

TRACTION MACHINE FOR ELEVATOR

Background of the Invention

The present invention relates to an elevator traction machine that lifts and lowers a cage of an elevator system and, more particularly, to a thin elevator traction machine having reduced length in the axis direction of the traction machine.

5 As an elevator system, a so-called machine-room-less elevator system is widespread recently. In the machine-room-less elevator system, for the purpose of suppressing the height of a building, a machine-room in which machines such as a traction machine are stored is not provided in an upper part of a hoistway and the machines are provided in the hoistway.

10 In the case of the machine-room-less elevator system, all of the machines including the traction machine, which were set in the machine room in the past, are set in the hoistway.

 There are various configurations for setting the traction machine in the hoistway. However, in order to set the traction machine in a relatively narrow space between a cage and a
15 hoistway wall, a thin traction machine set to be opposed to the hoistway wall is necessary.

 A balance weight is often arranged in the hoistway beside such a thin traction machine. The traction machine is set to be surrounded by the hoistway wall, the cage, and the balance weight on all sides.

 Therefore, if the traction machine can be reduced in size, the cross section of the
20 hoistway can be reduced and a degree of freedom of a layout of the machines set in the hoistway can be increased.

 With this view, it is an important technical object to reduce the size of the traction machine used in the machine room-less elevator system, in particular, reduce the axial length dimension of the entire traction machine, i.e., reduce the thickness of the traction machine.

25 As a thin traction machine in the past, for example, as described in JP-A-2004-137037, JP-A-2004-299824, and WO/2006-129338, there is known a traction machine in which a stator is formed integrally with a housing in the outer circumference of a fixed main shaft fixed and pivotally supported by a housing, a rotor is integrally formed in the outer circumference of a sheave rotatably attached to one end of the fixed main shaft via a bearing, and an electric motor
30 unit is configured by the rotor and the stator arranged to be opposed to each other.

 There is also known a traction machine that, in the operation of an elevator

system, lifts and lowers a cage through a main rope wound around a sheave when the sheave is driven to rotate by an electric motor unit and, in stopping the operation, stops energization to the electric motor unit and holds a disk, which is provided integrally with the sheave, from both sides with brake linings of disk brake devices to brake the disk.

5 Brief Summary of the Invention

In a conventional traction machine of thin type for an elevator, a suspending load caused by a cage and a balance weight is applied through a main rope to a sheave and a fixed main shaft supporting the sheave in a rotatable manner, whereby the fixed main shaft is bent through the sheave by the suspending load.

10 That is, since the fixed main shaft is fixed at its axial end to a housing, the fixed main shaft forms a cantilever supported at the axial end.

Therefore, when the suspending load is applied to the sheave, the fixed main shaft is bent in a direction of the suspending load. Further, when the fixed main shaft is bent, a movement of the fixed main shaft is transmitted to the sheave, whereby a disk mounted on the
15 sheave is also moved. In such situation, a displacement on the disk increases radially outward from a rotational center of the sheave (= a rotational center of the fixed main shaft).

Incidentally, since the suspending loads applied to the sheave of a traction machine generated under (1) no load before the traction machine is installed, (2) a light load before a passenger rides on a cage after the traction machine is installed, and (3) a heavy load
20 after the passengers rides on the cage so that the load reaches its maximum value, are different from each other, the movement of the fixed main shaft changes in accordance with a change in the suspending load. That is, the movement of the fixed main shaft changes among no displacement, a slight displacement and a maximum displacement under the maximum suspending load.

25 In the traction machine disclosed by each of JP-2004-137037-A and JP-2004-299824-A, since the disk brake device is mounted at a top of the sheave in a direction of the suspending load (in the vicinity of a radially farthestmost periphery of the sheave in a direction in which the fixed main shaft is bent), the displacement on the disk caused by the bend of the fixed main shaft is significantly amplified.

30 Therefore, in the traction machine of general type disclosed by each of JP-2004-137037-A and JP-2004-299824-A, the displacement between the no load or light load condition and the heavy load condition is taken into account, whereby a brake stroke is increased to keep a clearance between the disk and the brake lining sufficient when the brake is released.

Therefore, a size of the disk brake device is increased in an axial direction of the traction machine by at least such increased value of the brake stroke.

Further, in WO/2006-129338, both axial ends of the fixed main shaft are supported by the housing to restrain the displacement of each of the fixed main shaft and the disk caused by the suspending load, and the sheave is mounted in a rotatable manner on an intermediate part of the fixed main shaft between the axial ends. However, in this structure, although the displacement of each of the fixed main shaft and the disk caused by the suspending load is restrained, an axial size of the fixed main shaft is increased by a length of one of the axial ends supported by the housing.

An object of the invention is to provide a traction machine for an elevator, which traction machine has a disk brake device enabling an axial length of the traction machine to be decreased significantly.

A distinctive feature of the invention is, in a traction machine for an elevator, comprising a housing body containing therein a stator and a stator coil, a fixed main shaft having an end fixed to the housing body and another end as a free end, a sheave which is supported on the another end in a rotatable manner through a bearing and on which a main rope is wound, a rotor joined with the sheave and capable of cooperating with the stator to form an electric motor, and a disk rotatable together with the sheave, that the traction machine further comprises a disk brake device for braking the disk at a rotary surface of the disk, the disk brake device being arranged at an outside of the main rope extending on and from the sheave and at an upper side with respect to a central axis, which central axis extends perpendicularly to an imaginary line extending parallel to a direction of a load to be borne by the sheave to drive the main rope and passing a rotational center of the sheave, and which central axis passes the rotational center of the sheave, so that the disk brake device is arranged in a region in which a distance between a position of the rotary surface of the disk tilted under a maximum value of the load and the position of the rotary surface of the disk under one of no load borne by the sheave to drive the main rope and a light value of the load is within a predetermined degree.

With using this structure, since the disk brake device is arranged in the region in which the distance between the position of the rotary surface of the disk tilted under the maximum value of the load and the position of the rotary surface of the disk under one of no load borne by the sheave to drive the main rope and the light value of the load is within the predetermined degree, a clearance between a brake lining and the disk can be decreased, whereby the axial length of the disk brake device can be decreased by the decreased clearance.

Brief Description of the Several Views of the Drawings

Fig. 1 is a sectional view showing a general configuration of a machine room-less elevator system;

Fig. 2 is a sectional view of a cage, a balance weight, and an elevator traction machine arranged in a hoistway;

Fig. 3 is a sectional view showing the configuration of a thin traction machine, which is an object the present invention;

Fig. 4 is a front view of the traction machine shown in Fig. 2 viewed from the opposite side of the cage, wherein disk brake devices are not shown;

Fig. 5 is a side view showing the traction machine in a no-load state to explain an influence due to bending;

Fig. 6 is a side view showing, to explain the influence due to bending, the traction machine in which a maximum load acts and bending deflection occurs;

Fig. 7 is a front view of a traction machine according to an embodiment of the present invention; and

Fig. 8 is a sectional view of a disk brake device shown in Fig. 7.

Detailed Description of the Invention

An elevator traction machine according to an embodiment of the present invention is explained below with reference to the accompanying drawings. Fig. 1 is a sectional view for explaining a general configuration of a machine room-less elevator. Reference numeral 10 denotes a hoistway provided in a building. An elevator is housed on the inside of the hoistway.

The elevator mainly includes a cage 11, a balance weight 12, and a traction machine 13. Pulleys 14 are attached to a lower part of the cage 11. A pulley 15 is attached to the balance weight 12. A sheave 16 is attached to a rotating shaft of the traction machine 13 (i.e., a rotating shaft or an electric motor).

The traction machine 13 is placed on the floor at the bottom of the hoistway 10. However, the traction machine 13 may be attached to a beam fixed near the top of the hoistway 10.

A beam 17 is fixed to an upper part of the hoistway 10. First and second intermediate pulleys 18A and 18B are attached to the beam 17 to change a winding direction of a main rope 19. One end of the main rope 19 is attached to an upper wall surface of the hoistway 10. Starting from the one end, the main rope 19 is wound around the pulley 15 of the balance

weight 12, the first intermediate pulley 18A, the sheave 16 of the traction machine 13, the second intermediate pulley 18B, and the pulleys 14 of the cage 11. The other end of the main rope 19 is attached to the upper wall surface of the hoistway 10. This roping is called 2-to-1 roping. Hoisting power of the traction machine 13 is reduced using the principle of a running block.

5 A shock absorber 191 that buffers a shock due to collision of the balance weight 12 is set below the balance weight 12. A shock absorber that buffers a shock due to collision of the cage 11 is set under the cage 11 as well.

 In such an elevator, an operation command is given to an electric motor, a braking mechanism, and the like of the traction machine 13 by a not-shown controller. The cage 11
10 rises or falls to a predetermine floor of the building according to the operation command.

 Fig. 2 is a sectional view of the hoistway 10 in which an elevator including a thin elevator traction machine, which is an object of the present invention, is set.

 In the hoistway 10, the cage 11 and the balance weight 12 coupled by the main rope 19 not shown in the figure are arranged to be capable of rising and falling.

15 The thin traction machine 13 is set in a space between the hoistway 10 and the cage 11. The thin traction machine 13 includes a housing assembly 20 in which a stator included in an electric motor unit is housed, a rotor arranged to be opposed to the stator and included in the electric motor unit, and a sheave assembly 21 formed integrally with the rotor and integrated with the sheave 16 around which the main rope 19 is wound. The traction
20 machine 13 is configured to rotate the sheave 16 together with the rotor to lift and lower the cage 11 via the main rope 19.

 Inspection work for the thin traction machine 13 is usually performed from the cage 11 side. Therefore, the housing assembly 20 of the traction machine 13 is arranged to face the cage 11 side.

25 A specific configuration of the thin traction machine 13 is explained with reference to Fig. 3. A housing body 22 of the housing assembly 20 includes a boss section 23 formed in the center of the housing body 22. One end of a fixed main shaft 24 is inserted into and fixed in the boss section 23. The sheave assembly 21 is rotatably supported on a free end side of the fixed main shaft 24, whereby a motor having a cantilevered structure is formed.

30 Electric components such as a stator 26 and a stator coil 27 included in the electric motor unit are housed in an annular housing recess 25 located on the outer circumferential side of the boss section 23 of the housing body 22.

 Further, a sheave housing 29 is rotatably supported via a bearing 28 on a free end side of the fixed main shaft 24. The sheave housing 29 is formed integrally with a sheave 30

(corresponding to the sheave 16 shown in Fig. 1) and electric sections such as a rotor 31 included in the electric motor unit.

The housing body 22 is manufactured by casting pig-iron or the like into a mold and molding the pig-iron into an approximate shape and then machining portions that require
5 dimensional accuracy.

As explained above, the housing body 22 is cast and manufactured to integrally form, in the center of the housing body 22, the hollow boss section 23 and form, in the outer circumference of the housing body 22, the bottomed annular housing recess 25 in which the stator 26, the stator coil 27, and the like can be housed.

10 The rotor 31 is arranged to be opposed to the stator coil 27 via a predetermined gap using the housing recess 25. Plural permanent magnets 32 are fixed on the inner circumferential surface of the rotor 31. Consequently, a rotor of a surface magnet type motor is configured. In this case, the rotor 31 needs to be a magnetic body. The rotor 31 is integrally
molded by the magnetic body together with the sheave housing 29 and the sheave 30.

15 A brake disk 33 is integrally formed in the outer circumference of the rotor 31. The brake disk 33 is configured as an annular disk, which projects in the radial direction, on the outer circumferential side of the rotor 31.

The sheave housing 29, the sheave 30, and the rotor 31 do not have to be an integrated molded product. The sheave housing 29, the sheave 30, and the rotor 31 may be
20 manufactured as separate components, which can be divided separately, and then fixed by, for example, bolts or fitting such as shrink-fit.

In the permanent magnets 32 arranged on the inner side of the rotor 31 as explained above, N poles and S poles are alternately arranged in the circumferential direction. The number of N poles and the number of S poles are the same. The number is a half of the
25 number of poles.

The rotor 31 is arranged to be opposed to the stator coil 27, which is arranged in the housing recess 25 formed integrally with the housing body 22, on the outer side of the stator coil 27 in the radial direction across a very small air gap. An electric motor of a so-called outer rotor type is configured by this structure.

30 Torque generated by the electric motor unit is transmitted to the sheave 30 via the rotor 31 to drive plural main ropes 19 wound around the sheave 30 and lift and lower the cage 11. In Fig. 3, details of disk brake devices are not shown. However, when the cage is lifted and lowered, the disk brake devices separate brake linings from a disk to release a braking operation according to a signal from a not-shown control device. When the cage is stopped and

the position of the cage is maintained, the disk brake devices press the brake linings against the disk and give a braking force to the disk to perform the braking operation according to a signal from the control device.

Figs. 4 to 6 are diagrams for explaining a phenomenon of bending deflection of the fixed main shaft 24 due to a suspension load. Fig. 4 is a front view of the traction machine 13 shown in Fig. 2 viewed from the opposite side of the cage 11. Fig. 5 is a side view of the traction machine 13 in which the suspension load does not act on the sheave 30. Fig. 6 is a side view of the traction machine 13 in which the suspension load acts on the sheave 30. In the figures, the disk brake devices are not shown.

As explained with reference to Fig. 3, when the sheave assembly 21 is rotatably attached to the housing assembly 20, the fixed main shaft 24 that supports the sheave 30 is formed in a cantilever structure in which one shaft end thereof is fixed to the boss section 23 of the housing body 22 and the other shaft end (i.e., a free end) thereof rotatably supports the sheave 30.

The suspension load applied to the sheave of the traction machine as explained above fluctuates among (1) no-load before installation of the traction machine, (2) a suspension load applied when no user gets on the cage after the installation of the traction machine, and (3) a suspension load applied when users get on the cage until the weight of the users reaches a maximum load. Therefore, the bending deflection of the fixed main shaft occurs according to the fluctuation in the suspension load.

Fig. 5 shows a no-load (or light load) state before the installation of the traction machine. In this case, no suspension load acts or, even if a suspension load acts, the suspension load is light. Therefore, the fixed main shaft 24 does not cause bending deflection. Naturally, the sheave 30, the rotor 31, and the disk 33 are not affected by bending of the fixed main shaft 24.

On the other hand, when users get on the cage until the weight of the users reaches the maximum load after the installation of the traction machine, if an upward suspension load is applied to the sheave 30 via the main rope 19 as shown in Fig. 6, a force of rotation in the counterclockwise direction is applied to the sheave 30 as indicated by an arrow P in Fig. 6 with a sliding contact section with the main rope 19 set as a point of action.

Therefore, bending occurs on the free end side of the fixed main shaft 24. As a result, the sheave 30, the rotor 31, and the disk 33 supported on the free end side of the fixed main shaft 24 tilt along a center line 34 shown in Fig. 6. As a result, a rotation surface of the disk 33 also tilts while receiving the influence of the bending from a rotation surface 35 in the

no-load state as shown in Fig. 6.

Therefore, in the traction machine described in JP-A-2004-137037, JP-A-2004-299824, since the disk brake devices are provided in the peak portion in a direction in which the suspension load of the sheave is applied (near the outermost circumference in a bending
5 direction of the fixed main shaft 24), the displacement of the disk 33 due to the bending of the fixed main shaft 24 is substantially amplified.

If an air gap between the disk 33 and the brake linings is adjusted to air gap length between the disk 33 and the brake linings in the case of no load, the disk 33 and the brake linings come into contact with and slide against each other because of the tilt of the disk 33 due to
10 bending that occurs on the free end side of the fixed main shaft 24. If the contact and the slide last long, it is likely that the brake linings wear and a regular braking operation cannot be obtained.

As measures against this problem, in the past, the air gap length between the disk 33 and the brake linings is increased to prevent the brake linings from coming into contact with
15 the disk 33 even if the disk 33 tilts.

Therefore, the disk brake devices are increased in size in the axis direction of the traction machine by at least the length of the air gap between the disk 33 and the brake linings set long. As a result, the axial length dimension in the axis direction of the traction machine is increased.

20 If the air gap length between the disk 33 and the brake linings is increased, there is also a concern about a phenomenon in which large noise is emitted when the brake linings collide with the disk 33 during a braking operation.

In order to solve such a problem, the present invention proposes a solution explained below. In the traction machine having the cantilever structure, even in a
25 displacement state of the disk 33 in the case of no-load (or light load) (in this case, no displacement or very small displacement) and a displacement state in which a large tilt of the disk 33 occurs because a maximum load is applied and the fixed main shaft 24 tilts, as indicated by reference numeral 36 in Fig. 6, there is a region where the displacement of the disk 33 does not change or, even if the displacement of the disk 33 changes, the displacement is in a degree
30 that does not practically cause a problem.

As it is seen in Fig. 6, if the disk brake devices are arranged in the region 36 where the position of the rotation surface 35 of the disk 33 tilting in the state in which the maximum load is applied and the position of the rotation surface 35 in the no-load (or light load) state are almost the same, even if the air gap between the disk 33 and the brake linings is set to

the air gap length between the disk 33 and the brake linings in the case of no load (or light load), it is possible to prevent the disk 33 and the brake linings from coming into contact with each other even if the disk 33 tilts in a state in which the maximum load is applied.

The region 36 can be deduced from calculation or actual measurement.

5 However, the region 36 is not uniformly set because of various factors, for example, the size and the thickness of the disk 33, the size of the rotor 31, and the deformation of the housing body 22.

Therefore, when the present invention is applied, the region 36 where the position of the rotation surface 35 of the disk 33 tilting in the state in which the maximum load is applied and the position of the rotation surface 35 in the no-load (or light load) state are almost the same
10 only has to be deduced according to the idea of the present invention. The disk brake devices only have to be arranged in the region.

A thin traction machine based on such an idea according to an embodiment is explained with reference to Fig. 7. Fig. 7 is a front view of the traction machine 13 viewed from the opposite side of the cage. The main rope 19 is wound around the sheave 30 in a U
15 shape with both ends of the main rope 19 extended upward.

In the outer circumference of the sheave 30, the rotor 31 formed integrally with the sheave 30 and the disk 33 formed integrally with the rotor 31 are arranged.

Therefore, the disk 33 is rotated integrally with the sheave 30 and the rotor 31 and is configured to be capable of rotating without coming into contact with the housing assembly 20
20 located in the back. Disk brake devices 37 are fixed to the housing assembly 20. As shown in Fig. 7, fixing positions of the disk brake devices 37 are arranged in the region 36 located on the outer side of the main rope 19, which is wound around the sheave 30 and extended upward, and above a lateral center line CH of the sheave 30 to avoid a position right beside the sheave 30.

The disk brake device 37 is configured as shown in Fig. 8. In Fig. 8, the disk
25 brake device 37 includes an electromagnet section including a fixed iron core 39 and an electromagnetic coil 40 incorporated in a brake housing 38, a movable iron core 41 attracted to the fixed iron core 39 of the electromagnet section and brake linings 42 fixed to the surface of the movable iron core 41, and a spring 43 that urges the movable iron core 41 to the disk 33 side. The brake housing 38 includes an opening 44 that receives the disk 33 therein. The disk 33 is
30 guided into the brake housing 38 from the opening 44.

In a state in which the brake is not applied, a direct current is fed from a not-shown driving circuit to the electromagnetic coil 40. The direct current is obtained by rectifying an AC power supply using a full-wave rectifying bridge including four diodes. In a normal operation state, since the brake is not applied, the electromagnetic coil 40 is energized.

In this state, a magnetic force is generated in the fixed iron core 39. Therefore, the movable iron core 41 is attracted by the fixed iron core 39 resisting the repulsion of the spring 43, the brake linings 42 are separated from the disk 33, and a braking force is not generated in the disk 33.

5 When the brake is applied, the energization from the not-shown driving circuit to the electromagnetic coil 40 is shut off and the magnetic force generated in the fixed iron core 39 disappears. Therefore, the movable iron core 41 is pushed to the disk 33 side by the urging force of the spring 43 and the brake linings 42 hold the disk 33 from both sides. Consequently, a braking force is generated in the disk 33.

10 The disk brake device 37 may have any structure other than the structure shown in Fig. 8.

As shown in Fig. 7, the disk brake devices 37 having such a configuration are located on the outer side of the main rope 19 folded back in a U shape in a position overlapping the disk 33 and are arranged in a region shifted by about a distance L2 from a longitudinal center line CV extending in a direction in which the suspension load of the sheave 30 or the fixed main shaft 24 is applied and located about a distance L1 above the lateral center line CH orthogonal to the longitudinal center line CV. The disk brake devices 37 are arranged in a pair symmetrically (line symmetrically) with respect to the longitudinal center line CV.

20 In the case of this embodiment, the disk brake devices 37 are arranged in an angle range of about 20° to 40° from the lateral center line CH about the axis of the sheave 30.

As explained above, the positions where the disk brake devices 37 are arranged are selected in the region 36 where the position of the rotation surface 35 of the disk 33 tilting in the state in which the maximum load is applied and the position of the rotation surface 35 in the no-load (or light load) state are almost the same.

25 The region 36 is set in a predetermined range from an invariant point where the position of the rotation surface 35 of the disk 33 tilting in the state in which the maximum load is applied and the position of the rotation surface 35 in the no-load (or light load) state are the same. Specifically, the region 36 is set in a range in which displacement of length about 1/10 of a stroke of the movable iron core 41 of the disk brake device 37 occurs.

30 As explained above, the disk brake device 37 are arranged on the outer side of the main rope 19 folded back in a U shape. Therefore, since the disk brake device 37 can brake the disk 33 without coming into contact with the main rope 19, the traction machine 13 can be configured thin.

If the main rope 19 and the disk brake devices 37 are arranged in series, in terms

of dimension, axial length is obtained by adding up the dimensions of the main rope 19 and the disk brake devices 37. However, since the disk brake devices 37 are arranged on the outer side of the main rope 19, the main rope 19 and the disk brake devices 37 are arranged in parallel. Therefore, the axial length can be reduced.

5 Since the disk brake devices 37 are arranged in the region 36 where the position of the rotation surface 35 of the disk 33 tilting in the state in which the maximum load is applied and the position of the rotation surface 35 in the no-load (or light load) state are almost the same, it is possible to reduce the length of the air gap between the brake linings 42 and the disk 33 and braked by the brake linings 42. Therefore, the axial length of the disk brake devices 37 can be
10 reduced. Further, a reduction in collision noise can be expected.

As explained above, the disk brake devices 37 are arranged on the outer side of the main rope 19 and are arranged in the region 36 where the position of the rotation surface 35 of the disk 33 tilting in the state in which the maximum load is applied and the position of the rotation surface 35 in the no-load (or light load) state are almost the same. Therefore, it is
15 possible to reduce the axial length in the axis direction of the traction machine 13 as much as possible.

In the embodiment shown in Fig. 7, the traction machine 13 is provided at the bottom of the hoistway 10. However, as another method, the present invention can also be applied in the same manner when the traction machine 13 is provided in a beam present near the
20 top of the hoistway 10. In this case, since the main rope 19 extends downward, the suspension load acts downward. Therefore, a configuration in this case is obtained by rotating the configuration of the embodiment shown in Fig. 7 180 degrees.

Naturally, action and effects same as the action and the effects explained above can be obtained also by this configuration.

Claims :

1. A traction machine for an elevator, comprising a housing body containing therein a stator and a stator coil, a fixed main shaft having an end fixed to the housing body and another end as a free end, a sheave which is supported on the another end in a rotatable manner through a bearing and on which a main rope is wound, a rotor joined with the sheave and capable of cooperating with the stator to form an electric motor, and a disk rotatable together with the sheave,

wherein the traction machine further comprises a disk brake device for braking the disk at a rotary surface of the disk, the disk brake device being arranged at an outside of the main rope extending on and from the sheave and at an upper side with respect to a central axis, which central axis extends perpendicularly to an imaginary line extending parallel to a direction of a load to be borne by the sheave to drive the main rope and passing a rotational center of the sheave, and which central axis passes the rotational center of the sheave, so that the disk brake device is arranged in a region in which a position of the rotary surface of the disk tilted under a maximum value of the load is substantially equal to the position of the rotary surface of the disk under one of no load borne by the sheave to drive the main rope and a light value of the load.

2. The traction machine according to claim 1, comprising only a pair of the disk brake devices arranged symmetrically with respect to the imaginary line.

3. The traction machine according to claim 3, wherein the disk brake devices are fixed to the housing body.

4. A traction machine for an elevator, comprising a housing body containing therein a stator and a stator coil, a fixed main shaft having an end fixed to the housing body and another end as a free end, a sheave which is supported on the another end in a rotatable manner through a bearing and on which a main rope is wound, a rotor joined with the sheave and capable of cooperating with the stator to form an electric motor, and a disk rotatable together with the sheave,

wherein the traction machine further comprises a disk brake device for braking the disk at a rotary surface of the disk, the disk brake device being arranged at an outside of the main rope extending on and from the sheave and at an upper side with respect to a central axis, which central axis extends perpendicularly to an imaginary line extending parallel to a direction of a load to be borne by the sheave to drive the main rope and passing a rotational center of the sheave, and which central axis passes the rotational center of the sheave, so that the disk brake device is arranged in a region in which a distance between a position of the rotary surface of the disk tilted under a maximum value of the load and the position of the rotary surface of the disk

under one of no load borne by the sheave to drive the main rope and a light value of the load is within a predetermined degree.

5. The traction machine according to claim 4, wherein the predetermined degree is not more than one tenth of a moving stroke of a moving core contained by the disk brake device.