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(54) **Elevator with pulley assembly**  
Aufzug mit Scheibenkonstruktion  
Ascenseur avec un ensemble de poulies

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**EP-A- 0 375 208 EP-A- 0 631 967**  
**WO-A-99/33743 JP-A- 2001 122 564**

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## Description

**[0001]** The present invention relates to an elevator as defined in the preamble of claim 1.

**[0002]** A widely used elevator suspension solution is to suspend the elevator car and counterweight on the hoisting ropes by means of a diverting pulley or diverting pulleys because in this way the elevator hoisting machine can be designed according to a lower torque requirement than if the elevator car and counterweight were suspended without such suspending diverting pulleys. Especially the suspension of the elevator car is often implemented by using a pair of diverting pulleys to guide a large rope loop or a rope loop passed under the elevator car so that it comprises a rope portion between the diverting pulleys which in most cases is substantially horizontal and that the ropes go upwards from the diverting pulleys. This type of solutions are known e.g. from specifications EP 0 631 967 and EP 0 749 931. It is also possible to develop solutions in which the ropes have to be passed downwards from the pair of diverting pulleys. The ropes in the rope portion between the pulleys of the pair of diverting pulleys should meet the diverting pulleys substantially in alignment with the rope grooves provided in these pulleys, because even a very small angle between the direction of the rope groove of the diverting pulley and the rope running in the rope groove causes a significantly increased wear of the rope groove and/or the rope. Especially in elevators having small diverting pulleys, aligning the diverting pulleys in a given exact orientation is a demanding task.

**[0003]** Document WO 99/33743 shows the connection between two pulleys of a pair of pulleys being in the form of a rectangular bar which aims an alignment between the pulleys.

**[0004]** An object of the invention is to provide an economical and both structurally and functionally simple method of aligning the ropes of a rope portion between the diverting pulleys of a pair of diverting pulleys mounted on an elevator car or counterweight and the rope grooves of the pair of rope pulleys with each other. Another object is to position mutually corresponding rope grooves of the pair of diverting pulleys in the same plane of rotation. A further object of the invention is to enable an aligned positioning of the pulleys forming the pair of diverting pulleys mounted on the elevator car and/or counterweight. Yet another object of the invention is to provide a method of positioning the rope pulleys to be mounted on the elevator car and/or counterweight and engaged by the same hoisting rope loop with respect to each other and preferably also with respect to the elevator car or counterweight so that they can be fixed to the elevator car or respectively the counterweight. An object of the invention is to develop the elevator without machine room so as to allow more efficient space utilization in the building and elevator shaft while at the same time facilitating installation and maintenance. It is also an object to increase the reliability of alignment of the diverting pulleys and to enable the use

of simpler fastening structures for mounting the diverting pulleys, especially in elevator solutions that use diverting pulleys having a clearly smaller diameter than those conventionally used at present.

**[0005]** As for the features of the invention, we refer especially to the claims. The elevator of the invention is characterized by what is disclosed in the characterization part of claim 1. Other embodiments of the invention are characterized by what is disclosed in the other claims.

**[0006]** The elevator of the invention comprises a set of hoisting ropes and an elevator car suspended by the hoisting ropes. Especially in the case of traction sheave elevators, it is advantageous to use a counterweight. The suspension of the elevator car and/or counterweight on the hoisting ropes has been implemented using a pair of rope pulleys. Each one of the rope pulleys forming the pair of rope pulleys is separately rotatably mounted with bearings on its mounting frame, which may be a box, a shaft support or extension or other frame part supporting the pulley on a fixing point or fixing support on the elevator car or counterweight, which may be e.g. a car or counterweight frame supporting the elevator car or counterweight, or some other suitable fixing point in these. Elevator cars without counterweight, especially light-weight elevator cars, often have reinforced parts for distributing the loads, and a mounting support can be easily formed in such a reinforced part. The mounting frame is secured to the car using screws, bolts and nuts, rivets, glue or by some other method. For example, in bolt and nut mounting, it is often necessary to provide suitable holes for the bolts in a suitable part of the mounting frame. The mounting frame sets the mutual orientation of the plane of rotation of the rope pulley and the fixing part of an aligning means provided in the frame so that when two rope pulleys are connected as a pair by means of one aligning means, the planes of rotation of both rope pulleys coincide with a sufficient accuracy, which in practice means that the direction of the ropes of the rope portion between the pulleys forming the pair of rope pulleys differs very little from the plane of rotation of the rope pulley as the ropes meet the rope groove of the rope pulley. A very slight difference like this is clearly under one degree. By applying the invention, it is easy to achieve a positioning of rope pulleys with a difference or at most 1/7 degree or even less than 1/10 degree. When a round bar or tube is used as an aligning means, the connection can be implemented using a sleeve provided in the mounting frame. The sleeve and the round bar or tube to be placed in it can be quite easily so fitted that the tolerance between them ensures accurate alignment and the sleeve can be placed accurately in position in the mounting frame.

**[0007]** By applying the invention, it is possible to achieve one or more the following advantages, among others:

- reliable alignment of the diverting pulleys reduces the threshold for the use of diverting pulleys of a small diameter, allowing a more compact elevator to be

- more easily achieved,
- the alignment and mounting of the diverting pulleys on the elevator car and/or counterweight is facilitated and elevator installation times and total installation costs are reduced,
- the mounting of the diverting pulleys on the elevator car or counterweight can be made simpler because mutual alignment of the diverting pulleys is ensured separately.

**[0008]** In the following, the invention will be described in detail with reference to a few embodiment examples, which do not constitute a limitation of the invention, referring to the attached drawings, wherein

Fig. 1 presents a diagram representing an elevator according to the invention, and

Fig. 2 presents a diagram representing a diverting pulley used according to the invention.

**[0009]** Fig. 1 presents an elevator structure applying the invention. The elevator is preferably an elevator without machine room, with the drive machine 6 placed in the elevator shaft. The elevator presented here is a traction sheave elevator with machine above. The passage of the hoisting ropes 3 is as follows: One end of the ropes is immovably secured to fixing point 13 in the upper part of the shaft above the path of a counterweight 2 moving along counterweight guide rails 11, said fixing point being supported e.g. by a wall or the ceiling of the elevator shaft or by at least one guide rail, from which fixing point the ropes go downwards and meet diverting pulleys 9 provided with rope grooves and used to suspend the counterweight, which diverting pulleys are rotatably mounted on the counterweight 2 and from which the ropes 3 go further upwards to the traction sheave 7 of the drive machine 6, passing over it along the rope grooves of the traction sheave. The diverting pulleys are interconnected by an aligning bar 20. From the traction sheave 7, the ropes 3 go further downwards to the elevator car 1 moving along car guide rails 10, passing under it via diverting pulleys 4 having rope grooves and used to suspend the elevator car on the hoisting ropes. From the elevator car, the ropes go further upwards to a fixing point 14 in the upper part of the shaft, where the second end of the ropes 3 is immovably secured. Of the diverting pulleys 4, only one is visible. The diverting pulleys of the pair of diverting pulleys suspending the elevator car are interconnected by an aligning bar 21. The fixing point 13 in the upper part of the shaft, the traction sheave 7 and the diverting pulley 9 suspending the counterweight on the ropes are preferably so disposed with respect to each other that both the rope portion going from fixing point 13 to the counterweight 2 and the rope portion going from the counterweight 2 to the traction sheave 7 are aligned substantially in the direction of the path of the counterweight 2. Another preferred solution is one in which the fixing point 14 in the upper part of the shaft, the traction sheave

7 and the diverting pulleys 4 suspending the elevator car on the ropes are so disposed with respect to each other that both the rope portion going from the fixing point 14 to the elevator car and the rope portion going from the elevator car 1 to the traction sheave 7 are substantially in alignment with the path of movement of the elevator car 1. In this case, no auxiliary diverting pulleys are needed to guide the passage of the ropes in the shaft. The effect of the rope suspension on the elevator car 1 is substantially centric as far as the diverting pulleys 4 suspending the elevator car are disposed substantially symmetrically with respect to the vertical center line passing through the mass center of the elevator car 1.

**[0010]** The drive machine 6 preferably placed in the elevator shaft is of a flat construction, in other words, it has a small thickness in relation to its width and/or height, or it is at least slim so that it can be accommodated between the elevator car and a wall of the elevator shaft. There are also other possibilities regarding the placement of the machine. It can be placed e.g. so that the slim machine is partly or completely between an imaginary extension of the elevator car and a shaft wall. Equipment needed for the supply of power to the motor driving the traction sheave 7 as well as equipment needed for the control of the elevator can advantageously be placed in the elevator shaft, as such equipment can be mounted in a common instrument panel 8, or they can be placed separately from each other or integrated partly or completely with the drive machine 6. The drive machine may be of geared or gearless type. A preferable solution is a gearless machine comprising a motor provided with permanent magnets. The drive machine can be secured in place to a wall or the ceiling of the elevator shaft, to a guide rail or guide rails or to some other structure, such as a beam or frame. If the elevator were to be implemented as an elevator with machine below, then another possibility would be to mount the machine on the floor of the elevator shaft. Fig. 1 represents a preferable 2:1 suspension arrangement, but the invention can also be implemented in the case of an elevator having a higher suspension ratio of the elevator car and/or counterweight, e.g. 4:1. The invention can also be applied in elevators without counterweight. The mutual alignment of two counterweight diverting pulleys 9 or two car diverting pulleys 9 implemented using aligning bars 20, 21 or other types of similarly functioning aligning means does not bear the supporting forces required when the diverting pulleys are secured to the counterweight or car but only align the diverting pulleys with each other.

**[0011]** Fig. 2 presents a rope pulley 4 or 9 belonging to the pair of rope pulleys on the elevator car or counterweight, with the ropes of the set of hoisting ropes 3 running in the rope grooves of the rope pulley. The rope pulley is rotatably mounted with bearings on a box-shaped mounting frame 23 of the rope pulley. The mounting frame has a first connecting part 24 for attachment to a mounting support provided in the elevator car or counterweight and a second connecting part 25 for at-

tachment to a separate aligning means 20 or 21 connecting the two rope pulleys of a pair of rope pulleys. The position and direction of the second connecting part 25, namely a sleeve, set the middle plane of the rope pulley to the middle plane of the aligning means 20, 21, being a tube, so the alignment takes place in the same way at both ends. With the help of a mark provided on the tube and the sleeve or by other means, the mounting frames at either end of the tube can be oriented in the same direction with respect to the axis of the tube.

**[0012]** It is obvious to the person skilled in the art that different embodiments of the invention are not limited to the examples described above, but that they may be varied within the scope of the claims presented below. In this application, different embodiments do not exclude each other, but different features of the embodiments can be used in other embodiments where appropriate. Inventive content may also be present in the goal setting or in sub-objectives as well as in the problem having led to the invention or likewise in the sub-problems described. Both matter of a nature relating to objectives and matter of a nature relating to problems may have been presented explicitly or it appears implicitly from the context.

## Claims

1. An elevator comprising a set of hoisting ropes (3), an elevator car (1) suspended by the set of hoisting ropes and possibly a counterweight (2) suspended by the set of hoisting ropes, in which elevator the hoisting ropes are received by a pair of rope pulleys provided on the elevator car and/or counterweight, which hoisting ropes have been arranged to pass via the rope pulleys of the said pair of rope pulleys so that they run from a first rope pulley of the pair of rope pulleys to a second rope pulley of the pair of rope pulleys, and in which elevator the rope pulleys are rotatably mounted with bearings on a mounting frame (23) of the aforesaid rope pulley, the said mounting frame comprising at least one first connecting part (24), by means of which the rope pulley is secured to a mounting support on the elevator car or counterweight, **characterized in that** the mounting frame (23) of each rope pulley in the pair of rope pulleys is provided with at least one second connecting part (25) as a sleeve provided in the mounting frame and that the second connecting part has been arranged to be connected with accurate alignment to an aligning means (20,21) being in the form of a round bar or tube and being separate from the mounting support.
2. An elevator according to claim 1, **characterized in that** the aligning means (20,21) is a part of the elevator car or counterweight.

3. An elevator according to claim 1, **characterized in that** the aligning means (20,21) is a part separate from the elevator car and counterweight.

4. An elevator according to any one of the preceding claims, **characterized in that** the aligning means (20,21) and the sleeve (25) are connected together by a form fit.

## Patentansprüche

1. Aufzug aufweisend einen Satz Hebeseile (3), eine Aufzugskabine (1), die durch den Satz Hebeseile aufgehängt ist, und möglicherweise ein Gegengewicht (2), das durch den Satz Hebeseile aufgehängt ist, bei welchem Aufzug die Hebeseile von einem Paar Seilrollen aufgenommen werden, die an der Aufzugskabine und/oder dem Gegengewicht vorgesehen sind, welche Hebeseile angeordnet sind, um über die Seilrollen des besagten Paares an Seilrollen zu laufen, so dass sie von einer ersten Seilrolle des Paares an Seilrollen an eine zweite Seilrolle des Paares an Seilrollen laufen, und bei welchem Aufzug die Seilrollen rotierbar mit Lagern auf einem Montagerahmen (23) der besagten Seilrolle montiert sind, wobei der besagte Montagerahmen mindestens ein erstes Anschlussstück (24) aufweist, mittels dem die Seilrolle an einer Montagestütze an der Aufzugskabine oder dem Gegengewicht festgelegt ist, **dadurch gekennzeichnet, dass** der Montagerahmen (23) einer jeden Seilrolle in dem Paar Seilrollen mit mindestens einem zweiten Anschlussstück (25) als eine in dem Montagerahmen vorgesehene Buchse versehen ist, und dass das zweite Anschlussstück angeordnet ist, um mit einer genauen Ausrichtung an Ausrichtmitteln (20, 21) angeschlossen zu werden, die in der Form eines runden Riegels oder Rohres und separat von der Montagestütze vorliegen.
2. Aufzug nach Anspruch 1, **dadurch gekennzeichnet, dass** die Ausrichtmittel (20, 21) ein Teil der Aufzugskabine oder des Gegengewichtes sind.
3. Aufzug nach Anspruch 1, **dadurch gekennzeichnet, dass** die Ausrichtmittel (20, 21) als separates Teil von der Aufzugskabine bzw. dem Gegengewicht vorliegen.
4. Aufzug nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Ausrichtmittel (20, 21) und die Buchse (25) miteinander durch einen Presssitz verbunden sind.

## Revendications

1. Ascenseur comprenant un jeu de câbles de levage

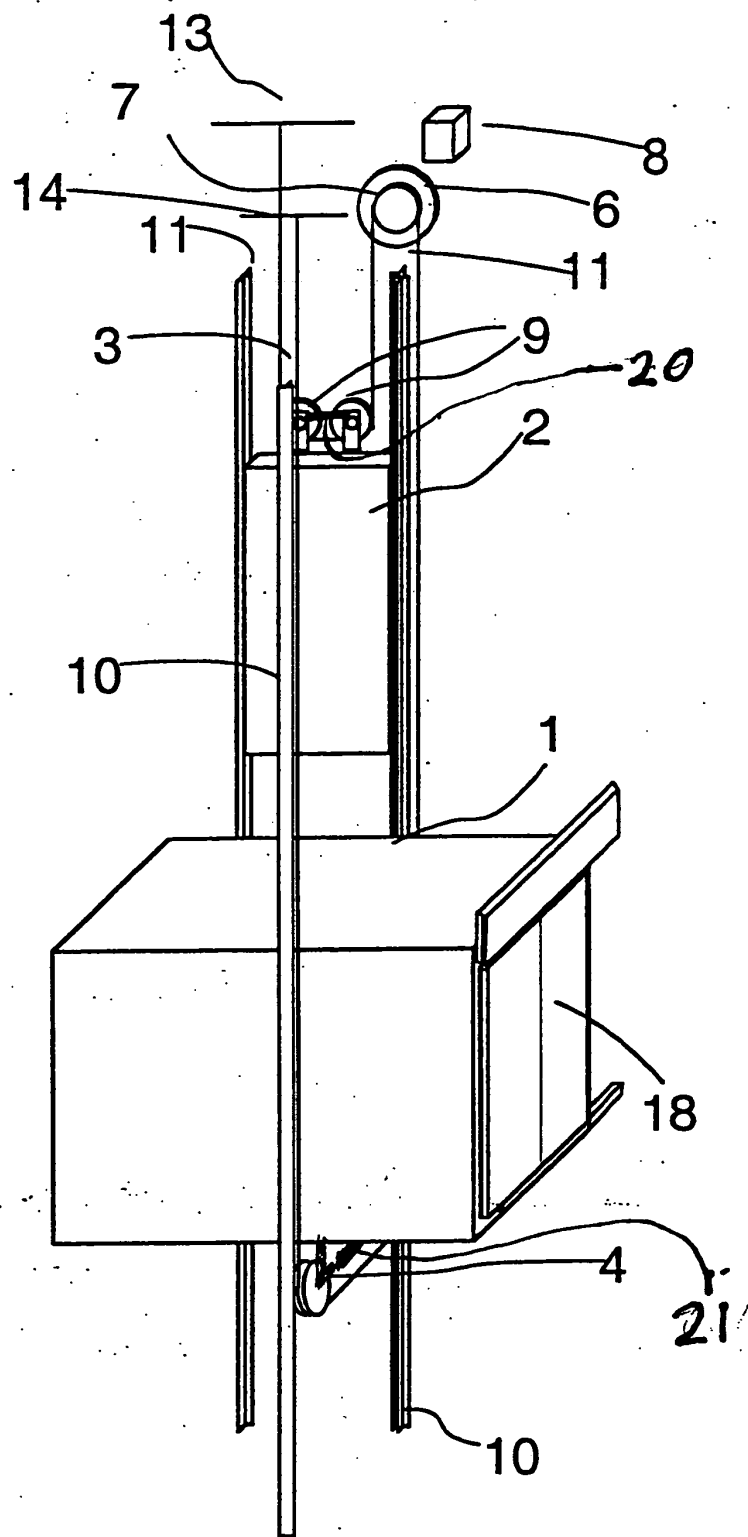
(3), une cabine d'ascenseur (1) suspendue par le jeu de câbles de levage et éventuellement un contrepoids (2) suspendu par le jeu de câbles de levage, dans lequel ascenseur les câbles de levage sont reçus par une paire de poulies à câble fournies sur la cabine d'ascenseur et/ou le contrepoids, lesquels câbles de levage ont été disposés pour passer par les poulies à câble de ladite paire de poulies à câble de telle sorte qu'ils passent depuis une première poulie à câble de la paire de poulies à câble jusqu'à une seconde poulie à câble de la paire de poulies à câble, et dans lequel ascenseur les poulies à câble sont montées rotatives avec des paliers sur un châssis de montage (23) de ladite poulie à câble, ledit châssis de montage comprenant au moins un premier élément de raccordement (24), au moyen duquel la poulie à câble est fixée à un support de montage sur la cabine d'ascenseur ou le contrepoids, **caractérisé en ce que** le châssis de montage (23) de chaque poulie à câble dans la paire de poulies à câble est pourvu d'au moins un second élément de raccordement (25) sous forme de manchon fourni dans le châssis de montage et **en ce que** le second élément de raccordement a été disposé pour être raccordé avec un alignement précis à un moyen d'alignement (20, 21) ayant la forme d'une barre ou d'un tube rond et étant séparé du support de montage.

2. Ascenseur selon la revendication 1, **caractérisé en ce que** le moyen d'alignement (20, 21) est un élément de la cabine d'ascenseur ou du contrepoids.
3. Ascenseur selon la revendication 1, **caractérisé en ce que** le moyen d'alignement (20, 21) est un élément séparé de la cabine d'ascenseur et du contrepoids.
4. Ascenseur selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le moyen d'alignement (20, 21) et le manchon (25) sont raccordés entre eux par complémentarité de forme.

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**Fig. 1**

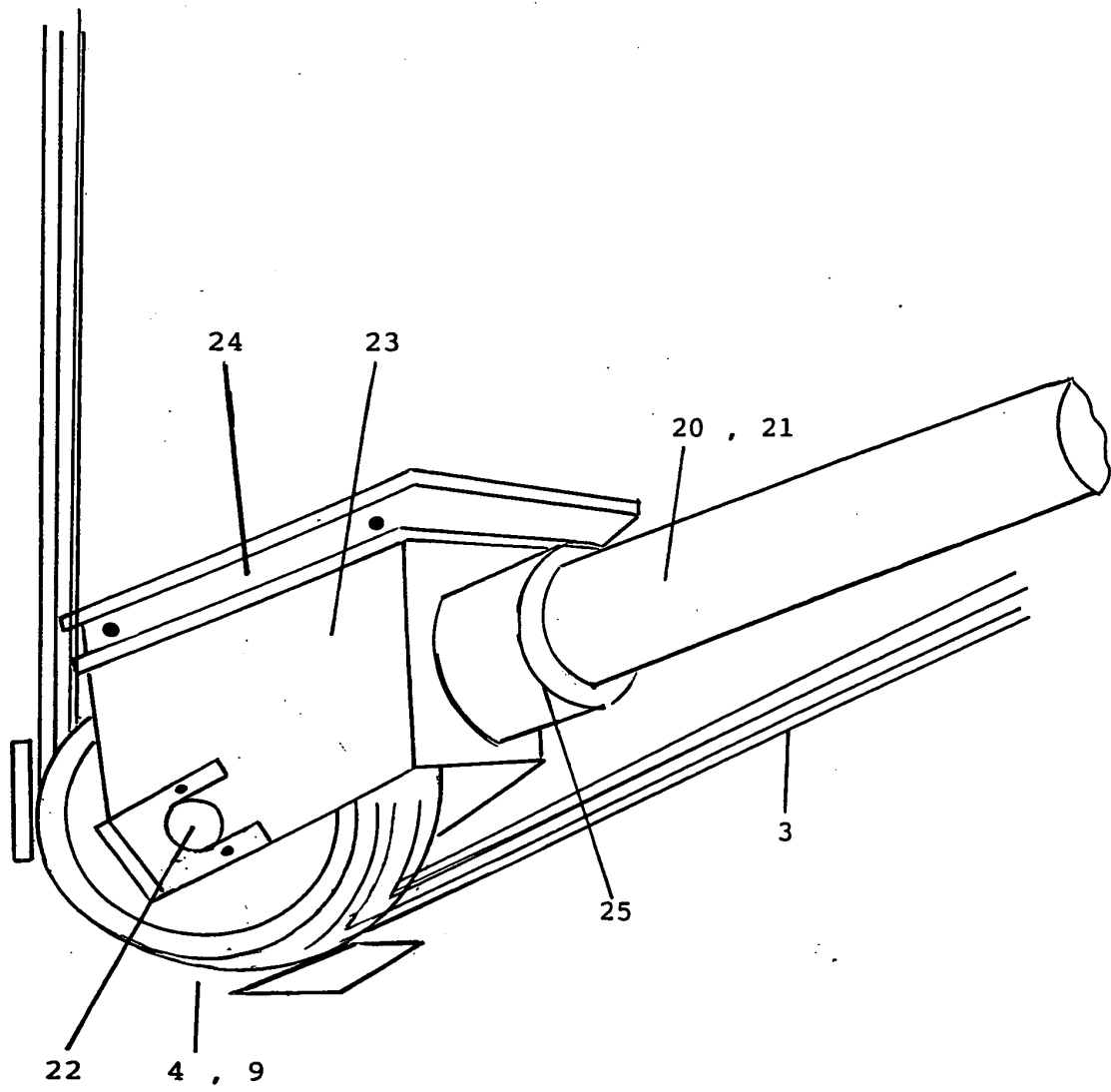


Fig. 2

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- EP 0631967 A [0002]
- EP 0749931 A [0002]
- WO 9933743 A [0003]