

TRACTION MACHINE FOR ELEVATOR

[Background of the Invention]

[Technical Field]

The present invention relates to a traction machine for elevator, which is arranged in a hoistway to be used.

5 With conventional and general elevator devices, a traction machine for elevator, by which a car or cars are caused to go up and down in a vertical direction, a motor control device, a speed governor which is used for an emergency braking when the car and cars are accelerated, or the like are mounted in a machine room formed at a topmost of a building. In recent years, however, elevators, which are provided with no machine room and called machine
10 room-less elevators, constitute a mainstream in the field of elevators, in which a car is comparatively slow in elevational speed. With such elevators, all equipment having been conventionally mounted in a machine room is mounted in a hoistway and a traction machine for elevator must be also arranged in a clearance in the order of several hundreds mm between a car and a hoistway wall, so that the traction machine be required to be formed thin. In such thin
15 traction machines, there is known an arrangement for air-cooling in order to restrict a temperature rise in a motor stator being a heat source (see, for example, International Publication WO 2004-108579 and JP-A-2006-81305).

 However, traction machines for elevator described in International Publication WO 2004-108579 and JP-A-2006-81305 are constructed to arrange brake drums rotatably in an
20 opposite manner in a housing, which bears a suspended load, and formed to cover the brake drums, but the construction covering a motor stator being a heat source transfers its heat to the brake drums through motor rotators to cause thermal expansion in the brake drums. Besides, since the air-cooling structure serves to restrict a temperature rise in a motor stator being a heat source, it cannot cool the brake drums effectively and when this thermal expansion increases, it
25 exerts an adverse influence upon the relationship between the brake drums and electromagnetic brake devices, by which the brake drums are brought into pressure contact to be braked, to lead to large scaling of the electromagnetic braking devices.

[Brief Summary of the Invention]

 It is an object of the invention to provide a traction machine for elevator, which
30 can cool the neighborhood of a brake drum effectively to enable miniaturization and thinning.

 In order to attain the object, the invention provides a traction machine for

elevator, comprising a housing, a brake drum rotatably supported on the housing, a motor stator arranged in an annulus-shaped recess defined on an opposed portion of the housing to the brake drum, a motor rotator arranged in a space portion in the annulus-shaped recess in a position opposed to the motor stator and fixed to the brake drum, a sheave, which rotates integrally with the brake drum, and an electromagnetic braking device provided on the housing to brake the brake drum, and wherein at least a pair of communicating holes communicated to the space portion in the annulus-shaped recess is formed on the housing, and an air flow forming projection is provided to rotate in the space portion to form a cooling air flow passing through the communicating holes.

With such construction, the air flow forming projection rotating together with the brake drum forcibly moves an air in the space portion formed in the annulus-shaped recess to generate an air flow in the space portion through the communicating holes formed on the housing and such air flow can cool the neighborhood of the motor stator and the motor rotator and the neighborhood of the brake drum. Therefore, it is possible to prevent thermal expansion, which results in a decrease in the gap between brake pads and the brake drum, thus enabling materializing miniaturization and thinning of the traction machine for elevator.

Also, in addition to the above construction, the invention has a feature in that the air flow forming projection is provided outside the motor rotator and the communicating holes are formed on the housing positioned outside the air flow forming projection.

With such construction, without changing the conventional construction much, an air flow passing through the communicating holes from the space portion to lead to an outside surrounding space is readily formed owing to rotation of the air flow forming projection, such air flow enabling effectively cooling not only a motor stator and the motor rotator but also the brake drum positioned in the vicinity thereof.

Also, in addition to the above construction, the invention has a feature in that the air flow forming projection is provided on the brake drum.

With such construction, without changing the conventional construction much, the space portion in a region, in which the motor stator and the motor rotator are opposed to each other with a gap therebetween, is made use of to enable forming an air flow, which effectively cools the brake drum.

Further, in addition to the above construction, the invention has a feature in that one of the pair of communicating holes is provided in an outside position, which is larger in a distance from a central axis of rotation of the brake drum than the air flow forming projection and the other of the pair of communicating holes is provided in an inside position, which is

smaller in a distance from the central axis of rotation of the brake drum than the air flow forming projection.

With such construction, when the air flow forming projection rotates together with the brake drum, an air in an outside surrounding space is taken from the communicating
5 holes positioned inside and an air flow discharged from the communicating holes positioned outside is formed to enabling achieving effective cooling.

With the traction machine for elevator, according to the invention, the air flow forming projection rotating together with the brake drum forcedly moves an air in the space portion formed in the annulus-shaped recess to generate an air flow in the space portion through
10 the communicating holes formed on the housing and such air flow can cool the neighborhood of the motor stator and the motor rotator and the neighborhood of the brake drum. Therefore, it is possible to prevent thermal expansion, which results in a decrease in the gap between brake pads and the brake drum, thus enabling materializing miniaturization and thinning of the traction machine for elevator.

15 [Brief Description of the Several Views of the Drawing]

Fig. 1 is a cross sectional view showing a traction machine for elevator, according to an embodiment of the invention.

Fig. 2 is a front view showing a motor rotator of the traction machine for elevator, shown in Fig. 1.

20 Fig. 3 is a side view showing the motor rotator shown in Fig. 2.

Fig. 4 is a front view showing the traction machine for elevator, shown in Fig. 1.

Fig. 5 is a side view showing the traction machine for elevator, shown in Fig. 4.

Fig. 6 is a rear view showing the traction machine for elevator, shown in Fig. 4.

Fig. 7 is a front view showing the traction machine for elevator, shown in Fig. 4,
25 when an air flow is formed.

Fig. 8 is a cross sectional view showing a traction machine for elevator, according to a further embodiment of the invention.

Fig. 9 is a front view showing a brake drum of the traction machine for elevator, shown in Fig. 8.

30 Fig. 10 is a plan view showing an elevator using the traction for elevator shown in Fig. 1.

[Detailed Description of the Invention]

An embodiment of the invention will be described below with reference to the drawings.

Fig. 10 is a cross sectional view showing an elevator device using a traction machine for elevator, according to an embodiment of the invention. Provided in a hoistway 1 are a car 3 capable of going up and down along a pair of guide rails 2, a counterweight 5 connected to the car 3 by a length of wire rope (not shown) to be able to go up and down along a pair of guide rails 4, and a traction machine 6 for elevator arranged in a clearance between the hoistway 1 and the car 3. While a detailed construction will be described below, the traction machine 6 for elevator positions a stationary side housing 7 toward the car 3 and positions a sheave 8, which is rotatable relative to the housing 7, toward a hoistway wall.

Figs. 4 and 5 are a front view and a side view showing the traction machine 6 for elevator described above. The traction machine 6 for elevator is constructed such that plural lengths of wire rope connecting between the car 3 and the counterweight 5 are wound round the sheave 8 in a manner to agree with a plurality of grooves formed thereon and when the sheave 8 rotates to drive the wire rope, the car 3 and the counterweight 5 go up and down along the respective guide rails 2, 4 in reverse directions. A brake drum 9 is integrally joined to an outer periphery of the sheave 8 toward the car 3 and the housing 7 is arranged on a side of the brake drum 9 further toward the car 3, the sheave 8 and the brake drum 9 being supported in a rotatable relationship with the housing 7.

As described below in detail, an outer rotor type motor is provided on fitting opposed portions of the sheave 8 or the brake drum 9 and the housing 7, a rotor of the outer rotor type motor is provided on an outer periphery of the sheave 8 or the brake drum 9, and a stator of the outer rotor type motor is provided on the opposed portion of the housing 7. Moving parts represented by the sheave 8 and the brake drum 9 are rotatably driven in an integral manner upon energization of the outer rotor type motor and braked when energization is shut off to cause brake pads 12, 13 of electromagnetic braking devices 10, 11, which are formed in the same manner and arranged on upper and lower portions of the housing 7.

As described below with respect to detailed actions of the traction machine 6 for elevator thus constructed, a plurality of communicating holes 14, through which an internal space portion is opened outside from a side of the housing 7, are formed on the side as shown in Fig. 5, a pair of communicating holes 14 being formed in symmetrical positions about a central axis of rotation of a main shaft 16 in the construction. Also, as shown in Fig. 6 being a rear view, a plurality of communicating holes 15, through which the internal space portion is opened outside from a front side of the housing 7 toward the car 3, are formed on the front side, a pair of communicating holes 15 being formed in symmetrical positions about the central axis of rotation of the main shaft 16 in the construction. The communicating holes 14, 15 are not limited to

those as shown but can be optionally set in positions and number.

Fig. 1 is a cross sectional view showing the traction machine 6 for elevator and illustrating the specific construction thereof. The main shaft 16 is fitted into a boss portion formed centrally of the housing 7, an inserted side of the main shaft 16 cantilever-supports the sheave 8 and a moving side housing 18, with which the brake drum 9 is formed integral, through a bearing 17. A sealing material 27 is arranged at an end of the bearing 17 to restrict movement of a lubricant for the bearing 17. An annulus-shaped recess 19 is formed on a side of the housing 7 toward the sheave 8 and an annular motor stator 20 is fittingly fixed in the annulus-shaped recess 19. An annular motor rotator 21 is arranged on an outer periphery of the motor stator 20 with a predetermined clearance therebetween, the motor rotator 21 being fixed to the brake drum 9 positioned in the annulus-shaped recess 19.

The motor rotator 21 comprises annulus-shaped laminated magnetic steel sheets 22 and a plurality of permanent magnets 23, the permanent magnets 23 being stuck circumferentially to inner peripheral surfaces of the laminated magnetic steel sheets 22 so that N poles and S poles are made alternate. A plurality of air flow forming projections 24 spaced substantially equally in a circumferential direction and extended radially outward as shown in Figs. 2 and 3 as viewed from the housing 7 are formed on outer peripheral surfaces of the laminated magnetic steel sheets 22 constituting the motor rotator 21.

An end of the brake drum 9 and the motor rotator 21 fixed to the end are inserted into and arranged in the annulus-shaped recess 19 formed on the housing 7, and a gap defined between opposed portions of the motor stator 20 and the motor rotator 21, a clearance defined between the motor stator 20 and the motor rotator 21 and the housing 7, and a clearance defined between an internal surface of an outer periphery 26 of the housing 7 and the opposed portion of the brake drum 9 are communicated to define a series of space portions 25. The air flow forming projections 24 described above are arranged in the series of space portions 25.

When rotating in the space portions 25 together with rotation of the motor rotator 21, the air flow forming projections 24 serve as a fan, which forwards an air outside from within the space portions 25. In order that an air flow be formed in the space portions 25 owing to rotation of the air flow forming projections 24, the communicating holes 14 shown in Fig. 5 are formed on the outer periphery 26 of the housing 7 positioned outside in the vicinity of the air flow forming projections 24 and the communicating holes 15 shown in Fig. 6 are formed on the front side of the housing 7 positioned toward the central axis of rotation relative to the air flow forming projections 24. Thus the space portions 25 are made open to a surrounding space by the communicating holes 15 and the communicating holes 14.

Accordingly, when the air flow forming projections 24 rotate in the space portions 25 together with rotation of the motor rotator 21, an air flow directed outward is formed owing to the configuration of the air flow forming projections 24, and the communicating holes 14 are made a discharge port while the communicating holes 15 are made a suction port. In order to form an air flow directed radially outward, an air flow directed spirally outward, and the like, it is possible to variously determine the air flow forming projections 24 in configuration and size. In addition, while sequence in description is lacked, for the ease of describing the air flow, a cross section in Fig. 1 is in a position, in which one of the communicating holes 14 shown in Fig. 5 and one of the communicating holes 15 shown in Fig. 6 appear.

When an alternating current is made to flow through the motor stator 20, a magnetic field changing rotatively in a circumferential direction is generated, so that an electromagnetic force acts on the motor rotator 21 to generate a driving force on the brake drum 9 and the housing 18. Therefore, the brake drum 9, the housing 18, and the sheave 8 rotate together and the car 3 is driven through the wire rope wound round the sheave 8 to go up and down. When the car 3 stops, energization of the motor stator 20 is shut off and the electromagnetic braking devices 10, 11 are actuated to push the brake pads 12, 13 against an outer peripheral surface of the brake drum 9 to brake the motor rotator 21 and the sheave 8. At this time, energization of the motor stator 20 and pushing of the brake pads 12, 13 against the brake drum 9 cause the neighborhood thereof to generate heat.

Since the air flow forming projections 24 provided on the motor rotator 21 move rotatively at this time, however, it is possible to forcedly move an air in the space portions 25 formed on fitting opposed portions of a stationary side represented by the housing 7 and the motor stator 20 and a moving side represented by the motor rotator 21, the sheave 8, etc. When the traction machine 6 for elevator is seen from, for example, the car 3 side, assuming that the brake drum 9 and the sheave 8 rotate in a clockwise direction, an air flow discharged from the communicating holes 14 formed on the outer periphery 26 of the housing 7 is generated while an air in the outside surrounding space is sucked into the space portions 25 from the communicating holes 15 formed on the front side of the housing 7 as shown in Fig. 7.

The air flow passes the neighborhood of the motor stator 20 and the motor rotator 21 and the neighborhood of the brake drum 9 shown in Fig. 1 to thereby enable cooling them. Beside, the air flow forming projections 24 provided on the laminated magnetic steel sheets 22 also produces an effect of an increase in heat release performance owing to enlargement in an area in contact with an air in the space portions 25 in addition to an effect of generating an air flow for cooling. Consequently, temperature rise in the brake drum 9 is restricted and gap

variation between the brake pads 12, 13 and the brake drum 9 due to thermal expansion is restricted. When heat in the gap were transferred to the brake drum 9 to cause thermal expansion in a conventional manner, the gap between the brake pads 12, 13 and the brake drum 9 would decrease and the electromagnetic braking devices 10, 11 would be made large in size in a trial for prevention of such decrease, but an air flow is formed to enable cooling associated parts as described above and so it is possible to make the electromagnetic braking devices 10, 11 small in size, thereby enabling materializing miniaturization and thinning of the traction machine 6 for elevator.

Even in the case where the brake drum 9 and the sheave 8 shown in Fig. 1 rotate in a reverse direction, a cooling air flow shown in Fig. 7 can be formed likewise and substantially the same effect can be produced. In the embodiment, since the plurality of air flow forming projections 24 spaced substantially equally in a circumferential direction and extended radially outward are formed on the outer peripheral surfaces of the laminated magnetic steel sheets 22 constituting the motor rotator 21, a cooling air flow directed somewhat outward will be formed by the air flow forming projections 24 as the motor rotator 21 rotates. Accordingly, it is desirable to form the communicating holes 15 toward the center of the main shaft 16 relative to the communicating holes 14.

With the traction machine for elevator described above, at least a pair of the communicating holes 14 and a pair of the communicating holes 15 are formed on the housing 7 to be communicated to the space portions 25 in the annulus-shaped recess 19 and the air flow forming projections 24 rotating in the space portions 25 together with the brake drum 9 to form a cooling air flow passing through the communicating holes 14, 15 are provided, so that the air flow forming projections 24 rotating together with the brake drum 9 forcedly move an air in the space portions 25 formed in the annulus-shaped recess 19 to generate an air flow in the space portions 25 through the communicating holes 14, 15 formed on the housing 7 and such air flow can cool the neighborhood of the brake drum 9 as well as the neighborhood of the motor stator 20 and the motor rotator 21. Therefore, it is possible to prevent thermal expansion, which results in a decrease in the gap between the brake pads 12, 13 and the brake drum 9, thus enabling materializing miniaturization and thinning of the traction machine 6 for elevator.

Also, with the traction machine for elevator described above, since the air flow forming projections 24 are provided outside the motor rotator 21 and the communicating holes 14 are formed on the housing 7 positioned outside corresponding to the air flow forming projections 24, without changing the conventional construction much, it is possible to effectively form a cooling air flow using the space portions 25, in which the motor stator 20 and the motor

rotator 21 are opposed to each other with a gap therebetween. Beside, it is possible to effectively conduct an air flow, which is formed by the air flow forming projections 24, to the communicating holes 14 to discharge the same.

Further, with the traction machine for elevator described above, since the
5 communicating holes 14 shown in Fig. 5 are formed on the outer periphery 26 of the housing 7 positioned outside in the vicinity of the air flow forming projections 24 and the communicating holes 15 shown in Fig. 6 are formed on the front side of the housing 7 positioned toward the central axis of rotation relative to the air flow forming projections 24, when the air flow forming projections 24 rotate together with the brake drum 9, the communicating holes 15
10 positioned inside are made a suction port, through which an air in the surrounding space is taken, the communicating holes 14 positioned outside are made a discharge port, through which an air in the space portions 25 is discharged to the outside surrounding space, and the air flow is made use of to effectively cool the brake drum 9, etc. as well as the motor stator 20 and the motor rotator 21.

15 Fig. 8 is a cross sectional view showing a traction machine for elevator, according to a further embodiment of the invention. Parts equivalent to those in the embodiment shown in Fig. 1 are denoted by the same reference numerals as those therein, a detailed description therefor is omitted, and different parts are described. In this embodiment, air flow forming projections 24 acting in space portions 25 so as to form an air flow for cooling are formed not on
20 a motor rotator 21 but on a brake drum 9. As seen specifically from a front view of the brake drum 9 shown in Fig. 9, the air flow forming projections 24 are shaped to be exposed to wind pressure so as to move an air in the space portions 25 described above when rotating together with rotation of the motor rotator 21. A plurality of the air flow forming projections 24 spaced at predetermined intervals in a circumferential direction are formed on an outer periphery of the
25 brake drum 9 to have an appropriate pressure receiving area so as to be exposed to wind pressure in a rotating direction of the brake drum 9.

Also, with the traction machine for elevator, according to the embodiment, the air flow forming projections 24 rotate in the same manner as the motor rotator 21, so that it is possible to forcibly move an air in the space portions 25 formed in an annulus-shaped recess 19,
30 which defines a fitting portion of a stationary side represented by a housing 7 and a motor stator 20 and a moving side represented by the motor rotator 21, a sheave 8, etc. While an air in an outside surrounding space is sucked into the space portions 25 from communicating holes 15 formed on a front side of the housing 7 like the case in Fig. 7, an air flow discharged from communicating holes 14 formed on an outer periphery 26 of the housing 7 is generated and

owing to the air flow, a cooling air flow is caused to act on the brake drum 9 provided with the air flow forming projections 24 as well as on the neighborhood of the motor stator 20 and the motor rotator 21 shown in Fig. 8 to enable cooling the same.

5 Besides, since the air flow forming projections 24 in the embodiment is shaped not to extend mainly in a radial direction like the construction shown in Fig. 1 but to extend mainly in a horizontal direction, the air flow forming projections 24 in the embodiment will not interfere with brake pads 12, 13 put in a steady state even if the brake drum 9 thermally expands in a manner to influence a gap between it and the brake pads 12, 13.

10 In addition, in the respective embodiments of the invention, the moving side comprising the sheave 8, the brake drum 9, and the moving side housing 18 is rotatably cantilever-supported on the free end side of the main shaft 16, one end of which is fixed to the housing 7, with the bearing 17 therebetween, but the embodiments can be also applied to that construction, in which the main shaft 16 and the brake drum 9 are formed integral and a central boss portion of the housing 7 is rotatably arranged on the free end side of the main shaft 16 with
15 the bearing 17 therebetween.

CLAIMS:

[Claim 1]

A traction machine for elevator, comprising a housing, a brake drum rotatably supported on the housing, a motor stator arranged in an annulus-shaped recess defined on an opposed portion of the housing to the brake drum, a motor rotator arranged in a space portion in the annulus-shaped recess in a position opposed to the motor stator and fixed to the brake drum, a sheave, which rotates integrally with the brake drum, and an electromagnetic braking device provided on the housing to brake the brake drum, and

wherein at least a pair of communicating holes communicated to the space portion in the annulus-shaped recess is formed on the housing, and an air flow forming projection is provided to rotate in the space portion to form a cooling air flow passing through the communicating holes.

[Claim 2]

The traction machine for elevator, according to claim 1, wherein the air flow forming projection is provided outside the motor rotator and the communicating holes are formed on the housing positioned outside the air flow forming projection.

[Claim 3]

The traction machine for elevator, according to claim 1, wherein the air flow forming projection is provided on the brake drum.

[Claim 4]

The traction machine for elevator, according to claim 1, wherein one of the pair of communicating holes is provided in an outside position, which is larger in a distance from a central axis of rotation of the brake drum than the air flow forming projection and the other of the pair of communicating holes is provided in an inside position, which is smaller in a distance from the central axis of rotation of the brake drum than the air flow forming projection.