

Description

The conventional traction type of elevator is widely used. This type of elevator utilizes a machine room which is provided above the lift, in which a traction machine is installed and whereon ropes are hung, on respective ends of which ropes a car and a counterweight are suspended.

The dimension of this machine is relatively large, and at the same time in the machine room are installed a brake apparatus and other control apparatus. Thus the machine room occupies considerable space and has to be designed having the necessary structural strength.

In order to avoid those problems, an elevator having a linear motor as its power source has been provided. The linear motor itself moves in a well known manner in a linear direction, and there is no need of a traction machine, reduction device, and traction sheaves; whereby the whole equipment is quite lightweight. A machine room for the traction machine is not necessary.

The invention relates to an elevator of the linear motor drive type, the linear motor comprising a stator designed as the primary side or the secondary side of the linear motor and comprising a moving element designed as the other side of the linear motor, both ends of the stator being fastened to a building equipped with the elevator, the fastening means for one end of the stator comprising a spring.

Such an elevator is known from the document EP-A-0 048 847. The stator of its linear motor is rigidly fastened to the building at its upper end and is connected to the building via a coil spring at its lower end.

Stators provided for such elevators have a considerable length, depending on the height of the building where the elevator is to be installed. By earthquakes vibrations and shocks are transmitted to the stator, resulting in a risk of stator breakage.

It is the problem underlying the invention to provide an elevator which is safer in regard of stator breakage.

As a solution of this problem the elevator according to the invention is characterized in that the fastening means for the other end of the stator comprises a joint which allows relative pivoting movements of the stator in vertical planes; and that the spring is provided such that it provides a pre-determined tension to the stator and absorbs vibrations acted on the stator.

The way how the stator is fastened to the building allows the stator to vibrate and absorbs the vibration acted on the stator. The joint allows a swivelling motion of the stator within a certain range. The spring allows the stator to swing within a certain range. Since displacement of the stator is

allowed by the movement of the joint and by the spring, vibrations are reduced and absorbed, so that the stator is protected from breakage.

In the following, referring to the attached drawings, a preferred embodiment of the invention is elucidated

Fig. 1 is a schematic diagram of a linear motor drive type of elevator,

Fig. 2 shows the lower support structure for a column as a stator of a linear motor

Fig. 3 shows the upper support structure,

Fig. 4 shows how to connect columns partially in section,

Fig. 5 shows a perspective view showing a column connecting member,

Fig. 6 shows a sectional view of a gap sensor,

Fig. 7 shows a circuitry for the gap sensor.

The linear motor of the elevator as shown consists of a hollow cylindrical moving element 1 and a column 10 as a stator. The cylindrical moving element 1 functions as a primary side. Counterweights 2 are installed in a casing consisting of a channel member to form as a whole a counterweight 3 for a car 4. This counterweight 3 is usually set in its weight as 1.5 times of the car 4. The car 4 and the counterweight 3 are connected by four ropes 6 through four sheaves 5 provided above. Further, both the car and the counterweight have guide rails 7 and 8 respectively on both sides thereof and engage the guide rails via slide members 9 when going up and down. The column 10 of the stator side is made of aluminum alloy, which passes through the cylindrical moving element 1 at the middle portion between the guide rails 8 for the counterweight 3. The lower end portion of the column 10 is fastened through a support member 14 to a lower support frame 11 provided on the lower portion of the guide rails 8. The upper end portion of the column 10 is fastened through a support member 13 to the upper support consisting of a support channel 12. Incidentally, the desired length of column 10 in a elevator of 600 kg loading capacity, is obtained practically by connecting a plurality of column sections having 1,500 mm length and 100 mm diameter each.

In the cylindrical linear motor, as is well known, a pre-determined gap has to be provided between the primary side and the secondary side, and in order to maintain the gap the moving element 1 is supported by rollers 15 provided on both the upper side and the lower side of the moving element 1 by four pieces. Further, considering the change of this gap due to vibrations, shocks to the linear motor or wearing of the rollers 15, gap sensors 16 are provided on the upper and lower portions of the casing frame 17. In Fig. 1, the linear motor is shown as being installed in the counterweight 3,

but it is also possible to install the linear motor on the car 4.

Next, Fig. 2 is explained. This figure shows the structure of the lower support member 14 for the column 10. On the free end of the lowest column section 100 there is mounted a ball joint 105 as a coupling means having an eyebolt 101. On the floor an eyebolt 102 is fastened to the support frame 11 which is connected to the lower ends of the guide rails 8 at both sides of the linear motor. The column 10 is kept vertical by connecting the eyebolts 101 and 102 with a coil spring 103 and a turnbuckle 104, both of which have hooks on both ends thereof respectively. The turnbuckle 104 can add a specific tension to the column 10 by regulating the distance between the spring 103 and the joint 105. Further, the provision of the turnbuckle 104 allows for an easy regulation of the tension to the column 10 and for an easy assembly of the spring 103.

The ball joint 105 has such a structure that it holds a ball 109 by a pair of yokes 106 which are connected to the eyebolt 101, and the ball 109 is kept therein by a pin 111 penetrating the pair of yokes 106 and the ball 109. On the other hand, the end of column 10 has a shaft 107 having a ring which accepts the ball. Accordingly, due to this construction, the yoke portion can rotate approximately 36° relative to the shaft 107; further, in the plane perpendicular to the above rotating plane, it can rotate within a certain angle. These structures will allow the column itself to vibrate within certain angles.

Fig. 3 shows the structure of the upper support member 13 of the column 10. As to the upper support structure, although it is possible to connect the column 10 to the upper support channel 12 by using the same structure as the lower support structure, in this embodiment, because it is enough for either upper or lower support member to bear a spring to damp the vibration or the shock of the column, the upper support structure has merely a ball joint 110. This ball joint 110 can also rotate within a certain range, and functions to allow the displacement of the column 10 due to the vibration with the lower support member 14.

Therefore, according to the support structure of the column 10 mentioned above, even if the vibration and shock acted on the column 10, it is possible to protect the column 10 effectively. Moreover, in the lower support structure of column 10, the structure consisting of a ball joint 105 and coil spring 103 without a turnbuckle 104 is enough for effecting the functions thereof.

Fig. 4 shows how to construct the column 10. The column 10 obtains its desired length, as mentioned above, by connecting a plurality of column sections.

In this kind of linear motor, because of the requirement of precise linearity along the whole length of the column 10, it is an issue how to connect the column sections. Practically it is needed to connect two column sections in such a manner that surface steps between the column are not more than 0.1 mm.

Therefore, a connecting member 200 shown in Fig. 5 is used. This connecting member 200 has a structure machined integrally by a lathe with a flange 201 formed in the middle portion of it and both ends thereof being threaded 202. On the other hand, the end portions of the column sections to be connected are drilled and threaded, and counterbores 203 receive the flange 201. The threads in the drill holes can be manufactured easily with a lathe sufficiently concentrically.

Accordingly, it is possible to connect the column sections in such a manner that the allowable linearity of the whole column 10 is satisfied by screwing one male screw portion of the above connecting member 200 into a female screw threaded on one end of a column section, the other male screw portion of the connecting member 200 being screwed into the female screw of the other column section.

Figs 6 and 7 show a gap sensing system to detect the abnormality of the distance between the column 10 and the moving element 1 of the linear motor.

As mentioned above, normally in a linear motor, it is necessary to provide a certain gap between the stator and the moving element, and in order to maintain this gap a support mechanism becomes necessary.

Thus, as shown in Fig. 1, in this embodiment the support mechanism consists of the rollers 15.

However, these rollers have the problem that the gap between the stator and the moving element 1 is changed due to the wearing of the surface of the rollers 15 by frequent up-down travelling of the elevator, breakage, or dropping out.

To detect abnormal changes of the gap, gap sensors 16 are provided on both of the upper and lower sides of the linear motor.

This gap sensor system consists of a hollow casing 300, a conductive strip 301, a conductive strip fastening screw 302, a regulator screw 303, and a detecting circuit 310. One end of the conductive strip 301 is fastened to the inner side of the casing 300 by the fastening screw 302 and the other end thereof sets a change of the allowable gap between the column 10 and the moving element 1 of the linear motor through the regulator screw 303.

Further, the fastening screw 302 and the column 10 are connected to a DC source through a lead wire 304 respectively. The conductive strip

301 is preferably installed at each of four positions of the quarter inner circumference of the casing 300, but it may be at three positions or a plurality of positions over five.

Furthermore, the conductive strip may be ring shaped.

A detecting circuit 310 has a structure as shown in Fig. 7.

As mentioned above, if a change is generated in the gap due to wearing of the rollers 15, a conductive strip 301 of the gap sensors 16 provided on both of the upper and lower sides of the linear motor touches the surface of the column 10, whereby relay coils X_1 and X_2 are energized and contacts Y_1 and Y_2 which are normally open are closed. Because those relay coils and the contacts constitute a self holding circuit, the warning lamps I_1 and I_2 continue to light.

Further, a safety means may be provided, which reads the signal generated when the conductive strip 301 contacts the column 10 and operates the brake apparatus to stop the car 4.

In the above described embodiment, a support structure for a cylindrical type of linear motor, particularly a support structure of the column of the stator side is described, but the structure according to the present invention is not limited to the application to the cylindrical type of linear motor, but is also applicable for instance to a support structure of a conductive plate of a plate type of linear motor.

According to the present invention, the stator functioning as the primary side or the secondary side of the linear motor is provided on a building by being mounted in a hoist-way of the elevator through coupling members allowing relative movement provided on the upper and the lower portions of the stator. If a shock or vibration was imparted to the stator, the movement of the stator itself is appropriately allowed, particularly the vibration etc is reduced or absorbed by the spring provided on the lower portion of the stator to protect the stator effectively from the damages such as breaking.

Claims

1. Elevator of the linear motor drive type, the linear motor comprising a stator (10) designed as the primary side or the secondary side of the linear motor and comprising a moving element (1) designed as the other side of the linear motor, both ends of the stator (10) being fastened to a building equipped with the elevator, the fastening means (14) for one end of the stator (10) comprising a spring (103), characterized in that the fastening means (110) for the other end of the stator (10) comprises a joint which allows

relative pivoting movements of the stator (10) in vertical planes; and that the spring (103) is provided such that it provides a predetermined tension to the stator (10) and absorbs vibrations acted on the stator (10).

2. Elevator as defined in claim 1, characterized in that the fastening means (114) for the one end of the stator (10) comprises a joint (105) which allows relative pivoting movements of the stator (10) in vertical planes.
3. Elevator as defined in claim 1 or 2, characterized in that the fastening means (114) for the one end of the stator (10) comprises a turn buckle (104).

Patentansprüche

1. Aufzug des Typs mit Linearmotorantrieb, wobei der Linearmotor einen Stator (10), der als Primärseite oder Sekundärseite des Linearmotors vorgesehen ist, und ein bewegbares Element (1) aufweist, das als die andere Seite des Linearmotors vorgesehen ist, wobei beide Enden des Stators (10) an einem mit dem Aufzug ausgerüsteten Gebäude befestigt sind, und die Befestigungseinrichtung (14) für ein Ende des Stators (10) eine Feder (103) aufweist, dadurch gekennzeichnet, daß die Befestigungseinrichtung (110) für das andere Ende des Stators (10) ein Gelenk aufweist, das Relativ-Schwenkbewegungen des Stators (10) in Vertikalebene zuläßt; und daß die Feder (103) so vorgesehen ist, daß sie für den Stator (10) eine festgelegte Spannung schafft und Schwingungen absorbiert, die auf den Stator (10) wirken.
2. Aufzug nach Anspruch 1, dadurch gekennzeichnet, daß die Befestigungseinrichtung (114) für das eine Ende des Stators (10) ein Gelenk (105) aufweist, das Relativ-Schwenkbewegungen des Stators (10) in Vertikalebene zuläßt.
3. Aufzug nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Befestigungseinrichtung (114) für das eine Ende des Stators (10) ein Spannschloß (104) aufweist.

Revendications

1. Ascenseur du type à entraînement par moteur linéaire, le moteur linéaire comprenant un stator (10) conçu comme étant le côté primaire



301 is preferably installed at each of four positions of the quarter inner circumference of the casing 300, but it may be at three positions or a plurality of positions over five.

Furthermore, the conductive strip may be ring shaped.

A detecting circuit 310 has a structure as shown in Fig. 7.

As mentioned above, if a change is generated in the gap due to wearing of the rollers 15, a conductive strip 301 of the gap sensors 16 provided on both of the upper and lower sides of the linear motor touches the surface of the column 10, whereby relay coils X_1 and X_2 are energized and contacts Y_1 and Y_2 which are normally open are closed. Because those relay coils and the contacts constitute a self holding circuit, the warning lamps l_1 and l_2 continue to light.

Further, a safety means may be provided, which reads the signal generated when the conductive strip 301 contacts the column 10 and operates the brake apparatus to stop the car 4.

In the above described embodiment, a support structure for a cylindrical type of linear motor, particularly a support structure of the column of the stator side is described, but the structure according to the present invention is not limited to the application to the cylindrical type of linear motor, but is also applicable for instance to a support structure of a conductive plate of a plate type of linear motor.

According to the present invention, the stator functioning as the primary side or the secondary side of the linear motor is provided on a building by being mounted in a hoist-way of the elevator through coupling members allowing relative movement provided on the upper and the lower portions of the stator. If a shock or vibration was imparted to the stator, the movement of the stator itself is appropriately allowed, particularly the vibration etc is reduced or absorbed by the spring provided on the lower portion of the stator to protect the stator effectively from the damages such as breaking.

Claims

1. Elevator of the linear motor drive type, the linear motor comprising a stator (10) designed as the primary side or the secondary side of the linear motor and comprising a moving element (1) designed as the other side of the linear motor, both ends of the stator (10) being fastened to a building equipped with the elevator, the fastening means (14) for one end of the stator (10) comprising a spring (103), characterized in that the fastening means (110) for the other end of the stator (10) comprises a joint which allows

relative pivoting movements of the stator (10) in vertical planes; and that the spring (103) is provided such that it provides a predetermined tension to the stator (10) and absorbs vibrations acted on the stator (10).

2. Elevator as defined in claim 1, characterized in that the fastening means (114) for the one end of the stator (10) comprises a joint (105) which allows relative pivoting movements of the stator (10) in vertical planes.
3. Elevator as defined in claim 1 or 2, characterized in that the fastening means (114) for the one end of the stator (10) comprises a turn buckle (104).

Patentansprüche

1. Aufzug des Typs mit Linearmotorantrieb, wobei der Linearmotor einen Stator (10), der als Primärseite oder Sekundärseite des Linearmotors vorgesehen ist, und ein bewegbares Element (1) aufweist, das als die andere Seite des Linearmotors vorgesehen ist, wobei beide Enden des Stators (10) an einem mit dem Aufzug ausgerüsteten Gebäude befestigt sind, und die Befestigungseinrichtung (14) für ein Ende des Stators (10) eine Feder (103) aufweist, dadurch gekennzeichnet, daß die Befestigungseinrichtung (110) für das andere Ende des Stators (10) ein Gelenk aufweist, das Relativ-Schwenkbewegungen des Stators (10) in Vertikalebene zuläßt; und daß die Feder (103) so vorgesehen ist, daß sie für den Stator (10) eine festgelegte Spannung schafft und Schwingungen absorbiert, die auf den Stator (10) wirken.
2. Aufzug nach Anspruch 1, dadurch gekennzeichnet, daß die Befestigungseinrichtung (114) für das eine Ende des Stators (10) ein Gelenk (105) aufweist, das Relativ-Schwenkbewegungen des Stators (10) in Vertikalebene zuläßt.
3. Aufzug nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Befestigungseinrichtung (114) für das eine Ende des Stators (10) ein Spannschloß (104) aufweist.

Revendications

1. Ascenseur du type à entraînement par moteur linéaire, le moteur linéaire comprenant un stator (10) conçu comme étant le côté primaire



- ou le côté secondaire du moteur linéaire et comprenant un élément mobile (1), conçu comme étant l'autre côté du moteur linéaire, les deux extrémités du stator (10) étant fixées à un bâtiment équipé de l'ascenseur, le moyen de fixation (14) pour une extrémité du stator (10) comprenant un ressort (103), caractérisé en ce que le moyen de fixation (110) pour l'autre extrémité du stator (10) comprend un joint permettant des mouvements de pivotement relatifs du stator (10) dans des plans verticaux et en ce que le ressort (103) est prévu de telle sorte qu'il procure une tension prédéterminée au stator (10) et absorbe les vibrations exercées sur le stator (10).
2. Ascenseur suivant la revendication 1, caractérisé en ce que le moyen de fixation (114) pour l'une des extrémités du stator (10) comprend un joint (105) permettant des mouvements de pivotement relatifs du stator (10) dans des plans verticaux.
3. Ascenseur suivant la revendication 1 ou 2, caractérisé en ce que le moyen de fixation (114) pour l'une des extrémités du stator (10) comprend un manchon de serrage (104).

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