of the rates of travel of the individual adjustment movements of the elevator cars 15, 16. This applies accordingly to an increase in the car spacing 77, in which the first elevator car 15 is moved in the direction of adjustment 24 and the second elevator car 16 is moved in the direction of adjustment 61. A further advantage is the fact that the possible change in the car spacing 77 – that is to say the difference between a maximum car spacing 77 and a minimum car spacing 77 – is formed by the possible adjustment movements for the elevator cars 15, 16. Here, the possible stroke for the hydraulic adjustment elements 20, 21 for the first elevator car 15 and the possible stroke for the hydraulic adjustment elements 32, 33 for the second elevator car 16 are added to give the possible change in the car spacing 77. This means that the constructional requirements of the hydraulic adjustment elements 20, 21, 32, 33 are reduced for a number of reasons. On the one hand, flexural forces or similar that occur are reduced in the pistons and bushings (which can now be of shorter construction) of the adjustment elements when jolts occur transversely in relation to the directions of movement 11, 12. Moreover, the structural stability of the adjustment elements is generally greater. Because of the smaller oil columns that result in the respective cylindrical spaces, the demands made on seals and valves are also reduced. Furthermore, the constructional layout in respect of safety requirements, which also necessitate a robust construction for the event of emergency stop or similar, is also made easier. This also makes it possible to dispense with special arrest or deceleration means that arrest or decelerate the elevator cars 15, 16 in relation to the elevator car carrier.

In this way, an elevator installation 1 having an elevator car carrier 2 may be provided which receives two or more elevator cars 15, 16. Here, different spacings between landings 4, 5 within the building may be compensated.

- 5 With a combination of the adjustment movements of the elevator cars 15, 16, a relatively quick adjustment of the two elevator cars 15, 16 in relation to one another may be performed. The high degree of efficiency of the hydraulic pump 48 makes it possible here advantageously to convert the energy required for pumping into raising the respective elevator car 15, 16.

10

A major advantage of the invention is the hydraulic communication between the adjustment elements 20, 21 of the first elevator car 15 and the adjustment elements 32, 33 of the second elevator car 16. Here, the gravitational force of the first elevator car 15 balances the gravitational force of the second elevator car 16, or the difference in pressures between p_1 and p_2 in the adjustment elements 20, 21, 32, 33 is kept small. This has the result that the conveying output to be performed by the pump 48 is also small. Accordingly, relatively small and lightweight pumps may be used. This results in a further considerable reduction in weight in the movable mass of the elevator installation and in savings on energy in operation.

- 20 The invention is not restricted to the exemplary embodiments described.

In particular, the hydraulic adjustment elements 20, 21 of the first elevator car 15 may be mounted in a further arrangement on the lower transverse support 18, and the hydraulic adjustment elements 32, 33 of the second elevator car 16 may be mounted on the middle transverse support 17. In a further arrangement, the hydraulic adjustment elements 20, 21 of the first elevator car 15 may be mounted on the middle transverse support 17 and the hydraulic adjustment elements 32, 33 of the second elevator car 16 may be mounted on the upper transverse support 19. In a further arrangement, both the hydraulic adjustment elements 20, 21 of the first elevator car 15 and the hydraulic adjustment elements 32, 33 of the second elevator car 16 may be mounted on the middle transverse support 17.

30

The two further arrangements of the hydraulic adjustment elements 20, 21 and 32, 33 which are first mentioned are of advantageous construction in respect of the volume of the working

regions 29, 30 and 39, 40 and the upper regions 25, 26 and 35, 36. This is because in these arrangements these volumes are of largely the same size, since the reciprocal effect of reducing the volume of the pistons 27, 28 and 37, 38 is dispensed with. For this reason, in these arrangements the pressure accumulator 54 and throttle valve 53 in the hydraulic
5 connections 42 and 52 become redundant.

Moreover, the hydraulic adjustment elements 20, 21, 32, 33 may be constructed such that each elevator car 15, 16 has only one hydraulic adjustment element. In this case the connection lines 31, 51, 41, 71 are dispensed with.

Claims

1. An elevator installation (1) having at least one elevator car carrier (2), which may be moved in a movement space (3) provided for movement of the elevator car carrier (2), a first
5 elevator car (15) that is arranged on the elevator car carrier (2), and at least one second elevator car (16) that is arranged on the elevator car carrier (2), wherein at least one hydraulic adjustment element (20, 21) is provided for the first elevator car (15) and serves to adjust the first elevator car (15) in relation to the elevator car carrier (2), and wherein at least one hydraulic adjustment element (32, 33) is provided for the second elevator car (16) and serves
10 to adjust the second elevator car (16) in relation to the elevator car carrier (2), characterized in that
a stroke of the hydraulic adjustment element (20, 21) for the first elevator car (15) for adjusting the first elevator car (15) in a first direction of adjustment (23, 24) is converted into a stroke of the hydraulic adjustment element (32, 33) for the second elevator car (16) for
15 adjusting the second elevator car (16) in an opposing direction of adjustment (62, 61).
2. The elevator installation as claimed in claim 1,
characterized in that
a possible stroke of the hydraulic adjustment element (20, 21) for the first elevator car (15)
20 for adjusting the first elevator car (15) is at least approximately the same size as a possible stroke of the hydraulic adjustment element (55, 56) for the second elevator car (16) for adjusting the second elevator car (16).
3. The elevator installation as claimed in claim 1 or 2,
25 characterized in that
a direction of adjustment (23, 24) for the first elevator car (15), in which the first elevator car (15) may be adjusted by the hydraulic adjustment element (20, 21) for the first elevator car (15), and a direction of adjustment (61, 62) for the second elevator car (16), in which the second elevator car (16) may be adjusted by the hydraulic adjustment element (32, 33) for the
30 second elevator car (16), are parallel to a direction of movement (11, 12) of the elevator car carrier (2) in which the elevator car carrier (2) may be moved through the movement space (3).

4. The elevator installation as claimed in one of claims 1 to 3,
characterized in that,

in the event of adjustment of the first elevator car (15) in relation to the elevator car carrier (2), the hydraulic adjustment element (20, 21) for the first elevator car (15) is adjusted
5 synchronously with the hydraulic adjustment element (32, 33) for the second elevator car (16) in a direction of adjustment (23, 24) of the first elevator car (15) and in a direction of adjustment (61, 62) of the second elevator car (16).

5. The elevator installation as claimed in one of claims 1 to 4,

10 characterized in that

a hydraulic connection (42) is provided between the hydraulic adjustment element (20, 21) for the first elevator car (15) and the hydraulic adjustment element (32, 33) for the second elevator car (16) and a pump (48) is arranged in the hydraulic connection (42), wherein the pump (48) for lowering the first elevator car (15) and for raising the second elevator car (16)
15 in relation to the elevator car carrier (2) conveys from the hydraulic adjustment element (21, 22) for the first elevator car (15) to the hydraulic adjustment element (20, 21) for the first elevator car (15).

6. The elevator installation as claimed in claim 5,

20 characterized in that

a blocking valve (50) is arranged in the hydraulic connection (42), wherein the pump (48) conveys from the hydraulic adjustment element (21, 22) for the first elevator car (15) to the hydraulic adjustment element (20, 21) for the first elevator car (15) by way of the open blocking valve (50).

25 7. The elevator installation as claimed in one of claims 1 to 4,

characterized in that

a hydraulic connection (42) is provided between the hydraulic adjustment element (20, 21) for the first elevator car (15) and the hydraulic adjustment element (32, 33) for the second
30 elevator car (16) and a blocking valve (50) is arranged in the hydraulic connection (42), wherein for a rest position, in which the first elevator car (15) and the second elevator car (16) are at rest in relation to the elevator car carrier (2), the blocking valve (50) blocks the hydraulic connection (42).

8. The elevator installation as claimed in one of claims 1 to 7,
characterized in that

the hydraulic adjustment element (20, 21) for the first elevator car (15) is arranged below the first elevator car (15) on a transverse support (18) of the elevator car carrier (2), and in that
5 the hydraulic adjustment element (32, 33) for the second elevator car (16) is arranged above the second elevator car (16) on a transverse support (19) of the elevator car carrier (2).

9. The elevator installation as claimed in one of claims 5 to 7,
characterized in that

10 the hydraulic adjustment element (20, 21) of the first elevator car (15) and the hydraulic adjustment element (32, 33) of the second elevator car (16) each have a lower working region (29, 30; 39, 40) and an upper region (25, 26; 35, 36) which are divided by a piston face of a piston (27, 28; 37, 38) which is guided in the respective adjustment element (20, 21; 32, 33), wherein at least the lower working region (25, 26) of the hydraulic adjustment element (20,
15 21) and the lower working region (35, 36) of the hydraulic adjustment element (32, 33) are connected by way of the hydraulic connection (42).