

Lift with two lift cages disposed one above the other in a lift shaft

The invention relates to a lift with at least two lift cages which are disposed one above the other and are vertically movable in a shaft. This invention is defined in the introductory part of the independent patent claim.

A lift consists of at least one lift cage which is vertically movable in a shaft and receives passengers in order to move these to a desired storey of a building. In order to be able to exercise this task the lift usually has at least one of the following lift components: a drive, deflecting rollers, traction elements, a counterweight and a respective pair of rails for guidance of a lift cage and a counterweight.

In that case the drive produces the power required for transport of the passengers present in the lift cage. An electric motor usually looks after this function. This directly or indirectly drives a drive pulley disposed in friction contact with a traction element. The traction element can be a belt or a cable. It serves for suspending as well as conveying a lift cage and a counterweight, which are both suspended in such a manner that the gravitational forces thereof act in opposite direction along the traction element. The resulting gravitational force which has to be overcome by the drive correspondingly substantially reduces. In addition, due to the greater contact force of the traction element with the drive pulley a greater drive moment can be transmitted from the drive pulley to the traction element. The traction element is guided by deflecting rollers.

Optimum utilisation of the shaft volume has ever increasing significance in lift construction. Particularly in high-rise buildings with a high degree of utilisation of the building the most efficient possible management of the passenger traffic for a given shaft volume is to be sought. This objective can be achieved firstly by an optimum space-saving arrangement of the lift components, which creates room for larger lift cages, and secondly by lift concepts which enable vertical movement of several independent lift cages in one shaft.

A lift with at least two lift cages disposed one above the other in the same shaft is known from EP 1 489 033. Each lift cage has an own drive and an own counterweight. The drives are arranged near first and second shaft walls and the counterweights are also suspended near first or second shaft walls in each instance below the associated drive at driving or holding cables. The axes of the drive pulleys of the drives are perpendicular to

first and second shaft walls. The two independently movable lift cages guarantee a high transport performance. The positioning of the drives in the shaft near first or second walls makes a separate engine room redundant and enables a space-saving compact arrangement of the drive elements in the shaft head.

The object of the present invention is to further improve the arrangement of lift components for the vertical movement of several lift cages in a lift shaft.

The above-mentioned objective is fulfilled by the invention in accordance with the definition of the independent patent claim.

The lift according to the invention has at least two lift cages, which are disposed one above the other, in a shaft, which cages are vertically movable and each have an own drive, an own counterweight and an own traction means, wherein these drives are fixed in the region of the shaft head in such a manner that one drive is fixed to a first shaft wall and a further drive is fixed to an opposite second shaft wall and each has at least one drive pulley. At least one first deflecting pulley is associated with one drive and is positioned on a second or first shaft wall, which is opposite this drive, above the counterweight associated with this drive. The traction means is led from the counterweight over the deflecting roller to the drive pulley and from there to the lift cage. Advantageously a first deflecting roller is associated with each of the two drives.

The advantage of the lift according to the invention resides in the space-saving arrangement of the drives in the shaft head near first and second shaft walls. In addition, the traction means is, in the change of the sides in the shaft head above the lift cage, led in space-saving manner from the first shaft side to the second shaft side between drive and first deflecting roller in an otherwise unutilised space. Finally, the counterweight can be suspended in simple manner below the first deflecting roller.

Advantageously, a traction means is so guided by the drive pulley and the first deflecting roller above the lift cage that the traction means forms an acute angle with third and fourth shaft walls. This angle is as a rule not greater than 20°. Advantageously, the lift cage is guided by cage guide rails and the counterweight is positionable between cage guide rails and third and fourth shaft walls.

The advantage of this embodiment of the invention resides in the space-saving arrangement of the counterweights in the shaft between the cage guide rails and third and fourth shaft walls.

Advantageously at least one lift cage is suspended in block-and-tackle manner. The lift cage is in that case suspended in block-and-tackle manner at second and third deflecting rollers. The traction means is led between the drive pulley and a first fixing point via second and third deflecting rollers. The lift cage is usually suspended in upper or lower block-and-tackle manner. The traction means is, for example, led in lower block-and-tackle manner from the drive pulley laterally of the lift cage downwardly to the second deflecting roller. From the second deflecting roller the traction means is then led below the lift cage through to the third deflecting roller and from there further laterally of the lift cage upwardly to a first fixing point of the traction means. The arrangement of the second and third deflecting rollers is carried out analogously in the case of an upper block-and-tackle suspension with corresponding guidance of the traction means. The traction means is led from the drive pulley along first or second shaft walls to the second deflecting roller. From there the traction means is led above the lift cage to the third deflecting roller and finally along second or first shaft walls to the first fixing point.

The advantage of this embodiment of the invention is that thanks to the suspension of the lift cage in block-and-tackle manner smaller traction moments are sufficient for operation of the lift and correspondingly smaller and more economical drives are usable. If further advantage resides in the space-saving change of side of the traction means between first and second shaft walls from the drive pulley to the first fixing point via a second and third deflecting roller in an otherwise unutilised space laterally of and below the lift cage.

Advantageously the lift has fourth deflecting rollers at which the counterweight is suspended in block-and-tackle manner. The traction means is in that case led from the first deflecting roller downwardly to the fourth deflecting roller and from there back up to a second fixing point of the traction means.

The advantage of this embodiment of the invention is that thanks to the suspension of the counterweight in block-and-tackle manner smaller traction moments are sufficient for operation of the lift and correspondingly smaller and more economical drives are usable.

Advantageously the fixing points associated with a traction means lie on the same side of the associated lift cage.

The advantage of this embodiment of the invention resides in the simpler mounting of the fixing points of the traction means. Already just the physical proximity of the two fixing points of the traction means facilitates mounting of the same for the engineer. In addition, thanks to the integration of the two fixing points in one component the number of individual parts of the lift can be reduced.

Advantageously the traction means is a belt, which is guided by the drive pulley and at least first, second, third and fourth deflecting rollers and is disposed in contact with the drive pulley and deflecting rollers at only one side of the belt, and the belt is guided between the drive pulley, the deflecting rollers and its fixing points to be substantially free of twisting.

The advantage of this embodiment is the simple use of belts with a surface structured at one side, such as ribs, teeth or wedges. Since the guidance of the traction means takes place substantially free of twisting, guidance of the belt in the same sense by the drive pulley and the deflecting rollers is possible. Engagement of the structuring at one side in the drive pulleys and the deflecting rollers is thereby possible without twisting of the belt about its longitudinal axis. The belt has two dimensions transversely to the traction direction, i.e. a first dimension with a relatively wide extent and a second dimension with a relatively narrow extent. This means that the belt occupies substantially more space in the lift shaft transversely to its traction direction in its first dimension than in its second dimension. In the case of twist-free guidance of the belt in the same sense the belt occupies minimum space in the shaft area, since the first wide dimension of the belt is parallel to first or second shaft walls and only the short second dimension is disposed in the shaft area perpendicularly to the first or second shaft walls. For that reason this arrangement of the lift with a twist-free guidance of the belt is particularly space-saving. Moreover, the belts, with a substantially twist-free guidance, are exposed to lower friction forces and transverse forces and have a longer service life. The lift is thereby also more maintenance-friendly.

Advantageously the drives are disposed in the region of the shaft head. In that case the drives are fastened at different levels so that the guidance of the traction means above the

lift cage between a drive pulley and an associated first deflecting roller takes place free of conflict. A first drive and its associated first deflecting roller are then fastened at a first level and a second drive and its associated first deflecting roller at a second level disposed above or below the first level. Correspondingly, the traction means of a first and second lift cage are guided at two different levels.

The advantage of this embodiment of the invention resides in the space-saving arrangement of the drives and associated first deflecting rollers. Moreover, a conflict-free, i.e. contact-free, guidance of the traction means above the lift cage is guaranteed.

Advantageously the drives are disposed in the region of the shaft head, wherein the drives are fastened at the same level.

The advantage of this embodiment of the invention resides in the space-saving arrangement of the drives and associated first deflecting rollers adjacent to one another in the shaft head, whereby a minimum amount of shaft head height is obstructed. Moreover, a conflict-free, i.e. contact-free, guidance of the traction means above the lift cage is guaranteed.

Advantageously, first and second drives are fixed on a common beam. Alternatively, each of the drives is fixed on a respective beam.

The advantage of this embodiment of the invention resides in the simple, flexible and space-saving arrangement of the drives in the shaft head.

Advantageously the lift has shaft doors and cage doors, wherein the shaft doors consist of two sliding elements and the cage doors of more than two sliding elements.

The advantage of this embodiment of the invention is that sufficient space is created in order to position the counterweight of a lift cage in the vicinity of first or second shaft walls between the guide rails of the lift cage and third or fourth shaft walls.

The co-operation of the above-described elements of the invention, the positioning of the at least two drives, the deflecting rollers and the counterweights and the substantially twist-free guidance of the traction means resulting therefrom, particularly in the case of belts,

gives a compact space-saving and nevertheless very flexible arrangement of the lift components in the lift shaft.

The invention is clarified and described in more detail in the following by examples of embodiment and drawings, in which:

Fig. 1 shows a side view of an arrangement according to the invention of a lift with two lift cages, two drives, two drive pulleys, two traction means and several deflecting rollers;

Fig. 2 shows a plan view of an arrangement according to the invention of a lift with two lift cages, two drives, two drive pulleys, two traction means and several deflecting rollers;

Fig. 3 shows a schematic plan view of an arrangement according to the invention of a lift with two lift cages, two drives, which are positioned in front of the cage guide rails, two drive pulleys, two traction means, several deflecting rollers, two counterweights, two counterweight guide rails, a four-part cage door and a door at the shaft side;

Fig. 4 shows a schematic plan view of an arrangement according to the invention of a lift with two lift cages, two drives, which are positioned each in front of and behind the cage guide rails, two drive pulleys, two traction means, several deflecting rollers, two counterweights, two counterweight guide rails, a four-part cage door and a door at the shaft side;

Fig. 5 shows a schematic side view of an arrangement according to the invention of a lift with two lift cages, which are each suspended as a lower block-and-tackle or upper block-and-tackle, two drives, two drive pulleys, two traction means, several deflecting rollers, two counterweights and two counterweight guide rails;

Fig. 6 shows a schematic side view of an arrangement according to the invention of a lift with two lift cages, which are each suspended as an upper block-and-tackle, two drives, two drive pulleys, two traction means, several deflecting rollers, two counterweights and two counterweight guide rails;

Fig. 7 shows a schematic side view of an arrangement according to the invention of a lift with two lift cages, which are suspended at the top 1:1 and at the bottom as a lower block-and-tackle, two drives, two drive pulleys, two traction means, several deflecting rollers, two counterweights and two counterweight guide rails; and

Fig. 8 shows a schematic side view of an arrangement according to the invention of a lift with two lift cages, which are suspended at the top 1:1 and at the bottom as a lower block-and-tackle, two drives, two drive pulleys, two traction means, several deflecting rollers, two counterweights and two counterweight guide rails.

Figures 1 and 2 show a lift for at least two lift cages which each have an own drive A1, A2 and are movable independently of one another in vertical direction. The drives A1, A2 are positioned in the shaft head above the lift cages in the vicinity of first and second shaft walls. The first and second shaft walls are those mutually opposite shaft walls not having shaft doors. In that case the drives A1, A2 are disposed at two different levels so that the two traction means Z1, Z2, at which the lift cages A1, A2 are suspended, are free of conflict and can be guided without mutual contact.

With knowledge of the invention numerous possibilities of fixing the drives A1, A2 in the shaft are open to the expert. The expert can also arrange the two drives A1, A2 at the same level. This variant is not shown purely for reasons of space, since a side view of the drives A1, A2, which then lie one behind the other, has restricted significance. However, the plan view of Figure 4 shows an arrangement of the drives A1, A2 which enables not only the already mentioned fixing of the drives A1, A2 at different levels, but also a fixing of the drives at the same level. This arrangement is primarily of advantage when the space conditions in the shaft head are particularly tight. Moreover, a conflict-free guidance of the traction means Z1, Z2 is also guaranteed in this variant.

Advantageously the drives A1, A2 are each mounted on a respective beam, whereby substantial freedoms in the orientation of the drives A1, A2 are given. In a further advantageous variant the drives A1, A2 are mounted at the same beam, namely an upper drive A1 on the upper side of the beam and a lower drive A2 on the lower side of the beam. This arrangement of the drives A1, A2 is very compact and has the advantage of obstructing as little space as possible in the shaft head.

The drive A1, A2 forms, together with a drive pulley 1a, 1b for driving the traction means Z1, Z2, a drive module. The drive pulley 1a, 1b is so designed that it is suitable for receiving single or several traction means Z1, Z2. The traction means Z1, Z2 are preferably belts such as wedge-ribbed belts with ribs, which engage in one or more depressions at the drive pulley side, at one side. Belt variants such as smooth belts and belts toothed at one side or both sides, with corresponding drive pulleys 2a, 2b equally usable. In addition, different kinds of cables, such as single cables, double cables or multiple cables, are usable. The traction means have strands of steel wire or aramide fibres.

The traction means Z1, Z2 is configured in Figure 1 as a block-and-tackle, wherein not only at least one lift cage, but also at least one counterweight are suspended in block-and-tackle manner. The traction means Z1, Z2 is so led from a first fixing point 13a, 13b to a second fixing point 14a, 14b that it is guided in substantially twist-free manner by several deflecting rollers 2a, 2b, 3a, 3b, 4a, 4b, 5a, 5b as well as the drive pulley 1a, 1b.

The traction means Z1, Z2 is in that case so led from a first fixing point 13a, 13b to the first deflecting roller 2a, 2b that the respective counterweight associated with each lift cage is suspended at the rollers 3a, 3b in block-and-tackle manner. The traction means Z1, Z2 thus extends from the first fixing point 13a, 13b along a first or second shaft wall downwardly to the roller 3a, 3b, loops around this from inside to outside at an angle of approximately 180° and leads further along a first or second shaft wall upwardly to the first deflecting roller 2a, 2b. This first deflecting roller 2a, 2b lies opposite the associated drive pulley 1a, 1b in the vicinity of second or first shaft walls. In the present form of embodiment the first deflecting roller 2a, 2b is a component of a deflecting module which is connected with the drive module by way of rigid bar-shaped rods and forms a subassembly therewith. The advantage of this form of embodiment resides in the reduction in the number of components and the simple assembly connected therewith. In addition, the driving and deflecting modules can be displaced longitudinally of the connecting rods so that a flexible length adaptation of the subassembly to the actual dimensions of the shaft is possible. A further advantage resides in the modular construction of the subassembly, which permits favourable maintenance or replacement thereof.

From the first deflecting roller 2a, 2b the traction means Z1, Z2 is now led to the drive pulley 1a, 1b along the shaft roof and loops around this drive pulley 1a, 1b from the inside to the outside in a looping angle of 90 to 180°. In the further course, the traction means Z1, Z2 produces below the drive pulley 1a, 1b, together with second deflecting rollers 4a, 4b and third deflecting rollers 5a, 5b, a block-and-tackle suspension of the lift cage in that the traction means Z1, Z2 is led from the drive pulley 1a, 1b along first or second shaft walls downwardly to second deflecting rollers 4a, 4b. The traction means Z1, Z2 loops around the deflecting roller 4a, 4b from the outside to the inside at a looping angle of approximately 90° and thereafter leads horizontally to the third deflecting roller 5a, 5b. Finally, the traction means Z1, Z2 after looping around the third deflecting roller 5a, 5b from inside to outside at a looping angle of approximately 90° passes upwardly along first or second shaft walls to the second affixing point 14a, 14b.

An adjusting pulley 6a, 6b is an optional component of the drive module. With this adjusting pulley 6a, 6b the looping angle of the traction means at the drive pulley 1a, 1b can be adjusted or increased or reduced in order to transmit the desired traction forces from the drive pulley 1a, 1b to the traction means A1, A2.

It is apparent from Figures 2 to 4 that the two axes, formed from the drives A1, A2 and the deflecting rollers 2a, 2b, are disposed at an acute angle to third and fourth shaft walls. The third and fourth shaft walls are those mutually opposite walls in the shaft which have at least one shaft door 8. It is thus achieved that the associated counterweights 12a, 12b, which are suspended at the first fixing point 13a, 13b and the first deflecting roller 2a, 2b in block-and-tackle manner, are positioned between the cage guide rails 10 of the lift cages 7a, 7b as well as third and fourth shaft walls. The advantage of such an arrangement of the drive A1, A2 and the deflecting roller 2a, 2b resides in the space-saving and simple positioning of the counterweights 12a, 12b. The counterweights 12a, 12b are in that case guided by counterweight guide rails 11a, 11b.

Moreover, the axis, formed by the two deflecting rollers 5a, 5b and 4a, 4b, at which the lift cage 7a, 7b is suspended lies near the cage guide rails 10. Moments which are transmitted by the suspension forces from the traction means Z1, Z2 via the lift cages 7a, 7b to the cage guide rails 10 are thereby kept small.

Figures 3 and 4 show two variants of the previously described form of embodiment of the

invention. In that case the suspension axes, formed from the deflecting rollers 4a, 4b and 5a, 5b, at which the lift cages 7a, 7b are suspended lie either both in front of the cage guide rails 10 or one in front of and one behind the cage guide rails 10. The expert may, depending on the respective space conditions in the shaft, prefer one or other solution, wherein the first-mentioned symmetrical suspension is advantageous with respect to the moment exerted by the lift cages 7a, 7b on the cage guide rails 10. The spacing from the suspension axis of the lift cages 7a, 7b from the cage guide rails 10 is kept to a minimum and thus reduces the moment, while in addition the two mutually oppositely acting moments are partly or entirely cancelled. With knowledge of the above teaching further variants (not shown) are available such as, for example, the position of the two suspension axes behind the cage guide rails.

The spacing-saving positioning of at least one counterweight 12a, 12b between the cage guide rails 10 and a third or fourth shaft wall can be realised thanks to a special arrangement of the cage door 9. In normal operation of the lift the lift cages 7a, 7b are, at a storey stop, flush with the storey and the cage doors 9 are opened together with the shaft doors 8 so as to enable transfer of passengers from the storey to the lift cages 7a, 7b. On opening of the cage doors 9 the sliding elements thereof protrude into the shaft space and occupy to a certain extent an otherwise unusable shaft space. If the cage door 9 does not consist, as usual, of two sliding elements, but of at least four sliding elements which are telescopically retractable and extensible, less shaft space is occupied during the opening process of the cage doors 9. Thanks to the shorter sliding elements these sliding elements project, when the cage door 9 is open, less far into the shaft room and thus keep more space free for the counterweights 12a, 12b or other objects in the shaft, such as electric installations, sensors, safety equipment or terminal boxes.

The expert has available, in accordance with invention, various possibilities for suspending the lift cages 7a, 7b. A suspension variant is optimum depending on the respective space availability in the shaft head, shaft pit or between storeys.

Figures 5 and 6 show an arrangement with two lift cages 7a, 7b suspended in block-and-tackle manner. In Figure 5 the upper lift cage 7a is suspended as upper block-and-tackle and lift cage 7b as lower block-and-tackle. This suspension variant is primarily advantageous when a minimum approach between the lift cages is desired, if, for example, the storey spacings are small. According to Figure 6 the two lift cages 7a, 7b are

suspended as upper block-and-tackles. This variant is of advantage when the space conditions in the shaft pit are tight. In addition, in both examples the upper lift cage 7a with upper block-and-tackle cannot be forced by the traction means Z1, Z2 into the shaft head.

Figures 7 and 8 show a suspension with a 1:1 suspension of the upper lift cage 7a. The lower lift cage 7b is, according to the invention, suspended in block-and-tackle manner. Depending on the respective space conditions in the lift shaft the lower lift cage 7b can be suspended as an upper block-and-tackle or a lower block-and-tackle.

Claims

1. Lift with at least two lift cages (7a, 7b) which are disposed one above the other, in a shaft, which cages are vertically movable and each have an own drive (A1, A2), an own counterweight (12a, 12b) and an own traction means (Z1, Z2), wherein these drives (A1, A2) are fixed in the region of the shaft head in such a manner that one drive (A1) is fixed at a first shaft wall and a further drive (A2) is fixed an opposite second shaft wall and each have at least one drive pulley (1a, 1b), characterised in that at least one first deflecting roller (2a, 2b) is associated with one drive (A1, A2) and is positioned on a second or first shaft wall, which is opposite this drive (A1, A2), above the counterweight (12a, 12b) associated with this drive (A1, A2), and that the traction means (Z1, Z2) is led from the counterweight (12a, 12b) over the deflecting roller (2a, 2b) to the drive pulley (1a, 1b) and from there to the lift cage (7a, 7b).
2. Lift according to claim 1, characterised in that a respective first deflecting roller (2a, 2b) is associated with each of the two drives (A1, A2).
3. Lift according to any one of the preceding claims, characterised in that at least one traction means (Z1, Z2) is so guided by the drive pulley (1a, 1b) and the first deflecting roller (2a, 2b) above the lift cage (7a, 7b) that the traction means (Z1, Z2) forms an acute angle with third and fourth shaft walls.
4. Lift according to claim 3, characterised in that the angle is at most 20°.
5. Lift according to any one of the preceding claims, characterised in that the lift cage (7a, 7b) is guided by cage guide rails (10) and that the counterweight (12a, 12b) is positionable between cage guide rails (10) and third and fourth shaft walls.
6. Lift according to any one of the preceding claims, characterised in that a first lift cage (7a, 7b) is suspended in block-and-tackle manner.
7. Lift according to claim 6, characterised in that the lift cage (7a, 7b) is suspended in block-and-tackle manner at second deflecting rollers (4a, 4b) and third deflecting rollers (5a, 5b) and that the traction means (Z1, Z2) is led between the drive pulley (1a, 1b) and a first fixing point (13a, 13b) via second deflecting rollers (4a, 4b) and third deflecting rollers

(5a, 5b).

8. Lift according to any one of the preceding claims, characterised in that the counterweight (10) is suspended in block-and-tackle manner at a fourth deflecting roller (3a, 3b), wherein the traction means (Z1, Z2) is led from the first deflecting roller (2a, 2b) downwardly to the fourth deflecting roller (3a, 3b) and from there back up to a second fixing point (14a, 14b) of the traction means (Z1, Z2).

9. Lift according to any one of the preceding claims, characterised in that the associated fixing points (13a, 13, 14a, 14b) of a traction means (Z1, Z2) lie on the same side of the lift cage (7a, 7b).

10. Lift according to any one of the preceding claims, characterised in that the traction means (Z1, Z2) consist of at least one cable or double cable.

11. Lift according to any one of claims 1 to 9, characterised in that the traction means (Z1, Z2) is a belt.

12. Lift according to claim 11, characterised in that the traction means (Z1, Z2) is a belt structured at one side.

13. Lift according to claim 11 or 12, characterised in that the traction means (Z1, Z2) is a cogged belt, ribbed belt or V-belt.

14. Lift according to any one of the preceding claims, characterised in that the belt is guided by the drive pulley (1a, 1b) and at least first deflecting rollers (2a, 2b), second deflecting rollers (4a, 4b), third deflecting rollers (5a, 5b) and fourth deflecting rollers (3a, 3b), and is disposed in contact with the drive pulley (1a, 1b) and deflecting rollers (2a, 2b, 3a, 3b, 4a, 4b, 5a, 5b) only at one side of the belt and that the belt is guided between the drive pulley (1a, 1b), the deflecting rollers (2a, 2b, 3a, 3b, 4a, 4b, 5a, 5b) and its fixing points (13a, 13b, 14a, 14b) to be substantially free of twisting.

15. Lift according to any one of the preceding claims, characterised in that the drives (A1, A2) are disposed in the region of the shaft head, wherein the drives (A1, A2) are fastened at different levels.

16. Lift according to any one of the preceding claims, characterised in that the drives (A1, A2) are located in the region of the shaft head, wherein the drives (A1, A2) are fastened at the same level.
17. Lift according to any one of the preceding claims, characterised in that the drives (A1, A2) are positioned on the same beam.
18. Lift according to any one of the preceding claims, characterised in that the drives (A1, A2) are each positioned on a respective beam.
19. Lift according to any one of the preceding claims, characterised in that the lift has shaft doors (8) and a cage door (9), wherein the shaft doors (8) consist of two sliding elements and the cage door (9) consists of more than two sliding elements.
20. Lift according to any one of the preceding claims, characterised in that the lift cages (7a, 7b) are guided by cage guide rails (10), wherein the two drive modules and the two associated deflecting modules each lie on a respective side of the connecting line of the cage guide rails (10).
21. Lift according to any one of the preceding claims, characterised in that the lift cages (7a, 7b) are guided by cage guide rails (10), wherein the two drive modules and the two associated deflecting modules each lie on the same side of the connecting line of the cage guide rails (10).