

SPECIFICATION

TITLE OF THE INVENTION

5 THIN TYPE TRACTION MACHINE FOR ELEVATOR AND
ELEVATOR DEVICE

FIELD OF THE INVENTION

10 The present invention relates to a traction
machine for driving an elevator, and, in particular,
relates to a thin type traction machine suitable for
a machine roomless elevator.

DESCRIPTION OF PRIOR ART

15 Such as a traction machine and a motor control
device for upward and downward running of an elevator
car, or a governor used for emergency brake when the
car runs in over speed are disposed generally in a
machine room provided in the upper most portion of a
20 building. However, for an elevator of which upward and
downward running speed of the car is comparatively slow,
a machine roomless elevator in which no machine room
is provided also becomes widespread.

25 In the case of this machine roomless elevator, ones
conventionally disposed in a machine room are disposed

in a hoistway, and a traction machine is also disposed in the hoistway. For this purpose, there are varieties of shapes and disposing states of the traction machine, for example, such as a part of the traction machine is
5 disposed in a manner to overlap with the cross section of the car at the lower most portion or the upper most portion in the hoistway, or the traction machine is disposed in a gap between the car and the hoistway wall at a middle portion in the height direction of the
10 hoistway. Since the gap between the car and the hoistway wall is usually about a few hundreds mm, in order to dispose the traction machine in the gap, a flat shaped traction machine is necessitated, thus a so called thin type traction machine is used.

15 With regard to such thin type traction machine, for example, such as JP-A-2004-2038 and JP-A-2003-104666 disclose technology of braking the outer circumferential face of the brake drum. Such as
20 brake pad (shoe) forming a part of an electromagnetic brake device in both disclosures is attached at left and right two portions on the outer contour portion of the thin type traction machine.

SUMMARY OF THE INVENTION

25 An example of cross section of a hoistway relating

to a machine roomless elevator to which the present invention is applied is shown in Fig.6. As shown in the drawing, a thin type traction machine 18 is generally disposed in a gap of about a few hundreds mm between
5 a hoistway 15 and a car 17 in a manner so that the thin type traction machine 18 faces the hoistway wall 16, and further, at the lateral side of the traction machine 18 a counter weight 19 is frequently disposed. Namely, the thin type traction machine 18 is disposed in a manner
10 that the four sides thereof are surrounded by the hoistway wall 16, the car 17 and the counter weight 19. Accordingly, if the size of the thin type traction machine 18 can be reduced, the cross section of the hoistway can be reduced, thereby, freedom of layout of
15 machines disposed within the hoistway 15 can be enlarged. Therefore, the size reduction of the thin type traction machine used for the machine roomless elevator, in particular, the reduction of axial length and the width size of the entire traction machine is an important
20 technical task.

On the other hand, with regard to the height size of the entire traction machine, since the hoistway 15 usually has a broad space in the height direction, the merit obtained when reduced the height size of the
25 entire thin type traction machine is small. Namely, with

regard to a machine roomless elevator in which the thin type traction machine is disposed in a gap between the car 17 and the hoistway wall 16 at a middle portion in the height direction of the hoistway 15, if the axial length and the width size of the entire traction machine can be reduced even while allowing enlargement of height size of the entire thin type traction machine, it is possible to enhance the value of the machine roomless elevator.

10 However, in a thin type traction machine wherein the outer circumferential face of the brake drum is braked, such as the brake pad (shoe) forming a part of an electromagnetic brake device has to be disposed at left and right two portions on the outer contour portion 15 of the traction machine as disclosed in JP-A-2004-2038 and JP-A-2003-104666, thereby, it was understood that the width enlargement of the entire traction machine in association with the pad provision was unavoidable.

 In view of the above task with regard to a thin 20 type traction machine wherein the outer circumferential face of the brake drum is braked, an object of the present invention is to provide a thin type traction machine for an elevator of which width size of the entire traction machine can be reduced and an elevator device 25 that uses such thin type traction machine.

By the way, in a thin type traction machine, in order to gain a drive torque while likely thinning an electrical motor, the diameter of a sheave for driving ropes is shortened on one hand, the diameter of a brake
5 drum tends to be enlarged in comparison with the diameter of the sheave for ensuring a sufficient brake torque. Namely, since one of the features of a thin type traction machine is that the diameter of the brake drum is larger than the diameter of the sheave, this fact
10 also operates as one of restrictions when reducing the width size of the thin type traction machine wherein the outer circumferential face of the brake drum is braked.

Accordingly, a feature of the present invention
15 for achieving the above object is, in a thin type traction machine for an elevator including a brake drum that rotates integrally with a sheave and has a larger diameter than that of the sheave, to dispose braking portions by an electromagnetic brake device on the outer
20 circumference face of the brake drum in opposing manner as well as to provide the electromagnetic brake device at upper and lower two portions on a housing of the traction machine, and further, to dispose the thin type traction machine within an elevator hoistway between
25 a car and a hoistway wall.

Herein, the upper and lower two portions on the housing are an upper and lower positions with reference to a horizontal line extending from the center of the sheave, and at least the upper side electromagnetic
5 brake device is within a region of the diameter of the sheave, namely, in an interval defined between the ropes. Thereby, with such provision of the electromagnetic brake device a possible enlargement of the width size is suppressed.

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EFFECTS OF THE INVENTION

According to the present invention, the width size of a thin type traction machine wherein the outer circumferential face of a brake drum is braked can be
15 reduced, and by disposing the thin type traction machine in a hoistway the freedom of layout of an elevator device can be enlarged.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

20 Fig.1 is a front view of a thin type traction machine used for an elevator relating to an embodiment of the present invention.

Fig.2 is a side view of the thin type traction machine of Fig.1.

25 Fig.3 is a partially cross sectioned side view of

the thin type traction machine of Fig.1.

Fig.4 is a side view of a thin type traction machine used for an elevator relating to another embodiment of the present invention.

5 Fig.5 is a front view of the thin type traction machine of Fig.4.

Fig.6 is a cross section of a hoistway for a machine roomless elevator to which the present invention is applied.

10 Fig.7 is a front view of a thin type traction machine used for an elevator relating to still another embodiment of the present invention.

Fig.8 is a plane view of the thin type traction machine of Fig.7.

15 Fig.9 is a side view of the thin type traction machine of Fig.7.

Fig.10 is a partially cross sectioned side view of a thin type traction machine used for an elevator relating to a further embodiment of the present
20 invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Herein below, embodiments for carrying out the present invention will be explained with reference to
25 the drawings. In addition to the above objects and

features of the present invention, effective devices are applied to these embodiments, and such will be explained in detail in connection with the respective embodiments.

5 [EMBODIMENT 1]

Figs.1 through 3 show a thin type traction machine used for an elevator relating to an embodiment of the present invention, wherein Fig.1 is a front view, Fig.2 is a side view and Fig.3 is a partially cross sectioned
10 side view. As shown in the drawings, the thin type traction machine is constituted by a housing 1, a sheave 2, a main shaft 3, bearings 4, a brake drum 5, a rotor 10 of a motor, stator 12 thereof and electromagnetic brake devices 6, and other than the above, although not
15 illustrated in the drawings, such as a rotation detector is mounted inside the housing 1.

The housing 1 is formed in such a manner that after forming its rough shape thereof by cast iron, and portions thereof requiring accurate size are machined,
20 and the inner shape of the housing 1 is formed in a cylindrical shape with a bottom so as to permit accommodation of such as the brake drum 5, the motor rotor 10, the stator 12, the bearings 4 and the rotation detector inside the housing 1. A boss portion provided
25 at the center portion of the housing 1 is hollow, and

therein the main shaft 3 is inserted and supported in cantilever fixation. When installing the thin type traction machine in an elevator hoistway 15, the housing 1 is fixed on a traction machine fixation member 5 attached in the hoistway 15 via a vibration proof rubber.

At an inner portion of the housing 1 and at the outside position of the main shaft 3, a cylindrical shaped projection formed integral with the housing 1 10 is provided, and on the outer circumferential face thereof the motor stator 12 is engaged by fitting. The stator 12 is primarily constituted by a stator core 13 formed by laminating electromagnetic steel plates, three phase stator windings 14 including U phase, V 15 phase and W phase and insulating members, and the stator windings 14 are disposed within slots provided in the stator core 13. For the purpose of thinning the traction machine, the stator windings 14 are formed in a concentrated winding 14 that permits to limit 20 comparatively easily the height of the coil ends. Further, the above referred to cylindrical shaped projection for fixing the stator 12 can be a separate member detachable from the housing 1 that is fixed by bolts or engaged by fitting to the housing 1 other than 25 the one integral with the housing 1. Further, other than

the engagement by fitting of the stator 12 on the outer circumference portion of the cylindrical shaped projection, through clearance fitting the stator 12 can be fixed on the inner side face of the housing 1 by bolts
5 by making use of through holes provided at yoke portions of the stator core 13. Further, it is necessary to provide a plurality of the through holes along the circumferential direction.

At an end of the main shaft 3, a plurality of
10 bearings 4 are arranged, and the sheave 2 is rotatably supported via the bearings 4. The brake drum 5 is disposed at the outside of the stator 12 along the outer circumferential direction and the inner portion of the housing 1 in a manner opposing to the motor stator 12,
15 and the brake drum 5 and the sheave 2 are formed integrally by such as cast iron. However, the brake drum 5 and the sheave 2 can be formed by detachable separate members, and can be connected such as by bolting and by fitting engagement.

20 By adhering a plurality of permanent magnets 11 on the inner circumferential face of the brake drum 5, the brake drum 5 constitutes a rotor of surface magnet type motor serving as the rotor yoke thereof. Accordingly, in this instance, the brake drum 5 is
25 required to be a magnetic substance, and the cast iron

meets the same. When the brake drum 5 is nonmagnetic substance or when the brake drum 5 cannot sufficiently fulfill the function of a rotor yoke even if the same is magnetic substance, concretely, such as when a cross
5 sectional area for magnetic flux passage required for the motor cannot be ensured because of thin thickness of the brake drum 5 or when the magnetization property of the material is poor, after attaching a magnetic substance separate from the brake drum 5 on the inner
10 circumferential face of the brake drum 5, permanent magnets 11 can be adhered on the inner circumferential face of the magnetic substance separate from the brake drum 5, and it is desirable to constitute the magnetic substance by laminated electromagnetic steel plates so
15 as to suppress iron loss.

Further, when constituting the same with the laminated electromagnetic steel plates, the motor rotor can be formed in a so called buried type wherein the permanent magnets 11 are buried in the inner portions
20 of the electromagnetic steel plates, and further, it becomes easy to form in such buried type. N poles and S poles of the permanent magnets 11 are arranged alternatively in circumferential direction, the numbers of the N poles and the S poles are the same,
25 and the numbers are the halves of the motor poles. The

rotor is disposed in a manner so as to oppose the outside of the stator 12 fixed to the housing 1 in radial direction through an air gap so that a so called outer rotor type motor is constituted. Rotating torque
5 generated by the motor portion is transmitted to the sheave 2 via the brake drum 5 and drives a plurality of ropes wound around the sheave 2. The ropes 20 suspend an elevator car 17 and a counter weight 19 in a manner of a well buckets, and by driving the ropes 20 the car
10 17 is caused to run in upward or downward direction.

At the top and bottom of the housing 1 each one set of electromagnetic brake devices 6 is fixed, and thus the traction machine is provided with two sets of mutually independent electromagnetic brake devices 6.
15 The electromagnetic brake device 6 is primarily constituted by an electromagnet 7, brake springs, a brake pad 8 and a brake pad supporting member 9, and each one set of the electromagnetic brake devices having the same structure is attached respectively at the top
20 and bottom of the housing 1. At the top and bottom of the housing 1, a hole or a cutout is provided, and the brake pad 8 and the brake pad supporting member 9 are disposed beyond the hole or the cutout. The center positions in circumferential direction where the brake
25 pad 8 and the brake pad supporting member 9 contact to

the brake drum 5 locate on the center axis line in width direction of the traction machine for both at the top and bottom portions, namely, the both are in opposing positional relationship by 180° with respect to the
5 rotating axis of the sheave 2 and the brake drum 5, and the pressing forces of the respective brake pads 8 on the brake drum 5 from the outer circumference toward the center direction are constituted cancelled out by the mutual pressing forces.

10 Now, the electromagnetic brake device 6 will be explained. The thickness of the electromagnetic brake device 6 is equal to or smaller than the axial length of the entire traction machine excluding the electromagnetic brake device 6, and further, the width
15 of the electromagnetic brake device 6 is determined to be smaller than the diameter of the sheave 2. Any electromagnetic brake devices 6 that fulfill these conditions are applicable, regardless to their constitutional parts and configurations. For example,
20 when speaking about the external configuration of the electromagnet 7, such as a circular shape and an angled shape such as a square shape will do. In a case of a machine roomless elevator using a thin type traction machine, contacting angle of ropes 20 wound around the
25 sheave 2 is usually about 180° , and the ropes 20 wound

around the sheave 2 generally run almost vertically toward upward or downward when viewed from the traction machine. Accordingly, any structural bodies like the electromagnetic brake device 6 should not be existed
5 in the space where the ropes 20 pass. By making the thickness of the electromagnetic brake device 6 to be equal to or smaller than the axial length of the entire traction machine excluding the electromagnetic brake device 6, and further, by making the width of the
10 electromagnetic brake device 6 to be smaller than the diameter of the sheave 2, the electromagnetic brake device 6 excluding fixing members can be disposed between the ropes 20 and in the dead space above the sheave 2 and the housing 1. Accordingly, a possible
15 interference between the electromagnetic brake device 6 and the ropes 20 can be avoided and at the same time, the axial length of the entire thin type traction machine and the size thereof in width direction can be reduced which are important for a thin type traction
20 machine used for a machine roomless elevator.

On one hand, by disposing the electromagnetic brake device 6 in the above referred to dead space above the sheave 2 and the housing 1, the height size of the entire thin type traction machine tends to enlarge.
25 However, since the hoistway 15 has a broad space in the

height direction, a merit of reducing the height size of the entire traction machine is small for the machine roomless elevator in which the thin type traction machine is disposed in middle in up and down direction
5 of the hoistway 15.

Now, an embodiment of the electromagnetic brake device 6 suitable for accommodating the same in the dead space above the sheave 2 and the housing 1 will be shown. Generally, an electromagnet 7 having a circular (true
10 circle) cross sectional shape shows maximum efficiency, and production ease thereof is desirable. And generally, when the shape moves away further from the circular cross sectional shape, for example, such as in a case of an angled shape electromagnet 7, both the efficiency
15 and the production ease are deteriorated. Accordingly, in the present embodiment, the electromagnetic brake device 6 is constituted by making use of a circular shaped electromagnet 7. In order to limit the axial length of the entire traction machine, the outer
20 diameter size of the circular electromagnet 7 is determined to be below the axial length of the entire thin type traction machine excluding the electromagnetic brake device 6, in particular, in a case of an axial length of an entire thin type traction
25 machine used for a machine roomless elevator having a

small load weight or small riding capacity of a car 17,
an extremely small axial length of about one hundred
and a few mm is generally required, and the reduction
of the outer diameter size of the circular shaped
5 electromagnet 7 is inevitably necessitated. For this
reason, in order to confine the outer diameter size of
the electromagnet 7 within one hundred and a few mm,
the core of the electromagnet 7 and the brake springs
are separated, and the plurality of brake springs are
10 constituted to be disposed at the outside of the core
of the electromagnet 7.

In an electromagnetic brake device 6 used for a
traction machine, there is one in which holes for
receiving brake springs are provided inside the core
15 of the electromagnet 7 and the brake springs are
disposed in the respective holes, however, through the
provision inside the core of the holes for receiving
the brake springs the magnetic flux passage becomes
small. For supplementing this, namely, in order to
20 enlarge the magnetic flux passage, it is common practice
to enlarge the outer diameter of the electromagnet 7.
However, in the present invention, since the size
reduction of the electromagnet 7 is important, by
arranging the brake springs on the outside the core not
25 by disposing the same inside the core, the axial length

required for the thin type traction machine is fulfilled while reducing the outer diameter size of the electromagnet 7.

[EMBODIMENT 2]

5 Figs.4 and 5 show another embodiment, in particular, with regard to fixing manner between the electromagnetic brake device and the housing, and the same portions as in the above embodiment are denoted by the same reference numerals and the explanation
10 thereof is omitted.

In the above embodiment, although the electromagnet 7 is directly fixed to the housing 1, in the present embodiment, the electromagnetic brake device 6 is designed fixed to the housing 1 via a fixing
15 member 50. In this instance, by forming the fixing member 50 in a thin type so as not to disturb the ropes 20 as shown in Fig.4, a possible interference with the ropes 20 can be prevented. Accordingly, the electromagnetic brake device as defined in the present
20 invention does not include the fixing member 50, and further, the structure where the electromagnetic brake device 6 is disposed in the region defined between the ropes 20 satisfies the other embodiment of the present invention.

25 [EMBODIMENT 3]

Figs.7 through 9 show still another embodiment, in particular, with regard to constituting parts of the electromagnetic brake device, and the same portions as in the above embodiments are denoted by the same
5 reference numerals and the explanation thereof is omitted.

As shown in the drawings, the electromagnetic brake device 6 is primarily constituted by an electromagnet 7, brake springs 51, a brake pad 8, a brake
10 pad supporting member 9 and an electromagnet supporting member 50, and the electromagnet 7 is primarily constituted by a core in which windings are buried and a movable iron core 71. The core is fixed to the electromagnet supporting member 50 and the movable iron
15 core is structured to have a mechanism that causes to perform relative movement during braking operation. To the movable iron core 71 a supporting column 72 coupling to the brake pad supporting member 9 is fixed, the brake pad 8 is attached to the brake pad supporting member
20 9 and with the supporting column 72 the movable iron core 71, the brake pad supporting member 9 and the brake pad 8 are operated integrally.

Although a plurality of brake springs 51 are arranged around the outside of the core, in order to
25 limit the axial length of the entire traction machine

as well as to maximize the outer diameter size of the electromagnet 7, the brake springs 51 are disposed at left and right outside of the core when viewed from the front face or back face of the entire thin type traction machine as well as the brake springs 51 are disposed at positions not protruding from the core with regard to the cross axial direction of the traction machine. Since the axial length of a thin type traction machine used for a machine roomless elevator is generally smaller than the diameter of the sheave 2, when a circular shaped electromagnet 7 having a smaller outer diameter size than the axial length of the entire traction machine excluding the electromagnet brake device 6 is used, the outer diameter size of the electromagnet 7 becomes smaller than the diameter of the sheave 2. Accordingly, there exists a dead space between the electromagnet 7 and the ropes 20, and the brake springs 51 are disposed in the dead space. Since the outer size of the movable iron core 71 with regard to the width direction of the traction machine is larger than the core, the one ends of the brake springs 51 are fixed at the portion protruding from the core. The other ends of the brake springs 51 are fixed to the side of the electromagnet supporting member 50, and the spring force is transmitted to the brake pad 8 via the movable

iron core 71. When the electromagnet 7 is operated, the movable iron core 71 is attracted toward the core against the spring force, and the brake pad 8 that operates integrally with the movable iron core 71 is structured to have a mechanism to remove from the brake drum 5.

[EMBODIMENT 4]

Fig.10 shows a further embodiment with regard to the motor portion constituting the traction machine, and the same portions as in the above embodiments are denoted by the same reference numerals and the explanation thereof is omitted. Although the motor portion in the above embodiments is constituted by an outer rotor type, Fig.10 shows a motor portion constituted by an inner rotor type. Namely, although the rotor 10 is disposed outside the stator 12 in Fig.3 embodiment, in Fig.10 embodiment, the rotor 10 is disposed inside the stator 12. As in this manner, conversion from the outer rotor type to the inner rotor type can be performed only by modifying the surrounding structure of the motor portion, accordingly, the present embodiment also achieves the effects of the present invention, namely, the effects of suppressing the width size of the traction machine.

EXPLANATION OF REFERENCE NUMERALS

- 1...Housing,
- 2...Sheave,
- 3...Main shaft,
- 5 4...Bearing,
- 5...Brake drum,
- 6...Electromagnetic brake device,
- 7...Electromagnet,
- 8...Brake pad,
- 10 9...Brake pad supporting member,
- 10...Rotor iron core,
- 11...Permanent magnet,
- 12...Stator,
- 13...Stator iron core,
- 15 14...Stator winding,
- 15...Hoistway,
- 16...Hoistway wall,
- 17...Car,
- 18...Thin type traction machine,
- 20 19...Counter weight and
- 20...Rope.

[Claims]

[Claim 1]

A thin type traction machine for an elevator comprising a housing supporting a suspending weight of the elevator, a main shaft supported by the housing in cantilever fixation, a sheave attached via bearings fixed to the other end of the main shaft, a brake drum that rotates integrally with the sheave as well as has a larger diameter than that of the sheave and electromagnetic brake devices that brake the brake drum, characterized in that

brake portions of the electromagnetic brake devices are arranged around the outer circumferential face of the brake drum so as to oppose each other, the electromagnetic brake devices are disposed at up and down two portions on the housing and are respectively arranged in up and down with reference to the horizontal line passing through the center of the sheave, at least the upper side electromagnetic brake device is arranged in a region defined by ropes wound around the sheave, and

brake springs in the electromagnetic brake device are located outside an electromagnet and are disposed inside the outer size of the electromagnet with respect to cross axial direction of the traction machine.

[Claim 2]

A thin type traction machine for an elevator according to

claim 1, characterized in that an electromagnet in the electromagnetic brake device is fixed to the housing.

[Claim 3]

5 A thin type traction machine for an elevator according to claim 1, characterized in that the electromagnetic brake device is fixed to the housing via a supporting member.

[Claim 4]

10 A thin type traction machine for an elevator according to claim 1, characterized in that the maximum outer size of the electromagnetic brake device in axial direction of the traction machine is equal to or less than the maximum outer size in axial direction of the entire traction machine excluding the
15 electromagnetic brake device.

[Claim 5]

 A thin type traction machine for an elevator according to claim 1, characterized in that the maximum outer size of the
20 electromagnetic brake device in the diameter direction of the sheave is less than the diameter of the sheave.

[Claim 6]

 A thin type traction machine for an elevator according to
25 claim 1, characterized in that the electromagnetic brake devices

are arranged in opposing manner with respect to the rotating axis of the brake drum and are disposed at positions where their brake drum pressing forces are canceled out each other.

5 [Claim 7]

A thin type traction machine for an elevator according to claim 1, characterized in that the electromagnetic brake devices are disposed on the center axial line in the width direction of the traction machine, and center positions thereof where the
10 brake drum is braked are located at the center in the width direction of the traction machine.

[Claim 8]

A thin type traction machine for an elevator according to
15 claim 1, characterized in that a three phase AC motor is built in inside the housing, and the stator winding thereof is a concentrated winding and the rotor thereof is a magnet type rotor wherein a plurality of permanent magnets are arranged.

20 [Claim 9]

A thin type traction machine for an elevator according to claim 8, characterized in that the stator is fixed to the housing and the rotor is fixed to the brake drum, the stator and the rotor are constituted in a manner to oppose each other in the
25 radial direction via an air gap, and the diameter of the air

gap is larger than the diameter of the sheave.

[Claim 10]

An elevator device, characterized in that the thin type
5 traction machine for an elevator according to claim 1 is disposed
between a car and a hoistway wall in an elevator hoistway.

[Claim 11]

An elevator device according to claim 10, characterized in
10 that a counterweight is disposed in parallel with the thin type
traction machine in a region between the car and the hoistway
wall.