

Double-decker lift installation

Background of the invention

5 The invention relates to an elevator system having at least one elevator car support that can hold two or more elevator cars. The invention relates specifically to the field of elevator systems designed as so-called double-decker elevator systems.

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Prior art

JP 10-236753 A discloses a double-decker elevator. The known elevator has two cars which are arranged one
15 above the other in a car frame. The two cars can hereby move relative to each other. For this purpose, hydraulic cylinders are arranged in a counterweight frame. A traction cable which is connected at one end to the counterweight frame and at the other end to the
20 car frame is guided over a drive pulley. Moreover, a second cable in addition to the traction cable is guided over a freewheeling pulley and is connected at one end to the hydraulic cylinders and at the other end to one of the cars. When the hydraulic cylinders
25 actuate the second cable, the cars are moved relative to each other.

The double-decker elevator known from JP 10-236753 A has the disadvantage that it has a complex design. On
30 the one hand, the design of the counterweight frame is complex because the hydraulic cylinders move with the counterweight frame through the elevator shaft, which requires an additional control means. Moreover, a cable guide for the second cable is additionally needed.
35 Elongation or shortening of the traction cable and the second cable, occurring during operation, are hereby also possible, which results in undesired relative movement between the two elevator cars.

Description of the invention

The object of the invention is to provide an elevator system which has an improved structure. Specifically,
5 an object of the invention is to provide an elevator system that permits relative movement between at least two elevator cars with a relatively low degree of complexity.

10 The object is achieved by an elevator system according to the invention having the features of Claim 1.

Advantageous developments of the elevator system described in Claim 1 are possible as a result of the
15 measures explained in the subclaims.

The elevator system is thus with at least one elevator car support which displaceable in a travel space provided for the travel of the elevator car support. A
20 first elevator car is arranged on the elevator car support. At least a second elevator car is additionally arranged on the elevator car support. An adjusting device is arranged in a lower end region of the travel space, it being possible to adjust the first elevator
25 car in the lower end region of the travel space relative to the second elevator car in the direction of travel using the adjusting device.

In the design of the elevator system, the elevator car support can be arranged in an elevator shaft that
30 defines the travel space, a drive motor unit being provided which serves to actuate the elevator car support. As a result, the elevator car support can be displaced along the travel path provided. The elevator car support can hereby be suspended from a traction
35 means connected to the elevator car support. The traction means can hereby be guided in a suitable fashion over a drive pulley of the drive motor unit. As

well as having the function of transmitting the force or the torque from the drive motor unit to the elevator car support in order to actuate the elevator car support, the traction means can here also have the function of carrying the elevator car support. Actuation of the elevator car support is hereby understood in particular as raising or lowering the elevator car support, it being possible for the elevator car support to be guided by one or more guide rails.

It is advantageous that the first elevator car can be fixed with respect to the second elevator car, and that the first elevator car can be unfixed with respect to the second elevator car in the lower end region of the travel space. It is also hereby advantageous that the elevator car support comprises a first elevator car support part and a second elevator car support part, that the first elevator car is connected to the first elevator car support part, that the second elevator car is connected to the second elevator car support part, and that a connecting and locking device is provided which connects the first elevator car support part to the second elevator car support part in the closed state and disconnects them in the open state. In the closed state, the elevator car support with the two elevator cars can be displaced through the travel space, a constant distance being maintained between the elevator cars. For example, upper storeys situated one above the other can each have the same inter-storey distance. As a result, in the closed state, people can enter and leave both elevator cars on the respective storeys. A basement or a lobby may, for example, be located in the lower end region of the travel space. Disconnecting the two elevator car support parts can hereby adjust the two elevator cars relative to each other. In the open state, the first elevator car can hereby in particular be lowered and positioned. People

can then enter and leave both elevator cars according to the storey to which they have moved. The first elevator car with the first elevator car support part can then be raised again. The connecting and locking device can then reconnect the two elevator car support parts.

It is hereby also advantageous that the connecting and locking device has at least one connecting element that interacts in the closed state with a connection point of the first elevator car support, and/or with a connection point of the second elevator car support part. The connecting element can, for example, have a bar-like design and in the closed state be guided through through bores which are formed in the elevator car support parts. In order to disconnect the elevator car support parts, the connecting element can be withdrawn from the through bores so that the open state is assumed.

It is moreover advantageous that the connecting and locking device is arranged on the second elevator car support part. The adjusting device advantageously serves to adjust the first elevator car support part with the first elevator car. By arranging the connecting and locking device on the second elevator car support part, the load on the adjusting device is removed as the weight of the connecting and locking device in the open state then does not act on the first elevator car support part.

A braking and/or retaining device is advantageously provided that serves to fix the second elevator car in the travel space when the first elevator car is adjusted relative to the second elevator car. The second elevator car can, for example, hereby be fixed via the second elevator car support part. It is hereby also advantageous that the braking and/or retaining

device interacts with an elevator shaft and/or with a guide rail. The braking and/or retaining device for fixing the second elevator car in the travel space can thus interact with a building structure or the like.

5 When the two elevator cars are disconnected, only the weight of the second elevator car and possibly other components connected to the second elevator car, in particular the second elevator car support, acts on the traction means. The load on the traction means is
10 thereby removed at one end. However, the load of for example a counterweight is applied to the traction means at the other end, so that the differential force is present at the drive pulley. This means that the drive pulley must be designed accordingly, so that the
15 second elevator car is not displaced upwards through the elevator shaft. The second elevator car can, however, be fixed by the braking and/or retaining device so that a force equilibrium is achieved.

20 It is also advantageous that the adjusting device is designed as a hydraulic adjusting device. As a result, inter alia, comfortable operation is enabled which is smooth and free of vibration.

25 It is moreover advantageous that the adjusting device is arranged in a pit of an elevator shaft and/or that the adjusting device is connected to a bottom of the elevator shaft. A simple design and advantageous alignment of the adjusting device are hereby possible.

30 Specifically, compressive forces that occur can be reliably absorbed and a compressive force that acts in order to make adjustments can advantageously be transferred onto the first elevator car from the adjusting device.

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It is moreover advantageous that the first elevator car and the second elevator car have a minimum base distance in a ready-to-travel state in which the

elevator car support can be displaced through the travel space. The first elevator car can be lowered in a controlled fashion in the lower end region of the travel space, as a result of which the distance between the elevator cars increases with respect to the minimum base distance. After people have entered and left the elevator cars, the first elevator car can then be raised again until the minimum base distance between the two elevator cars has been restored.

Brief description of the drawings

Preferred exemplary embodiments of the invention are explained in more detail in the following description with the aid of the attached drawings, in which corresponding elements are provided with matching reference numerals. In the drawings:

Figure 1 shows a schematic representation of an elevator system in accordance with a first exemplary embodiment of the invention in a closed state of a connecting and locking device, and

Figure 2 shows the elevator system shown in Figure 1 in an open state of the connecting and locking device.

Preferred embodiments of the invention

Figure 1 shows an elevator system 1 having at least one elevator car support 2 that can be displaced in a travel space 3 provided for the travel of the elevator car support 2. The travel space 3 is provided in an elevator shaft 4 of a building. Several storeys 5, 6 are provided, which represent stopping points 5, 6. The storeys 5, 6 are hereby the two lowest storeys of the elevator system 1. There are usually a larger number of other storeys or stopping points above the storeys 5, 6.

In this exemplary embodiment, the elevator car support 2 has a first elevator car support part 7 and a second elevator car support part 8. The elevator car support 2 has sheaves 9, 10 which are attached to the second elevator car support part 8. A traction means 11 is guided around the sheaves 9, 10. The traction means 11 moreover runs around a drive pulley 12 of a drive motor unit 13. According to the current direction of rotation of the drive pulley 12 driven by the drive motor unit 13, the elevator car support 2 is displaced upwards or downwards through the travel space 3. The elevator car support 2 with the two elevator car support parts 7, 8 can thus travel through the travel space 3.

The elevator car support 2 holds a first elevator car 15 and a second elevator car 16. The first elevator car 15 is hereby arranged on the first elevator car support part 7 and connected to it. Moreover, the second elevator car 16 is arranged on the second elevator car support part 8 and connected to it. The first elevator car 15 has an exit level 17. The second elevator car 16 also has an exit level 18. A distance 19 is defined between the two exit levels 17, 18. In the base position shown in Figure 1, a minimum base distance between the two elevator cars 15, 16 is provided, so that the distance 19 is also minimal. The distance 19 is hereby set to the usual distance between storeys that is needed for the higher-situated storeys. The distance 19 is, however, smaller than an inter-storey distance 21 between the storeys 5, 6 which are the lowest storeys.

In order to move to the storeys 5, 6, the elevator car support 2 is moved to a lower end region 22 by corresponding actuation of the drive pulley 12 in such a way that the exit level 18 of the second elevator car 16 is positioned at the storey 6. In this position of

the elevator car support 2, shown in Figure 1, the exit level 17 of the first elevator car 15 is, however, situated above the storey 5 because the distance 19 is smaller than the inter-storey distance 21.

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When the second elevator car 16 stops at the storey 6, the first elevator car 15, which is arranged in the first elevator car support part 7, is situated in the lower end region 22 of the travel space 3. The elevator shaft 4 has a pit 23 below the second elevator car support part 8. A hydraulic adjusting element 24, which has a cylinder 25 and a piston, guided in the cylinder 25, with a piston rod 26, is arranged in the pit 23. The piston rod 26 can hereby be adjusted upwards in a direction 27 or downwards in a direction 28. In the position of the elevator car support 2 which has been shown, the piston rod 26 has been adjusted upwards in the direction 27 until a plate-like end piece 29 connected to the piston rod 26 bears against the underside 30 of the first elevator car support part 7. The plate-like end piece 29 can hereby also already be positioned in this position so that the elevator car support 2 travels as far as the plate-like end piece 29.

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The elevator system 1 has a connecting and locking device 35. The connecting and locking device 35 is arranged on the elevator car support 2. In this exemplary embodiment, the connecting and locking device 35 is arranged on the second elevator car support part 8 and connected to the second elevator car 16. Moreover, the elevator system 1 has a braking and/or retaining device 36 for the second elevator car 16. The braking and/or retaining device 36 in this exemplary embodiment is hereby connected to the second elevator car support part 8. A guide rail 37, on which the elevator car support 2 is guided in a suitable fashion, is arranged in the elevator shaft 4. Specifically,

guidance during actuation by the drive motor unit 13 is ensured thereby. Moreover, the two elevator car support parts 7, 8 can each be guided independently on the guide rail 37. Further guide rails can hereby also be provided. The braking and/or retaining device 36 interacts with the guide rail 37. The braking and/or retaining device 36 hereby ensures that the second elevator car 16, which is arranged in the second elevator car support part 8, is fixed to the guide rail 37 and thus relative to the travel space 3.

The design of the elevator system 1 is described in more detail below with reference to Figure 2.

Figure 2 shows the elevator system 1 of the exemplary embodiment, when the connecting and locking device 35 is in an open state and when the braking and/or retaining device 36 is in an activated state. In contrast, Figure 1 shows the elevator system, when the connecting and locking device 35 is in a closed state and when the braking and/or retaining device 36 is in a deactivated state.

When the first elevator car 15 is supported on the hydraulic adjusting element 24 via the first car support part 7, the braking and/or retaining device 36 is actuated. The unactuated state of the braking and/or retaining device 36 is hereby shown in Figure 1 and the actuated state in Figure 2. A pair of brake shoes of the braking and/or retaining device 36 hereby interacts with the guide rail 37, for example. As a result, the second elevator car support part 8 is fixed to the second elevator car 16 immovably in the travel space 3.

The connecting and locking device 35 has connecting elements 38, 39. In the closed state, the connecting elements 38, 39 are extended so that they connect the elevator car support parts 7, 8 together. The

connecting element 38 hereby interacts with the first elevator car support part 7 at a connection point 40, and with the second elevator car support part 8 at a connection point 41. Through bores can, for example, hereby be provided at the connection points 40, 41 in the elevator car support parts 7, 8, into which through bores the connecting element 38 engages. In a corresponding fashion, connection points 42, 43 are also provided on the elevator car support parts 7, 8 for the connecting element 39. In the closed state, the connecting element 39 interacts with the connection points 42, 43. When the braking and/or retaining device 36 is activated, the connecting and locking device 35 is switched into the open state, the connecting elements 38, 39 being retracted. The retracted state is illustrated in Figure 2. The elevator car support parts 7, 8 are disconnected as a result. The piston rod 26 with the plate-like end piece 29 then moves downwards in the direction 28. This is achieved by the controlled draining of a pressurized fluid from the cylinder 25. The first elevator car support part 7 hereby moves downwards with the first elevator car 15. The distance 19 hereby increases. When the distance 19 is the same as the inter-storey distance 21, the first elevator car support part 7 with the first elevator car 15 stops. The exit level 17 of the first elevator car 15 is now situated at the storey 5. A distance 44 between the elevator cars 15, 16 has hereby increased with respect to the minimum base distance 20.

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In the situation shown in Figure 2, people can enter and leave the two elevator cars 15, 16 from the respective storey 5, 6 to which they have moved. It is thus also possible for people to enter and leave the two elevator cars 15, 16 at the same time in the case of the inter-storey distance 21 which differs from the usual inter-storey distance of the other storeys in the elevator shaft 4.

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After people have entered and left the elevator cars 15, 16, the piston rod 26 is adjusted in the direction 27. This is achieved by feeding pressurized fluid into the cylinder 25 by means of a pump. The distance 44 hereby decreases. When the distance 44 has reached the minimum base distance 20, the connecting and locking device 35 is actuated in order to connect the two elevator car support parts 7, 8 together via the connecting elements 38, 39. The braking and/or retaining device 36 is then deactivated. The situation shown in Figure 1 then reoccurs. The whole elevator car support 2 with the two elevator cars 15, 16 can then be displaced through the travel space 3 by the drive motor unit 13. The two elevator cars 15 16 are then moved to their destination storeys. The minimum base distance 20 between the elevator cars 15, 16 is hereby predetermined in such a way that the distance 19 then corresponds again to the usual inter-storey distance. As a result, people may also enter and leave both elevator cars 15, 16 at the same time at the other storeys.

Because the connecting and locking device 35 is arranged on the second elevator car support part 8, its mass or its weight does not need to be moved or raised by the hydraulic adjusting element 24. The same applies for the braking and/or retaining device 36 attached to the second elevator car support part. As a result, the design of the hydraulic adjusting element 24 can be optimized. This also affects other components, in particular a pump. On the other hand, the hydraulic adjusting element 24 is arranged immovably in the pit 23 so that the mass of the hydraulic adjusting element 24 does not need to be moved by the drive motor unit 13.

The hydraulic adjusting element 24 is connected to a

base 45 of the pit 23. As a result, forces are transmitted advantageously, because the piston rod 26 is oriented parallel to the direction in which the weight of the first elevator car support part 7 with the first elevator car 15 acts. In this exemplary embodiment, the hydraulic adjusting element 24 forms a hydraulic adjusting device 24. Depending on the design of the elevator system 1, multiple hydraulic adjusting elements 24 can also be provided for forming the hydraulic adjusting device 24.

The two elevator cars 15, 16 can thus have a minimum base distance 20 in a ready-to-travel state in which the elevator car support 2 can move through the travel space 3. In the unlocked state, in which the elevator car support parts 7, 8 are disconnected, a distance 44 between the elevator cars 15, 16 can be achieved that is greater than the minimum base distance 20. The second elevator car 16 can hereby be fixed by the braking and retaining device 36. The first elevator car 15 can be adjusted with a high degree of efficiency. The adjustment by means of the hydraulic adjusting element 24 has minimal vibration and is very smooth. A high degree of comfort is achieved as a result.

The invention is not limited to the exemplary embodiments described.

Claims

1. Elevator system (1) having at least one elevator car support (2) which can be displaced in a travel space (3) provided for the travel of the elevator car support (2), a first elevator car (15) which is arranged on the elevator car support (2), at least a second elevator car (16) which is arranged on the elevator car support (2), and an adjusting device (24) which is arranged in a lower end region (22) of the travel space (3), it being possible to adjust the first elevator car (15) in the lower end region (22) of the travel space (3) relative to the second elevator car (16) in the direction of travel using the adjusting device (24).
2. Elevator system according to Claim 1, characterized in that the first elevator car (15) can be fixed with respect to the second elevator car (16), and in that the first elevator car (15) can be unfixed with respect to the second elevator car (16) in the lower end region (22) of the travel space (3).
3. Elevator system according to Claim 1 or 2, characterized in that the elevator car support (2) has a first elevator car support part (7) and at least a second elevator car support part (8), in that the first elevator car (15) is connected to the first elevator car support part (7), in that the second elevator car (16) is connected to the second elevator car support part (8), and in that a connecting and locking device (35) is provided which connects the first elevator car support part (7) to the second elevator car support part (8) in the closed state and disconnects them in the open state.
4. Elevator system according to Claim 3, characterized in that the connecting and locking device (35) has at least one connecting element (38, 39) that interacts in

the closed state with a connection point (40, 42) of the first elevator car support part (7) and/or with a connection point (39, 43) of the second elevator car support part (8).

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5. Elevator system according to Claim 3 or 4, characterized in that the connecting and locking device (35) is arranged on the second elevator car support part (8).

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6. Elevator system according to one of Claims 1 to 5, characterized in that a braking and/or retaining device (36) is provided that is designed to fix the second elevator car (16) in the travel space (3) when the first elevator car (15) is adjusted relative to the second elevator car (16).

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7. Elevator system according to Claim 6, characterized in that the braking and/or retaining device (36) interacts at least indirectly with an elevator shaft (4) and/or at least indirectly with at least one guide rail (37).

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8. Elevator system according to one of Claims 1 to 7, characterized in that the adjusting device (24) is designed as a hydraulic adjusting device (24).

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9. Elevator system according to one of Claims 1 to 8, characterized in that the adjusting device (24) is arranged in a pit (23) of an elevator shaft (4) and/or in that the adjusting device (24) is connected at least indirectly to a bottom of an elevator shaft (4).

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10. Elevator system according to one of Claims 1 to 9, characterized in that the first elevator car (15) and the second elevator car (16) have a minimum base distance (20) in a ready-to-travel state in which the elevator car support (2) can be displaced through the

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travel space (3).