

TITLE OF THE INVENTION

HOIST FOR ELEVATOR AND ELEVATOR APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001]

The present invention relates to a hoist for an elevator and an elevator apparatus.

2. Description of the Related Art

[0002]

As recent elevator apparatuses, so-called machine room-less elevator apparatuses have been widely used. In the machine room-less elevator apparatus, in order to suppress the height of a building, a machine room that stores machinery such as a hoist for an elevator (hereinafter abbreviated as a hoist) is not provided at the upper part of a hoistway, and the machinery is provided in the hoistway.

[0003]

In the case of the machine room-less elevator apparatus, all the machinery including the hoist, which has conventionally been installed in the machine room, is installed in the hoistway. There are various configurations in which the hoist is installed in the

hoistway. However, in order to install the hoist in the hoistway, the weight of the hoist needs to be reduced. Needless to say, in a conventional elevator apparatus with a machine room, the weight of a hoist needs to be reduced.

[0004]

As a conventional hoist, for example, JP 2004-299824 A describes a technique in which "a rotating body block is formed by integrating a rotor of an electric motor, a drive sheave for winding up a hoisting rope, and a brake disc of a disc brake, the rotating body block is rotated by a magnetic force that acts between a stator and the rotor of the electric motor provided in a base block, and the rotation of the rotating body block is stopped by pressing a friction material of the disc brake against a side surface of the brake disc" (refer to Abstract of the Disclosure).

[0005]

Furthermore, as another conventional hoist, for example, structures shown in Figs. 7A to 7C and Fig. 8 have been known. A hoist 110 shown in Figs. 7A to 7C is fixed and installed in a machine room or to an inner wall in a pit of a hoistway and the like, and designed to wind up a hoisting rope linked to an elevator car of an elevator apparatus, by a predetermined operation. The hoist 110 includes a housing 101, a sheave 114 that is rotatably

attached to the housing 101 and on which the hoisting rope is wound up, a brake disc 126 that is provided integrally with the sheave 114 and rotates, and an electromagnetic brake device 115 configured to brake the brake disc 126. The electromagnetic brake device 115 is fixed to the housing 101 via a large support bracket 147 that encloses the electromagnetic brake device 115.

[0006]

Fig. 8 is a cross-sectional view of the electromagnetic brake device 115, as viewed from D direction of Fig. 7C. The electromagnetic brake device 115 is supported movably in an axial direction by support shafts 137. Both ends of the support shaft 137 are supported by the sheave 114 side section of the support bracket 147 with a width L and a thickness T.

[0007]

The above-described conventional hoist includes a so-called outer-rotor type electric motor. Therefore, in order to brake the rotor portion, a large braking force is needed. Therefore, two independent sets of electromagnetic brake devices are provided for the brake disc in order to secure a predetermined amount of a braking force to be applied to the brake disc.

SUMMARY OF THE INVENTION

[0009]

However, a support bracket for supporting an electromagnetic brake device needs to have sufficient strength against an excessive torque that the electromagnetic brake device receives at the time of emergency braking. Furthermore, the support bracket needs to have a high rigidity to stably hold a support shaft.

[0010]

In the hoist according to the conventional technique shown in Figs. 7A to 7C and Fig. 8, the position of the support shaft 137 and the position at which the support bracket 147 is attached to the housing are separated into both sides of the brake disc 126. The support bracket 147 also needs to be made large and robust enough to stride over both sides of the brake disc 126. Therefore, inevitably, the hoist needs to be heavy and thick. As a result, various problems have arisen. For example, a large crane or the like is needed to deliver a hoist when an elevator apparatus is installed or when the hoist is renewed, and a work burden for a worker is large at the time of installation work.

[0011]

The present invention has been made in view of the current situation described above. It is an object of the present invention to reduce the weight and overall

dimensions of a hoist for an elevator, and thus to facilitate installation work for the hoist when the elevator apparatus is installed or when the hoist is renewed.

[0012]

In order to accomplish the above-described object, a hoist for an elevator according to an embodiment of the present invention includes: a housing; a stator having an annular shape and provided to the housing; a main shaft having one end fixed to a center of the stator; a sheave rotatably provided to the main shaft; a brake disc integrally formed with the sheave; an annular rotor integrally formed with the sheave; an electromagnetic brake device configured to brake the brake disc with a pair of brake shoes; and a brake bracket fixed to the housing and supporting the electromagnetic brake device, wherein the electromagnetic brake device includes a brake body and an armature, the brake body holding one of the brake shoes on a side of the housing from a braking surface of the brake disc, the armature holding the other brake shoe on a side of the sheave from the braking surface of the brake disc, and the brake bracket has a support shaft movably supporting the brake body in an axial direction on the side of the housing from the braking surface of the brake disc.

[0013]

In addition, an elevator apparatus according to an embodiment of the present invention includes: an elevating body configured to move up and down in a hoistway in a building; a counterweight; a main rope from which the elevating body and the counterweight are suspended; a hoist disposed in the hoistway or a machine room and configured to wind up the main rope; and a guide rail configured to guide lifting and lowering of the elevating body, wherein the hoist includes: a housing; a stator having an annular shape and disposed in the housing; a main shaft having one end fixed to a center of the stator; a sheave rotatably disposed on the main shaft; a brake disc integrally formed with the sheave; an annular rotor integrally formed with the sheave; an electromagnetic brake device configured to brake the brake disc with a pair of brake shoes; a brake bracket fixed to the housing and supporting the electromagnetic brake device, wherein the electromagnetic brake device includes a brake body and an armature, the brake body holding one of the brake shoes on a side of the housing from a braking surface of the brake disc, the armature holding the other brake shoe on a side of the sheave from the braking surface of the brake disc, and the brake bracket has a support shaft movably supporting the brake body in an axial direction on the side of the housing from the braking surface of the brake disc.

[0014]

According to an embodiment of the present invention, the weight and overall dimensions of the hoist can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Figs. 1A to 1C are overall views of a hoist according to one embodiment;

Fig. 2 is a cross-sectional view taken along line A-A in Fig. 1C;

Figs. 3A to 3C are enlarged views showing main parts of Figs. 1A to 1C respectively;

Fig. 4 is an overall view of an elevator apparatus according to one embodiment;

Fig. 5 is a cross-sectional view of an electromagnetic brake device when a brake therein is working;

Fig. 6 is a cross-sectional view of the electromagnetic brake device when the brake therein is released;

Figs. 7A to 7C are overall views of a conventional hoist; and

Fig. 8 is an enlarged plan view showing a main part of a conventional electromagnetic brake device, as viewed from D direction.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016]

Embodiments of an elevator apparatus and a hoist according to the present invention will be described below with reference to the drawings.

[0017]

Fig. 4 is an overall view of an elevator apparatus according to one embodiment of the present invention. As shown herein, the elevator apparatus according to the present embodiment includes an elevating body (elevator car) 401, a counterweight 402, a main rope 403, a hoist 10, a guide rail 404, an emergency stop device 405, an actuating lever 406, a governor 407, a sheave 408, and a speed governing rope 409.

[0018]

The elevating body 401 and the counterweight 402 are suspended from the main rope 403. The hoist 10 is disposed in a machine room 1200 provided in a building 1000. The main rope 403 is wound around the hoist 10. In the machine room 1200, a drive device (not shown) configured to drive and brake the hoist 10 is disposed. The drive device

frictionally drives the main rope 403 by rotating the hoist 10, thereby causing the elevating body 401 and the counterweight 402 to move up and down. Note that although Fig. 4 shows an exemplary configuration in which the hoist 10 is disposed in the machine room 1200, the hoist 10 may be disposed in a hoistway 1100.

[0019]

The elevating body 401 is installed in the hoistway 1100 provided in the building 1000. The elevating body 401 has a plurality of guide devices (not shown), is slidably engaged with the guide rail 404, and guided by the guide rail 404 to move up and down in the hoistway 1100. Hereinafter, a direction in which the elevating body 401 and the counterweight 402 move up and down is referred to as a lifting and lowering direction.

[0020]

The counterweight 402 has a plurality of guide devices (not shown). The plurality of guide devices for the counterweight 402 is slidably engaged with a guide rail (not shown) fixed to a wall of the hoistway 1100, and guided by the guide rail (not shown) in the lifting and lowering direction to move up and down in the hoistway 1100.

[0021]

The emergency stop device 405 is provided in the elevating body 401, and grips the guide rail 404 by wedges and stops the elevating body 401 from falling in case of emergency. The actuating lever 406 is pivotally supported by the elevating body 401 and drives the emergency stop device 405. The actuating lever 406 is coupled to the speed governing rope 409.

[0022]

The governor 407 cuts off a power source for the drive device that drives the hoist 10 and a power source for a control device (not shown) that controls the drive device when a speed at which the elevating body 401 moves up and down exceeds a rated speed and reaches a first excessive speed (for example, a speed 1.3 times faster than the rated speed). The governor 407 actuates the actuating lever 406 provided in the elevating body 401 to actuate the emergency stop device 405 when a speed at which the elevating body 401 falls reaches a second excessive speed (for example, a speed 1.4 times faster than the rated speed). As a result, the elevating body 401 is mechanically stopped in case of emergency.

[0023]

Next, the hoist 10 according to the present embodiment will be described in detail. Figs. 1A to 1C are overall views of the hoist 10. Fig. 1A is a left side

view, Fig. 1B is a front view, and Fig. 1C is a right side view. As shown in Fig. 1B, the hoist 10 mainly includes a housing 1, a sheave 14 rotatably attached to the housing 1 and around which a rope is wound, a brake disc 26 that is integrally provided with the sheave 14 and rotates, an electromagnetic brake device 15 configured to brake the brake disc 26, and a brake bracket 50 fixed to an attaching portion 1a of the housing 1. As shown in Fig. 1A, the attaching portions 1a that project radially from a central portion toward both upper corners are provided on the housing 1. The brake bracket 50 having a substantially C-shaped cross section is attached to an inner surface side of the attaching portion 1a. Two support shafts 37 are provided in parallel at both ends of the brake bracket 50. The electromagnetic brake device 15 that slides over the support shafts 37 is installed so as to stride over the brake disc 26. A braking force can be given to the sheave 14 by clamping the brake disc 26 with a brake shoe 27 of the electromagnetic brake device 15.

[0024]

Note that in the present embodiment, the attaching portion 1a is provided on the back surface side (a side opposite to the side where the sheave 14 is provided) instead of at a central portion in a thickness direction of the housing 1.

This is because, even in a case where a suspended load acts on the sheave 14, thereby causing the housing 1 to deform toward the sheave 14, the influence of deformation of the housing 1 on the braking operation of the electromagnetic brake device 15 can be reduced by providing the attaching portion 1a at the back surface side where a deformation amount is small.

[0025]

Fig. 2 is a cross-sectional view taken along line A-A in Fig. 1C and describes the structure of an electric motor 7 that gives a driving force to the hoist 10 and the structure of the brake shoe 27 that gives a braking force to the sheave 14. As shown herein, in the housing 1, an annular storage recess 21 is formed on the front side and a cylindrical support wall 17 projects from a tip of a boss portion 16 that is left at the center of the storage recess 21. A shaft hole 18 is formed at an axial center position of this support wall 17 and the boss portion 16 so that the shaft hole 18 penetrates the housing 1. One end of a main shaft 19 is fixed to the shaft hole 18. A stator 22 of the electric motor 7 is attached to an inner surface of an outer peripheral wall of the storage recess 21. The stator 22 has a coil and continuously varies a magnetic field by energization.

[0026]

The sheave 14 and the brake disc 26 integrally constitute a rotating body block 2. The rotating body block 2 generally has a substantial disc-shape, and a shaft center portion thereof is supported by the main shaft 19 via a bearing 23. At the same time, an outer periphery of the rotating body block 2 is the brake disc 26. A rotor 31 of the electric motor 7 is provided to extend on one side of the rotating body block 2, and the sheave 14 for winding up the hoisting rope is fixed with a bolt or the like on the other side of the rotating body block 2.

[0027]

The rotor 31 of the electric motor 7 includes a cylindrical wall 24 integrally formed with the rotating body block 2 and a permanent magnet 25 fixed to an inner circumferential wall of the cylindrical wall 24. The rotor 31 is inserted and disposed in the storage recess 21 of the housing 1, and magnetism working surfaces of the rotor 31 and the stator 22 face each other with an air gap interposed therebetween.

[0028]

The electromagnetic brake device 15 includes a pair of brake shoes 27a and 27b, an armature 28 that holds the brake shoe 27a, a brake body (body) 33 that holds the brake shoes 27b, and the like.

[0029]

Next, a configuration in the vicinity of the electromagnetic brake device 15 will be described in detail with reference to Figs. 3A to 3C. Note that Fig. 3A is an enlarged view showing a main part of Fig. 1A. Fig. 3B is an enlarged cross-sectional view showing a main part of Fig. 1B. Fig. 3C is an enlarged view showing a main part of Fig. 1C.

[0030]

As shown in Figs. 3A and 3B, the brake bracket 50 having a substantially C-shaped cross section is fixed with a bolt 52 on the attaching portion 1a in the housing 1 on the side of the brake disc 26. Faces facing each other are formed at both ends of the brake bracket 50. An attaching hole 50a is provided at each of the faces so that the attaching holes 50a face each other. The support shaft 37 is installed so as to stride over the attaching holes 50a. The two support shafts 37 installed in parallel in the brake bracket 50 penetrate holes 33a on both sides of the brake body 33 of the electromagnetic brake device 15, and support the electromagnetic brake device 15 in a cantilever manner. With these configurations, the brake body 33 can slide in a thickness direction of the brake bracket 50, and the electromagnetic brake device 15 can move perpendicularly to the brake disc 26.

[0031]

As shown in Fig. 3B, a stopper bolt (stopper) 35 and a compression spring 42 are provided inside of the brake bracket 50. The stopper bolt 35 penetrates the brake body 33 and is fixed at a tip of the brake bracket 50. The compression spring 42 is fitted to the stopper bolt 35 between the brake body 33 and the brake bracket 50. With this configuration, the brake body 33 is biased in a direction away from the brake disc 26. Meanwhile, a range in which the brake body 33 slides in the direction away from the brake disc 26 is restricted. Furthermore, with this configuration, an interval between the brake disc 26 and the brake shoe 27a and an interval between the brake disc 26 and the brake shoe 27b are kept equivalent to each other.

[0032]

Note that as shown in Fig. 3B, the armature 28 the gravity center of which substantially matches that of the electromagnetic brake device 15 is disposed on the side of the sheave 14, and the brake bracket 50 and the support shaft 37 are disposed on the side of the housing 1. At the same time, as shown in Figs. 1C and 3C, the stopper bolt 35 and the compression spring 42 are disposed while being shifted in an outer circumferential direction of the brake disc 26 by a distance Y from the center of the support shaft 37. With this configuration, even though the

electromagnetic brake device 15 tends to shift in an inner circumferential direction of the brake disc 26 under the weight thereof, the electromagnetic brake device 15 is prevented from shifting by a repelling force of the compression spring 42. As a result, the shifting of the electromagnetic brake device 15 can be restricted.

[0033]

Thus, in the present embodiment, the electromagnetic brake device 15 is supported movably in an axial direction by the two support shafts 37. The support shaft 37 is attached to the housing 1 via the brake bracket 50. Therefore, it is unnecessary to configure the brake bracket 50 so as to stride over both sides of the brake disc 26, and as a result, it is possible to realize a substantially more compact and lighter bracket than conventional ones.

[0034]

Note that in the present embodiment, as shown in Fig. 3A, the support shaft 37 is fastened by a bolt 46 inserted into one hole of a flat securing member 39. The support shaft 37 is caused to penetrate the attaching hole 50a of the brake bracket 50 and the through hole 33a of the brake body 33. Then, the securing member 39 is fastened to the brake bracket 50 by a bolt 51 inserted into the other hole of the securing member 39. However, other fixing methods

may be used. For example, the support shaft 37 may be welded or bonded to the brake bracket 50.

[0035]

Next, the operation of the electromagnetic brake device 15 will be described with reference to Figs. 5 and 6. Fig. 5 is a view showing how a brake is working by the electromagnetic brake device 15. Fig. 6 is a view showing how the brake is released by the electromagnetic brake device 15.

[0036]

The electromagnetic brake device 15 is characterized by the above-described structure in which the electromagnetic brake device 15 is attached to the housing 1 by the support shaft 37. An overview of an internal structure of the electromagnetic brake device 15 will be described below. The electromagnetic brake device 15 includes the pair of brake shoes 27a and 27b, the armature 28, a brake spring 36, and an electromagnetic drive portion 29. The brake shoes 27a and 27b brake the brake disc 26 by pushing an outer peripheral side surface of the brake disc 26. The armature 28 holds the brake shoe 27a. The brake spring 36 biases the armature 28 to the side of the brake disc 26 (C direction in Fig. 4) in order to give a braking force to the sheave 14. The electromagnetic drive portion 29 causes the sheave 14 to be rotatable by compressing the

brake spring 36 and releasing the brake shoes 27a and 27b from the outer peripheral side surface of the brake disc 26.

[0037]

The electromagnetic drive portion 29 is directly fixed to the brake body 33 by a fixing bolt (not shown) or indirectly fixed to the brake body 33 via other attaching member. The brake shoe 27b is directly fixed to the brake body 33 or indirectly fixed to the brake body 33 via other attaching member. The brake body 33 has a mechanism that brakes or releases the other outer peripheral side surface of the brake disc 26. The brake body 33 has a structure in which a high braking force is obtained by pinching the brake disc 26 from both sides.

[0038]

The electromagnetic drive portion 29 functions as an electromagnet for attracting the armature 28 electromagnetically. The electromagnetic drive portion 29 includes a combination of a magnetic coil and an iron core (not shown). A material with a large magnetic permeability is used for the iron core. The brake spring 36 pushes, toward the brake disc 26 (C direction in the drawings), the armature 28 and a first assembly 43 of the brake shoe 27a (rightward-descending hatching) that are disposed in the electromagnetic brake device 15. As a result, the brake

shoe 27a strongly pushes one outer peripheral side surface of the brake disc 26 (the right side surface in the drawings). At this moment, the brake spring 36 is not extended to the full length and a spring power remains.

[0039]

Therefore, by a reaction force of the brake spring 36, the brake body 33 and a second assembly 44 of the electromagnetic drive portion 29 (rightward-ascending hatching) move in the opposite direction (D direction in the drawings) and the brake shoe 27b provided in the brake body 33 strongly pushes the other outer peripheral side surface of the brake disc 26 (the left side surface in the drawings). Thus, the brake spring 36 has a function of pinching the brake disc 26 from both sides by the brake shoes 27a and 27b and keeping the sheave 14 in a braking condition.

[0040]

In response to this, an electric current is passed through the magnetic coil in the electromagnetic drive portion 29, and as a result, the iron core is energized to attract the armature 28. As shown in Fig. 6, this causes the armature 28 to drive the brake shoe 27a in a direction away from the brake disc 26 against the spring power of the brake spring 36 and release a braking force for the brake disc 26.

[0041]

Then, the electromagnetic brake device 15 is moved by the compression spring 42 by a distance X in the left direction (C direction in the drawings) until the electromagnetic brake device 15 touches the head of the stopper bolt 35. A gap between the head of the stopper bolt 35 and the brake body 33 is set to X with respect to gap $2X$ between the armature 28 and a core. This enables a gap between the brake disc 26 and each of the brake shoes 27a and 27b on both sides to be equally X when the brake is released.

[0042]

Meanwhile, when energization to the magnetic coil in the electromagnetic drive portion 29 is interrupted, the electromagnetic drive portion 29 is demagnetized. Therefore, as described above, this causes the pair of brake shoes 27a and 27b to push the outer peripheral side surface of the brake disc 26 to brake the sheave 14.

[0043]

As described above, according to the present embodiment, a large-scale support bracket as conventional ones becomes unnecessary, and a structure of attaching the electromagnetic brake device 15 to the housing 1 can be simplified. As a result, the overall weight of the hoist 10 can be reduced. This is accomplished by the following

configurations. That is, the electromagnetic brake device 15 is supported movably in the axial direction by the two support shafts 37, a shaft member 5 is attached to the housing 1 via the brake bracket 50, the armature is disposed on the sheave side of the braking surface of the brake disc, and the support shafts and the brake bracket are disposed on the side of the housing.

[0044]

In comparison with Figs. 7A to 7C and Fig. 8, in the conventional hoist 110, the electromagnetic brake device 115 needs to be supported by the support shaft 137 in order to attach the electromagnetic brake device 115 to the housing 101. Also, the electromagnetic brake device 115 needs to be fixed to the housing 101 via a strong brake bracket 147 supporting both sides of the support shaft 137 to enclose the sides. Meanwhile, in the hoist 10 according to the present embodiment, the electromagnetic brake device 15 is supported movably in the axial direction by the two support shafts 37. The shaft member 5 is fixed to the attaching portion 1a of the housing 1 via the brake bracket 50. With this configuration, the size and weight of the hoist 10 can be reduced.

[0045]

Furthermore, the electromagnetic brake device 15 has also been made lightweight. Therefore, it is possible to

improve the workability for maintenance personnel when the electromagnetic brake device 15 is removed from the hoist 10 in cases where the brake shoes 27a and 27b are replaced with other ones and periodic maintenance is performed.

[0046]

It is to be understood that the present invention includes various modification, but is not limited to the above-described embodiment. For example, the above-described embodiment has been used to describe the present invention in detail in an easy-to-understand manner. The present invention is not limited to an embodiment that includes all the configurations described above.

Furthermore, a part of a configuration of an embodiment can be replaced with a configuration of another embodiment. Also, a configuration of an embodiment can be added to a configuration of another embodiment. With respect to a part of a configuration in each embodiment, additions, deletions, substitutions of other configuration can be made.

[0047]

Furthermore, the hoist according to an embodiment of the present invention can be used for either a machine room-less elevator apparatus or an elevator apparatus with a machine room. Furthermore, the electromagnetic brake device 15 is fixed to the housing 1 with two support shafts

37 and one brake bracket 50. However, the number of the support shafts 37 and the number of the brake bracket 50 are not limited to the above-described numbers.

What is claimed is:

1. A hoist for an elevator, comprising:

a housing;

a stator having an annular shape and provided to the housing;

a main shaft having one end fixed to a center of the stator;

a sheave rotatably provided to the main shaft;

a brake disc integrally formed with the sheave;

an annular rotor integrally formed with the sheave;

an electromagnetic brake device configured to brake the brake disc with a pair of brake shoes; and

a brake bracket fixed to the housing and supporting the electromagnetic brake device,

wherein the electromagnetic brake device includes a brake body and an armature, the brake body holding one of the brake shoes on a side of the housing from a braking surface of the brake disc, the armature holding the other brake shoe on a side of the sheave from the braking surface of the brake disc, and

the brake bracket has a support shaft movably supporting the brake body in an axial direction on the side of the housing from the braking surface of the brake disc.

2. The hoist for an elevator according to claim 1, wherein a compression spring and a stopper bolt are disposed inside the brake bracket, the compression spring biasing the brake body in a direction away from the brake disc, the stopper bolt restricting a range in which the brake body slides in a direction away from the brake disc.

3. The hoist for an elevator according to claim 2, wherein the compression spring is disposed while being shifted in an outer circumferential direction of the brake disc by a predetermined distance from the support shaft.

4. The hoist for an elevator according to claim 1, wherein a plurality of the support shafts is disposed in parallel inside the brake bracket.

5. An elevator apparatus comprising:

an elevating body configured to move up and down in a hoistway in a building;

a counterweight;

a main rope from which the elevating body and the counterweight are suspended;

a hoist disposed in the hoistway or a machine room and configured to wind up the main rope; and

a guide rail configured to guide lifting and lowering of the elevating body,

wherein the hoist comprises:

a housing;

a stator having an annular shape and disposed in the housing;

a main shaft having one end fixed to a center of the stator;

a sheave rotatably disposed on the main shaft;

a brake disc integrally formed with the sheave;

an annular rotor integrally formed with the sheave;

an electromagnetic brake device configured to brake the brake disc with a pair of brake shoes; and

a brake bracket fixed to the housing and supporting the electromagnetic brake device,

wherein the electromagnetic brake device includes a brake body and an armature, the brake body holding one of the brake shoes on a side of the housing from a braking surface of the brake disc, the armature holding the other brake shoe on a side of the sheave from the braking surface of the brake disc, and

the brake bracket has a support shaft movably supporting the brake body in an axial direction on the side of the housing from the braking surface of the brake disc.