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ELEVATOR DRIVE APPARATUS WITH VIBRATION
ISOLATION MEANS

The present invention relates to a drive apparatus for a traction elevator lifting a cage up and down with cables.

5 An apparatus having reduction gears driven by a motor and a traction sheave connected to a rotatable output shaft of the reduction gears is known for driving elevators. The apparatus drives a cage and a counter weight with cables wound over the traction sheave. In such an apparatus the
10 vibrations generated by the engagement between the teeth of the reduction gears travels through the cables to the cage, whereby passengers in the cage feel uncomfortable.

An elevator system employing reduction gears with parallel axis helical gears and a variable-voltage-variable-
15 frequency controlled (VVVFC) AC motor has also been introduced.

Such an elevator system has the advantages of saving energy because of less power loss with the parallel axis reduction gears, and because the AC motor is smaller than a DC motor, strong and reliable since there are no brushes, and less
20 costly and easy to maintain. The parallel axis gears,

however, generate a greater vibration when the teeth are engaged, and VVVFC drives ripple the AC motor by the current distortion which an inverter generates during modulation.

These vibrations are transmitted via the traction cables to
25 the passenger cage.

In Japanese laid-open patent application No. 90381/1982 published on June 5, 1982, an elevator apparatus has a motor resiliently supported in a motor housing which prevents vibration from the motor from travelling to other parts of the system, e.g. reduction gears and support members. In this apparatus, however, the vibrations from the reduction gears are directly transmitted to the traction sheave and travel through the cables to the cage, which results in deteriorated ride conditions. Furthermore, since vibration generated by the brake is also transmitted to the sheave, it is not sufficient in suppressing vibration to only consider countermeasures for the motor.

SUMMARY OF THE INVENTION

The apparatus according to this invention overcomes the above-mentioned disadvantages, and comprises drive means having a motor and reduction gears vibroisolatedly mounted on support means, a traction sheave vibroisolatedly mounted on the support means, and an elastic coupling between a shaft of the sheave and an output shaft of the drive means, whereby vibrations from the drive means are absorbed by the elastic coupling and vibrationally cushioned mountings, and are thus isolated from the sheave.

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a vertical sectional view of an elevator drive apparatus according to the invention;

Fig. 2 is a plan view partly in section of a reduction gear mechanism for the drive apparatus;

Fig. 3 is a vertical sectional view taken on line III-III of Fig. 1;

Fig. 4 is an enlarged sectional view of an elastic coupling of the invention; and

10 Fig. 5 is a plan view of an alternate elastic coupling.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In Figs. 1-4 reference numeral 1 designates an elevator shaft or hoistway, 2 a machine room disposed above the hoistway, 2a a floor of the machine room, 3 a pair of base members vertically upstanding from the floor, 4 a first support member comprising two beams extending across the base members 3, 5 a drive apparatus comprising reduction gears, an electric motor and a brake described more fully below and mounted on the first support member 4 via rubber vibration isolating pads 6, 7 a reduction gear box having helical gears 7a as shown in Fig. 2, an input shaft 7b and

an output shaft 7c, 8 an AC motor connected to the input shaft 7b, and 9 a magnetic brake attached to the motor for braking the drive apparatus when necessary. A second support member 10 comprises two parallel beams extending across the base members 3 separate from the first support member 4, reference numeral 11 designates a bed member mounted on the second support member via vibration isolating pads 12, 13 is a traction sheave mounted on a shaft 13a whose ends are rotatably journaled in bearing stands 14 on the bed member 11, and 15 is an elastic coupling connecting the shafts 13a and 7c. As shown in Fig. 4, the coupling has flanges 15a individually attached to the shafts 13a and 7c and a circular or toroidal rubber member 15b connecting the flanges together in a compact manner. Reference numeral 16 designates a deflection sheave 15 rotatably supported on the bottom surface of the bed member 11, 17 designates a plurality of hoist cables reeved over the traction and deflection sheaves and extending down into the hoistway, 18 is an elevator cage hung at one end of the cables, 18a is a cage sling connected to the cables, 18b is 20 a passenger enclosure of the cage supported on the sling via resilient rubbers 18c, and 19 is a counter weight hung at the other end of the cables.

In the above structure, by reason of the traction sheave 13 being rotatably supported on the bed member 11 attached to 25 the second support member 10 via the vibration isolating pads

12, the support member 10 being separate from the first support member 4 mounting the drive apparatus 5, and the traction sheave being connected to the output shaft 7c of the drive apparatus via the elastic coupling 15, any vibrations generated by the mesh of the reduction gears and by the pulsating rotation of the motor 8 under VVFC are absorbed by the coupling 15, which greatly reduces the vibration level of the traction sheave 13.

Considering vertical vibrations generated by the reduction 10 gears and the drive motor, because of the isolating rubbers 6 and 12 these vibrations are prevented from travelling to the sheave 13 through the path including the drive apparatus 5, the first support member 4, the base member 3, the second support member 10, and the bed member 11. The vibration of 15 the traction sheave 13 is thus substantially reduced, and attendantly the transmission of vibrations from the drive apparatus to the cage 18 via the ropes 17 is greatly attenuated, improving the comfort level in the cage.

In the above embodiment the elastic coupling 15 includes 20 a toroidal member 15b. As an alternative, an elastic belt 15c as shown in Fig. 4 may be employed as the force transmission member. The belt is reeved over two pulleys attached to the shafts 13a and 7c, and operates in the same manner as described above.

In the embodiment shown in Figs. 1-3, since both the traction sheave 13 and the deflection sheave 16 are rotatably supported on the same bed member 11, the horizontal force between the sheaves 13 and 16 is never applied to the rubbers 12, whereby the structure for isolating vibration is simple and can be inexpensively manufactured. Furthermore, since the drive apparatus 5 and the sheave 13 are vibration isolated from the building, vibration and noise are not generated in the rooms of the building and do not degrade the working environment.

With isolating rubbers 6 disposed between the first support member 4 and the drive apparatus 5, the amplitude of any vibrations generated is minimized. That is, if the rubbers were disposed between the first support member 4 and the base member 3, the first support member would also vibrate relative to the base member and reinforce the vibrations of the drive apparatus. The same analysis applies to isolating rubbers 12 by reason of their being mounted between the second support member 10 and bed member 11 instead of between the second support member and base members 3.

Since the deflection sheave 16 is supported on the bed member 11 via the isolating rubbers 12, the vibrations from the reduction gears and the drive motor are isolated from the deflection sheave, which further reduces any vibrations transmitted to the cage 18 through the deflection sheave and the

cables 17. The isolating rubbers 12 suppress vibrations to both the traction sheave 13 and the deflection sheave 16, whereby the deflection sheave does not require an independent rubber mounting and the quantity of parts can be reduced.



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CLAIMS

1. Drive apparatus for an elevator including an electric drive motor, reduction gearing driven by the motor, and a traction sheave driven by the reduction gears, said apparatus being installed in a machine room proximate an elevator shaft and comprising:
 - a) support means disposed in the machine room;
 - b) drive means including the said motor and reduction gearing mounted via first vibration isolating means on said support means;
 - c) the said traction sheave, wound with hoisting cables connected to the cage, mounted via second vibration isolating means on said support means; and
 - d) elastic torque transmission means including a resilient coupling member disposed between said drive means and said traction sheave.
2. Drive apparatus as claimed in claim 1, wherein said reduction gearing is helical gearing.
3. Drive apparatus as claimed in claim 1 or 2, wherein the motor is a variable-voltage, variable-frequency controlled AC motor.



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4. Drive apparatus as claimed in claim 1, 2 or 3 including a bed member vibroisolatedly mounted on said support means, said bed member mounting said traction sheave.
5. Drive apparatus as claimed in claim 4, including a deflection sheave wound with the cables, said deflection sheave together with said traction sheave being mounted on said bed member.
6. Drive apparatus as claimed in any preceding claim, wherein said drive means is mounted on said support means via a first support member disposed on said support means and wherein said first vibration isolating means is disposed on said first support member, said drive means being attached to said first vibration isolating means.
7. Drive apparatus as claimed in any preceding claim, wherein said traction sheave is mounted on said support means via a second support member disposed on said support means, said second vibration isolating means being disposed on said second support member, and a bed member disposed on said second vibration absorbing means, said traction sheave being supported on said bed member.



8. Drive apparatus as claimed in any preceding claim, wherein said drive means includes brake means.

9. Drive apparatus as claimed in any preceding, wherein said elastic transmission means comprises
5 a circular resilient connector having side surfaces individually connected to a rotative shaft of said traction sheave and an output shaft of said drive means.

10. Drive apparatus as claimed in claim 9,
10 wherein said circular resilient connector is hollow and has holes communicating with the hollow at central portions of each side surface, said connector being coupled to said shafts via respective flanges individually fixed to the
15 shafts and to peripheral portions of the holes.

11. Drive apparatus as claimed in claim 10, wherein said connector is a hollow toroidal ring having a peripheral wall shaped into a half
circle in radial section, and is bidirectionally
20 deformable along the axes of the shafts and the side surfaces of the connector.

12. Drive apparatus for elevator as claimed in claim 10, wherein the diameter of said circular connector is greater than that of the flanges.



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13. Drive apparatus for an elevator, substantially as herein described with reference to the accompanying drawings.
