

[DESCRIPTION]

[Title of Invention] BRAKE APPARATUS OF ELEVATOR

[Technical Field]

[0001]

The present invention relates to a brake apparatus of an elevator, which apparatus is provided with a determination portion making determination about condensation of dew on a surface of a brake drum based on a signal from a sensor detecting a surface state of the brake drum.

[Background Art]

[0002]

In a machine room of an elevator, dew may be condensed on a surface of an installed machine due to a temperature difference between the temperature of the machine per se and ambient temperature, etc. For example, in a rope type elevator in which a car is lifted up/down by use of a hoist, the car can be stopped/landed by operation of a brake apparatus. However, dew may be condensed on a brake drum which is a constituent member of the brake apparatus or a brake shoe which is made of a friction material, due to a temperature difference between the temperature of the brake drum or the brake shoe and ambient temperature, etc. Even when the dew is condensed thus on the brake drum or the brake shoe, normal operation of the elevator is generally continued as it is in the background art.

[0003]

However, due to the dew condensed on the brake drum or the brake shoe of the brake apparatus, the brake drum and the brake shoe may slip with each other when the car stops or lands. Thus, the car may stop or land out of a landing error permissible range. Incidentally, the dew condensed on the brake shoe causes expansion of the brake shoe. Therefore, a gap between the brake shoe and the brake drum is narrowed, so that there is a fear that the brake shoe and the brake drum may always come into contact with each other to cause an overload on operation control according to circumstances.

[0004]

To solve this problem, as a background-art technique for preventing condensation of dew on the brake drum, for example, there is a technique disclosed in Patent Literature 1. This background-art technique has a configuration in which a comparison determination portion which receives signals of a temperature sensor and a humidity sensor as inputs is provided. In the configuration, when the comparison determination portion determines that dew will be condensed on a surface of the brake drum based on the signals of the temperature sensor and the humidity sensor, a hoist is activated to operate the elevator without any load so that the surface temperature of the brake drum can be always kept to be not lower than a dew point by frictional heat generated thus between the brake shoe

and the brake drum.

[Citation List]

[Patent Literature]

[0005]

[Patent Literature 1] JP-UM-A-4-53773

[Summary of Invention]

[Technical Problem]

[0006]

The aforementioned background-art technique disclosed in the Patent Literature 1 is to prevent condensation of dew by use of the frictional heat generated between the brake shoe and the brake drum but it takes time to generate the frictional heat. That is, this background-art technique cannot rapidly remove condensation of dew but it is difficult to expect improvement of condensed dew removal efficiency. Therefore, the time for which getting on/off the car of the elevator must be suspended in order to remove condensed dew becomes so long that the elevator can easily deteriorate in terms of serviceability to passengers.

[0007]

The invention has been accomplished under the aforementioned actual circumstances in the background-art technique. An object of the invention is to provide a brake apparatus of an elevator, which apparatus can rapidly remove dew condensed on a brake drum.

[Solution to Problem]

[0008]

In order to achieve the object, the brake apparatus of the elevator according to the invention is a brake apparatus of an elevator, including: a brake drum which is integrally connected to a hoist on which a rope for coupling a car and a counterweight to each other is wound; a brake lever which is provided with a brake shoe for braking the brake drum; a sensor which detects a surface state of the brake drum; and a determination portion which makes determination about condensation of dew on the surface of the brake drum based on a signal outputted from the sensor; wherein: the sensor includes a dew condensation detection sensor which detects dew condensed on the surface of the brake drum; the brake apparatus further includes a dew condensation removal device which is operated to remove the dew condensed on the surface of the brake drum in accordance with a signal outputted from the dew condensation detection sensor; and the dew condensation removal device includes: a dew condensation determination portion which constitutes the determination portion and which determines whether it is necessary to remove the condensed dew or not based on the signal outputted from the dew condensation detection sensor; a suction portion which abuts against the surface of the brake drum so as to be able to suck the dew condensed on the surface of the brake drum when the dew

condensation determination portion determines that it is necessary to remove the condensed dew; and a suction portion driving unit which drives the suction portion to make the suction portion abut against the surface of the brake drum or to make the suction portion leave the surface of the brake drum based on the determination made by the dew condensation determination portion.

[Advantageous Effects of Invention]

[0009]

According to the invention, when dew is condensed on the brake drum, the suction portion driving unit is operated to make the suction portion of the dew condensation removal device abut against the brake drum. Thus, the dew condensed on the brake drum can be sucked by the suction portion so that the dew condensed on the brake drum can be rapidly removed. That is, the invention can improve condensed dew removal efficiency in comparison with the background art. Thus, the invention can shorten the time for which passengers' getting on/off the elevator must be suspended in order to remove the condensed dew so that the elevator can be improved in terms of serviceability to passengers in comparison with the background art.

[Brief Description of Drawings]

[0010]

[Figs. 1A and 1B] Views showing an embodiment of a brake

apparatus of an elevator according to the invention, in which Fig. 1A is a side view showing a braking release state and Fig. 1B is a side view showing a braking state.

[Fig. 2] A main part side view showing a part of a brake lever and a part of a brake shoe provided in the embodiment.

[Fig. 3] A front view showing the brake shoe provided in the embodiment.

[Fig. 4] A view showing configuration of a dew condensation removal device provided in the embodiment.

[Fig. 5] A front view showing a main part of the dew condensation removal device provided in the embodiment.

[Fig. 6] A flow chart showing control carried out in the embodiment.

[Description of Embodiment]

[0011]

An embodiment of a brake apparatus of an elevator according to the invention will be described below with reference to the drawings.

[0012]

Although not shown, the elevator provided with the brake apparatus according to the embodiment of the invention has a hoist on which a rope for coupling a car and a counterweight to each other is wound. When the hoist is rotated, the car and the counterweight are lifted up/down through the rope in a hoistway in a well bucket manner.

[0013]

As shown in Figs. 1A and 1B, a brake drum 1 which is integrally connected to the hoist so as to rotate in sync with the hoist and a brake lever 5 which is provided with a brake shoe 2 for braking the brake drum 1 are provided in the embodiment. The brake lever 5 moves rotatably around a fulcrum pin 4.

[0014]

In addition, an electromagnet 3 is provided in the embodiment. When an electric current is applied to the electromagnet 3, the brake lever 5 is rotated to be opened due to a moving force given in a direction of an arrow 30 shown in Fig. 1A. Thus, the brake shoe 2 is separated from the brake drum 1 and brought into a braking release state. When an electric current is not applied to the electromagnet 3, a moving force is given in a direction of an arrow 31 shown in Fig. 1B by an urging force of a returning spring 6. Thus, the brake lever 5 is rotated in a direction in which the brake lever 5 can be closed. In this manner, the brake shoe 2 can be pressed against the brake drum 1 and brought into a braking state.

[0015]

In addition, a sensor for detecting a surface state of the brake drum 1 is provided in the embodiment. This sensor is constituted by a dew condensation detection sensor 8 for detecting dew condensed on the surface of the brake drum 1.

As shown in Figs. 2 and 3, the dew condensation detection sensor 8 is urged toward the brake drum 1 by a pressing spring 9. In the braking state shown in Fig. 1B, the dew condensation detection sensor 8 is pressed against the surface of the brake drum 1 to detect the condensed dew.

[0016]

In addition, as shown in Figs. 1A and 1B and Fig. 2, a dew condensation removal device 7 which is operated to remove the dew condensed on the surface of the brake drum 1 based on a signal outputted from the dew condensation detection sensor 8 is provided in the embodiment.

[0017]

As shown in Figs. 4 and 5, the dew condensation removal device 7 includes a dew condensation determination portion 13, a suction portion 19, and a suction portion driving unit. The dew condensation determination portion 13 determines whether it is necessary to remove the condensed dew or not based on the signal outputted from the dew condensation detection sensor 8. The suction portion 19 is disposed to be opposed to the surface of a lower part of the brake drum 1 so that the suction portion 19 can abut against the surface of the lower part of the brake drum 1 to suck the dew condensed on the brake drum 1. The suction portion driving unit drives the suction portion 19 to make the suction portion 19 abut against the surface of the lower part of the brake drum 1 or to make the

suction portion 19 leave the surface of the lower part of the brake drum 1.

[0018]

The dew condensation determination portion 13 is connected to a control device 10 through signal lines 11 and 12. The control device 10 performs operation control on the elevator. The dew condensation determination portion 13 determines whether it is necessary to remove the condensed dew or not, based on information about car stop time outputted through the signal line 11 from the control device 10, information about temperature/humidity outputted from a not-shown thermometer/hygrometer, and the signal outputted from the aforementioned dew condensation detection sensor 8.

[0019]

The aforementioned suction portion 19 includes a water absorptive member and a rigid retention member which retains the water absorptive member. An entire shape including the water absorptive member and the retention member is, for example, set as a shape extending along a circumferential surface of the brake drum 1.

[0020]

The aforementioned suction portion driving unit includes a lifting portion 18 which lifts up/down the suction portion 19, a support portion 16 which supports the lifting portion 18, a motor 15 which operates the lifting portion 18,

and a battery 14 which supplies electric power to the motor 15.

[0021]

In addition, the suction portion driving unit includes a changeover switch 17 which can be changed over in accordance with the determination result of the dew condensation determination portion 13. When the dew condensation determination portion 13 determines that it is necessary to remove the condensed dew, the changeover switch 17 is changed over to a first switch position in accordance with a signal outputted from the dew condensation determination portion 13 so that the motor 15 can be rotated forward. In addition, when the dew condensation determination portion 13 determines that it is no longer necessary to remove the condensed dew after the determination that it is necessary to remove the condensed dew, the changeover switch 17 is changed over to a second switch position in accordance with a signal outputted from the dew condensation determination portion 13 so that the motor 15 can be rotated backward.

[0022]

A gear coupled to an output shaft of the motor 15 is received rotatably inside the aforementioned support portion 16. In addition, a rack engaged with the aforementioned gear is provided in the aforementioned lifting portion 18 to extend in an up/down direction. That is, the lifting portion 18 can

move up/down due to the aforementioned engagement between the gear and the rack.

[0023]

When the lifting portion 18 has been lifted up by the driving of the motor 15, the aforementioned control device 10 controls the driving of the not-shown hoist to rotate the brake drum 1 while the brake shoe 2 provided in the brake lever 5 is kept at the braking release state in which the brake shoe 2 is separated from the brake drum 1. When the lifting portion 18 has been lifted down by the driving of the motor 15, the control device 10 performs control to stop the driving of the hoist to thereby stop the rotation of the brake drum 1.

[0024]

In addition, a pair of positioning springs 20 by which the suction portion 19 abutting against the surface of the brake drum 1 can be kept at a normal position are provided in the embodiment. The aforementioned lifting portion 18 includes spring engagement portions 18a with which the pair of positioning springs 20 are engaged, and a retention shaft 18b where the aforementioned rack is provided.

[0025]

For example, when the suction portion 19 is made to abut against the surface of the brake drum 1 and the brake drum 1 kept at the braking release state is rotated, the suction portion 19 is about to be displaced in a direction perpendicular

to an axial direction, i.e. a radial direction of the brake drum 1. On this occasion, the suction portion 19 is urged by the aforementioned pair of positioning springs 20 so that the suction portion 19 can be kept at a position in which the suction portion 19 is correctly opposed to the surface of the brake drum 1.

[0026]

Operation of the brake apparatus of the elevator configured thus according to the embodiment will be described below with reference to Fig. 6.

[0027]

The dew condensation determination portion 13 according to the embodiment acquires information about car stop time through the signal line 11 from the control device 10 at any time (steps S1 and S2). When the car stop time measured by a timer belonging to the dew condensation determination portion 13 is not shorter than a predetermined time, for example, not shorter than 10 hours, the situation is regarded as a situation that there is a possibility that dew may be condensed on the surface of the brake drum 1. On this occasion, the dew condensation determination portion 13 acquires information about temperature/humidity from the not-shown thermometer/hydrometer (step S3).

[0028]

In addition, on this occasion, the dew condensation

determination portion 13 simultaneously acquires a signal from the dew condensation detection sensor 8 and determines whether it is necessary to remove the dew condensed on the surface of the brake drum 1 or not, based on a predetermined dew condensation threshold regarded as the condensed dew which must be removed (step S4). When the dew condensation determination portion 13 determines that it is not necessary to remove the condensed dew (NO), the flow of processing returns to the step S1.

[0029]

When determination is made in the step S4 that it is necessary to remove the condensed dew (YES), the dew condensation determination portion 13 transmits information about the determination of condensed dew generation to the control device 10 through the signal line 12, and outputs, to the changeover switch 17, a signal for changing over the changeover switch 17 to the first switch position. The control device 10 performs control to suspend a normal operation mode based on the information about the determination of condensed dew generation transmitted from the dew condensation determination portion 13 and to change the mode to a low-speed maintenance operation mode in which passengers are prohibited from using the elevator (step S5).

[0030]

The dew condensation determination portion 13 acquiring

the information about stop time and the information about temperature/humidity can indeed determine presence/absence of dew condensation with high accuracy. However, the dew condensation determination portion 13 may determine presence/absence of dew condensation based on only the signal outputted from the dew condensation detection sensor 8 when the dew condensation detection sensor 8 is a highly accurate sensor.

[0031]

When the aforementioned changeover switch 17 is changed over to the first switch position, the motor 15 rotates forward, for example, for a set time. In accordance with the forward rotation of the motor 15, the gear received in the support portion 16 rotates so that the rack engaged with the gear can move up. Thus, the lifting portion 18 moves up so that the suction portion 19 can abut against the surface of the lower part of the brake drum 1. After the motor 15 has rotated forward for the set time, the motor 15 stops. In addition, after a lapse of the set time, the electromagnet 3 is driven under the control of the control device 10 to provide a braking release state as shown in Fig. 1A, and the hoist rotates. In accordance with the rotation of the hoist, the brake drum 1 rotates. In this manner, dew condensed on the surface of the brake drum 1 can be relatively wiped off by the suction portion 19 (step S6).

[0032]

Here, the dew condensation determination portion 13 determines whether it is unnecessary to remove the dew condensed on the surface of the brake drum 1 or not, based on a signal from the dew condensation detection sensor 8 etc. (step S7). When determination is made that it is necessary to remove the dew condensed (NO), the flow of processing returns to the step S6, in which the condensed dew removal operation is continued.

[0033]

When determination is made in the step S7 that it is unnecessary to remove the condensed dew (YES), that is, when the condensed dew is regarded as removed, the dew condensation determination portion 13 outputs, to the control device 10 through the signal line 12, a signal for stopping the driving of the hoist, and outputs, to the changeover switch 17, a signal for changing over the changeover switch 17 to the second switch position. The rotation of the hoist is stopped by the control of the control device 10, and the electromagnet 3 is driven to provide a braking state as shown in Fig. 1B. In accordance with the rotation stop of the hoist, rotation of the brake drum 1 stops.

[0034]

In addition, when the changeover switch 17 is changed over to the second switch position, the motor 15 rotates

backward, for example, for a set time. In accordance with the backward rotation of the motor 15, the gear received in the support portion 16 rotates and the rack engaged with the gear moves down. In this manner, the lifting portion 18 moves down so that the suction portion 19 can leave the surface of the lower part of the brake drum 1. After the motor 15 has rotated backward for the set time, the motor 15 stops (step S8).

[0035]

In addition, after a lapse of the set time, the elevator is changed from the low-speed operation which had been performed till then to the normal operation which allows passengers to use the elevator, by the control of the control device 10 based on the signal outputted from the dew condensation determination portion 13 through the signal line 12.

[0036]

According to the embodiment, when dew has been condensed on the brake drum 1, the motor 15, the lifting portion 18, etc. are operated to make the suction portion 19 of the dew condensation removal device 7 abut against the brake drum 1. Thus, the dew condensed on the brake drum 1 can be sucked by the suction portion 19 so that the dew condensed on the brake drum 1 can be removed rapidly. In this manner, the brake drum 1 and the brake shoe 2 can be prevented from slipping with each other due to the dew condensed on the brake drum 1, so that

safe operation of the elevator can be achieved. According to the embodiment, the dew condensed on the brake drum 1 can be removed rapidly as described above. Accordingly, the time for which getting on/off the car of the elevator must be suspended in order to remove condensed dew can be made so short that the elevator can be improved in terms of serviceability to passengers. When the condensed dew is sucked by the suction portion 19 as described above, worn parts of the brake shoe 2 deposited on the brake drum 1 can be also sucked and removed by the suction portion 19. This also contributes to achievement of safe operation of the elevator.

[0037]

Incidentally, although dew condensed on a surface of the brake shoe 2 is not directly sucked in the embodiment, the dew condensed on the surface of the brake shoe 2 is easily deposited on the surface of the brake drum 1 in the braking state shown in Fig. 1B. Accordingly, when the dew condensed on the surface of the brake drum 1 is removed as described above, the dew condensed on the surface of the brake shoe 2 can be reduced indirectly.

[0038]

The aforementioned embodiment has a configuration in which for removal of dew condensed on the brake drum 1, the control device 10 performs control to rotate the brake drum 1 in a state in which the suction portion 19 is made to abut

against the surface of the lower part of the brake drum 1. However, the dew condensed on the brake drum 1 tends to be collected on the surface of the lower part of the brake drum 1 due to its own weight. Therefore, a substantial amount of the dew condensed on the brake drum 1 can be removed even if the suction portion 19 is simply made to abut against the surface of the lower part of the brake drum 1 without rotating the brake drum 1. From this viewpoint, the configuration in which the hoist and the brake drum 1 are rotated by the control device 10 when the condensed dew is sucked by the suction portion 19 as in the aforementioned embodiment may be replaced by a configuration in which control is performed simply to make the suction portion 19 abut against the surface of the lower part of the brake drum 1.

[Reference Signs List]

[0039]

- 1 brake drum
- 2 brake shoe
- 5 brake lever
- 7 dew condensation removal device
- 8 dew condensation detection sensor
- 10 control device
- 13 dew condensation determination portion
- 15 motor (suction portion driving unit)
- 16 support portion (suction portion driving unit)

- 17 changeover switch (suction portion driving unit)
- 18 lifting portion (suction portion driving unit)
- 18a spring engagement portion
- 18b retention shaft
- 19 suction portion
- 20 positioning spring

[CLAIMS]

[Claim 1]

A brake apparatus of an elevator, comprising: a brake drum which is integrally connected to a hoist on which a rope for coupling a car and a counterweight to each other is wound; a brake lever which is provided with a brake shoe for braking the brake drum; a sensor which detects a surface state of the brake drum; and a determination portion which makes determination about condensation of dew on the surface of the brake drum based on a signal outputted from the sensor; wherein:

the sensor includes a dew condensation detection sensor which detects dew condensed on the surface of the brake drum;

the brake apparatus further comprises a dew condensation removal device which is operated to remove the dew condensed on the surface of the brake drum in accordance with a signal outputted from the dew condensation detection sensor; and

the dew condensation removal device includes:

a dew condensation determination portion which constitutes the determination portion and which determines whether it is necessary to remove the condensed dew or not based on the signal outputted from the dew condensation detection sensor;

a suction portion which abuts against the surface of the brake drum so as to be able to suck the dew condensed on the surface of the brake drum when the dew condensation

determination portion determines that it is necessary to remove the condensed dew; and

a suction portion driving unit which drives the suction portion to make the suction portion abut against the surface of the brake drum or to make the suction portion leave the surface of the brake drum based on the determination made by the dew condensation determination portion.

[Claim 2]

A brake apparatus of an elevator according to Claim 1, wherein:

the suction portion driving unit includes a lifting portion which lifts up/down the suction portion, and a motor which operates the lifting portion.

[Claim 3]

A brake apparatus of an elevator according to Claim 1 or 2, wherein:

the suction portion includes a water absorptive member and a rigid retention member which retains the water absorptive member.

[Claim 4]

A brake apparatus of an elevator according to Claim 3, wherein:

an entire shape including the water absorptive member and the retention member is set as a curved shape extending along a circumferential surface of the brake drum.

[Claim 5]

A brake apparatus of an elevator according to Claim 2, further comprising:

a control device which controls driving of the hoist to rotate the brake drum while the brake shoe provided in the brake lever is kept at a braking release state in which the brake shoe is separated from the brake drum when the lifting portion has been lifted up by driving of the motor, and which performs control to stop the driving of the hoist to stop the rotation of the brake drum when the lifting portion has been lifted down by driving of the motor.