

SPECIFICATION

TITLE OF THE INVENTION

ELEVATOR DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority from the prior Japanese Patent Application No. 2013-179411, filed on August 30th, 2013, and the entire contents of which are incorporated herein by reference.

FIELD

Embodiments of the present invention relate to an elevator device for lifting or lowering, like a draw well, an elevator car and counterweight, which are provided in a hoistway so as to be able to go up or down, using a main rope of a novel configuration that is wound around a hoist.

BACKGROUND

— In general, in an elevator device, as a main rope for lifting or lowering an elevator car and a counterweight, a wire rope that is made by braiding strands of steel is used. However, in the case of an elevator device for high-rise buildings in which a lifting/lowering path is 500 to 600 meters in length, an increase in the weight of the rope leads to an increase in the slung load. Therefore,

it is hoped that an increase in the weight of the rope will be curbed.

In recent years, as a main rope of the elevator device, a main rope that is made of material other than steel has been proposed. For example, such ropes include a rope having a load bearing portion made of a composite material that is made by impregnating non-metallic fiber such as carbon or glass fiber with polymer matrix (See Patent Document 1); and a rope that contains carbon and a filament covered with a matrix made of polymer material (See Patent Document 2).

Patent Document 1: Japanese PCT National Publication No. 2011-509899

Patent Document 2: Japanese Laid-open Patent Publication No. 2013-504695

As described above, in the case of the elevator device that uses, as a main rope, a wire rope made of strands of steel, the problem is that the weight of the rope increases as the lifting/lowering path becomes longer, and the increase leads to an increase in the slung load. Therefore, what is proposed is a main rope for elevators that uses material other than steel.

The object of the present invention is to provide an elevator device that uses a main rope of a novel configuration which is made of material other than steel and which is lightweight and high in mechanical strength.

An elevator device of an embodiment of the present invention that lifts or lowers, like a draw well, an elevator car and counterweight, which are provided in a hoistway so as to be able to go up or down, using a main rope wound around a hoist, wherein the main rope includes a load bearing member made of strands of carbon material.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram illustrating the overall configuration of an elevator device according to one embodiment of the present invention;

FIG. 2 is a cross-sectional view of one example of a main rope for the elevator device shown in FIG. 1; and

FIG. 3 is a cross-sectional view of another example of a main rope for the elevator device shown in FIG. 1.

DETAILED DESCRIPTION

Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings.

First, with reference to FIG. 1, the basic configuration of an elevator device of this embodiment will be outlined. In FIG. 1, an elevator device 11 includes an elevator car 13 and counterweight 14, which are provided in a hoistway 12 so as to be able to go up or down. The elevator car 13 and the counterweight 14 are

connected together via a main rope 15, which is wound around a main sheave 21 of a hoist 20. The elevator car 13 and the counterweight 14 are driven in such a way as to go up or down like a draw well. That is, the elevator device is of a so-called draw-well type in which the elevator car 13 and counterweight 14 provided in the hoistway 12 are connected together via the main rope 15. A control panel 18 controls the driving of each part of the elevator device 11. As the elevator car 13 goes up or down in the hoistway 12, a user can get to a loading zone 17 of any destination floor.

The hoistway 12 is provided in a vertical direction of a building across a plurality of floors. The above-described hoist 20, control panel 18, and the like are provided in an upper machine room 19 of the hoistway 12 or the like, for example. In the elevator device 11, the control panel 18 controls the hoist 20. As the main sheave 21 is rotated, the main rope 15 is driven in a length direction due to a friction force with the main sheave 21, thereby alternately lifting or lowering the elevator car 13 and the counterweight 14.

Instead of a conventional steel wire rope, the main rope 15 used here has a load bearing member that is made of strands of carbon material. Examples of the configuration of the main rope 15 will be described with reference to FIGS. 2 to 3, which show a cross-section

thereof.

A main rope 15 shown in FIG. 2 includes a load bearing member that is made by twisting together a plurality of carbon-material strands 25, which are made by molding carbon fiber into an elongated rod-like shape, to form a rope. The periphery of the load bearing member, which is in the shape of a rope, is covered with a coating material 26, which is made of soft resin material such as urethane resin.

A main rope 15 shown in FIG. 3 includes a load bearing member that includes a single carbon-material strand 25, which is made by molding carbon fiber into an elongated rod-like shape. The periphery of the load bearing member, which includes the single carbon-material strand 25, is covered with a coating material 26, which is made of soft resin material such as urethane resin.

If the carbon-material strands 25, which are made by molding carbon fiber into an elongated rod-like shape, are used to form the load bearing members, the mass of the load bearing members made of carbon fiber is lighter than that of a steel-material rope. The strength thereof turns out to be $3,500\text{N/mm}^2$, depending on the type. Therefore, the ropes made of carbon fiber are strong enough to replace the conventional steel rope. That is, the carbon fiber is lightweight and is excellent in flexibility, wear resistance, and flexural fatigue resistance. Therefore,

the ultra-light, ultra-high strength ropes can be obtained as the carbon-material strands 25, which are made by molding carbon fiber into a rod-like shape, are used to form the load bearing members.

Moreover, the peripheries of the load bearing members made of carbon-material strands 25 are covered with the coating material 26, which is soft resin material such as urethane resin. Therefore, it is possible to achieve a sufficient traction performance that is required for elevator devices because of a high friction coefficient of the coating material 26.

For example, the coating material 26 may be made of ethylene-propylene-diene rubber, chloroprene rubber, chlorosulphonyl-polyethylene rubber, ethylene vinyl acetate rubber, butyl rubber, acrylonitrile-butadiene rubber, natural rubber, styrene-butadiene rubber, acrylic rubber, fluorine-contained rubber, silicone rubber, polyolefin rubber, or a material made by combining any two or more of the above compounds.

The coating material may be made of a thermosetting resin that is cured at 100 degrees Celsius or higher. For example, the thermosetting resin may be made of styrene-block copolymer, styrene-diene-block copolymer, a mixture of ethylene-propylene diene rubber and polypropylene, urethane-based thermoplastic elastomer, copolyester-based thermoplastic elastomer,

copolyamide-based thermoplastic elastomer, or a material made by combining any two or more of the above compounds.

In that manner, the load-bearing material fiber of carbon material, which is made by molding carbon fiber, is employed as a main rope. Therefore, in a recently-planned building that is higher than 500 meters, the mass of the main rope can be drastically reduced. As a result, it is possible to greatly reduce the load applied to a building structure, as well as the amount of structural material used.

Incidentally, as an example in which a rope other than the steel wire rope is used as the main rope of the elevator device, those proposed by the above Patent Documents 1 and 2 are illustrated. However, those ropes include a load bearing member made of a composite material that includes carbon fibers and the like in a matrix, and therefore are very different from the main ropes whose load bearing member itself is made of carbon material, which is made by molding carbon fiber, as shown in the embodiments of the present invention.

Several embodiments of the present invention have been described. However, the embodiments are given for illustrative purposes, and not intended to limit the scope of the invention. These novel embodiments may be embodied in other various forms. Various omissions, replacements and changes may be made without departing from the

subject-matter of the invention. The above embodiments and variants thereof are within the scope and subject-matter of the invention, and are similarly within the scope of the invention defined in the appended claims and the range of equivalency thereof.

WHAT IS CLAIMED IS:

1. An elevator device for lifting or lowering, like a draw well, an elevator car and counterweight, which are provided in a hoistway so as to be able to go up or down, using a main rope that is wound around a hoist, wherein

the main rope includes a load bearing member made of strands of carbon material.

2. The elevator device according to claim 1, wherein

the load bearing member is a single strand of the carbon material.

3. The elevator device according to claim 1, wherein

the load bearing member is formed in the shape of a rope by twisting together a plurality of strands of the carbon material.

4. The elevator device according to claim 3, wherein

a periphery of the load bearing member is covered with a coating material made of soft resin material.

5. The elevator device according to claim 4,

wherein

as the coating material, urethane resin is used.

6. The elevator device according to claim 5,
wherein

as the coating material, a thermosetting resin that
is cured at 100 degrees Celsius or higher is used.