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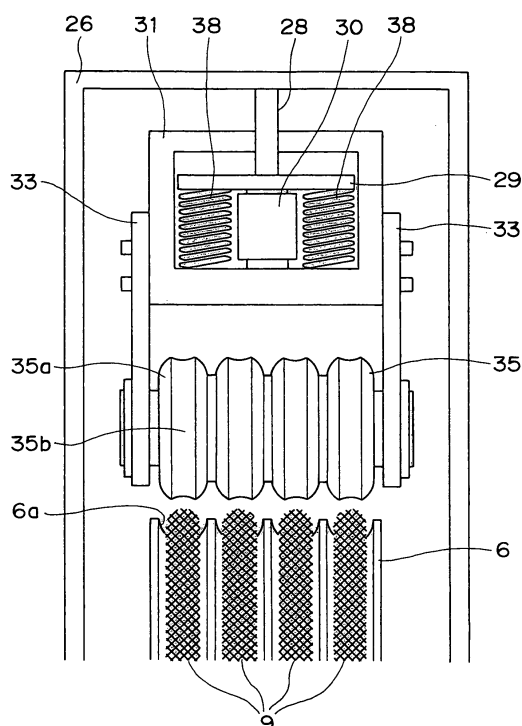
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(54) **BRAKE AUXILIARY DEVICE OF ELEVATOR**

(57) In an elevator, by braking rotation of a sheave, around which main ropes are wound, using a brake device, an emergency stop of a car is caused. The sheave is provided with a brake auxiliary device. The brake aux-

iliary device is provided with a rotatable brake auxiliary roller for pressing the main ropes against the sheave at a time of emergency braking. The brake auxiliary roller is separated from the main ropes in a normal state.

FIG. 4



Description

Technical Field

5 **[0001]** The present invention relates to a brake auxiliary device for an elevator, for assisting braking of a car at a time of emergency braking.

Background Art

10 **[0002]** In a conventional device, in a case where a braking force of a brake device at a time of emergency braking is excessively large, slip occurs between a sheave and main ropes. In order to prevent slippage from becoming larger, in a conventional brake controller, RPM of the sheave and an elevating speed of a car are detected and compared to each other, thereby calculating a slip velocity, and when the slip velocity exceeds a predetermined value at the time of emergency braking, a braking torque of the brake device is limited (refer to, for example, Patent Document 1).

15 **[0003]** Patent Document 1: JP 2004-231355 A

Disclosure of the Invention

Problem to be solved by the Invention

20 **[0004]** In such the conventional brake controller, when, for example, the slip velocity of the main ropes exceeds the predetermined value, a plurality of special functions, such as a function of limiting the braking torque of the brake device, are required. Therefore, a structure of the brake controller becomes complex.

25 **[0005]** The present invention has been made to solve the above-mentioned problem, and it is therefore an object of the present invention to provide a brake auxiliary device for an elevator, with which it is possible to suppress, with a simpler structure, slip of main ropes at a time of emergency braking.

Means for solving the Problem

30 **[0006]** According to the present invention, a brake auxiliary device for an elevator includes a brake auxiliary roller, which is rotatable, for pressing a main rope against a sheave which is braked by a brake device at a time of emergency braking.

Brief Description of the Drawings

35 **[0007]**

[Fig. 1] Fig. 1 is a structural view showing an elevator apparatus according to Embodiment 1 of the present invention.

[Fig. 2] Fig. 2 is an enlarged front view showing a brake device of Fig. 1.

40 [Fig. 3] Fig. 3 is an enlarged perspective view showing a sheave and a brake auxiliary device of Fig. 1.

[Fig. 4] Fig. 4 is a front view showing the brake auxiliary device of Fig. 3.

[Fig. 5] Fig. 5 is a front view showing a state of the brake auxiliary device of Fig. 3 at a time of emergency braking.

[Fig. 6] Fig. 6 is a view for illustrating slip of main ropes with respect to the sheave of Fig. 1.

Best Mode for carrying out the Invention

45 **[0008]** Hereinafter, a preferred embodiment of the present invention will be described with reference to the drawings.

Embodiment 1

50 **[0009]** Fig. 1 is a structural view showing an elevator apparatus according to Embodiment 1 of the present invention. In the figure, in an upper portion of a hoistway, there are provided a drive device 1 and a deflector sheave 2. The drive device 1 includes an electric motor 5 for generating a driving force, a drive sheave 6 rotated by the driving force of the electric motor 5, a brake device 7 for braking rotation of the drive sheave 6, and a brake auxiliary device 8 for assisting braking of a car 10 at a time of emergency braking. A plurality of main ropes 9 are wound around the drive sheave 6 and the deflector sheave 2. The car 10 and a counterweight 11 are suspended by the main ropes 9 within the hoistway.

55 **[0010]** Fig. 2 is an enlarged front view showing the brake device 7 of Fig. 1. In the figure, in the upper portion of the hoistway, a brake fixing pedestal 15 is fixed in position. The brake fixing pedestal 15 is mounted with a pair of brake

arms 16. Each of the brake arms 16 is pivotable on a proximal end thereof attached to the brake fixing pedestal 15. Between the proximal end and a distal end of each of the brake arms 16, a brake shoe 17 is fixed. The distal ends of the brake arms 16 are mounted with a brake spring 18 and a brake releasing portion 19. Between the brake shoes 17, there is provided a brake drum 20 coaxially connected to the drive sheave 6.

[0011] The brake spring 18 causes the brake shoes 17 to press against the brake drum 20. Rotation of the drive sheave 6 is braked by causing the brake drum 20 to be sandwiched by the brake shoes 17. The brake releasing portion 19 causes the brake shoes 17 to be spaced apart from the brake drum 20 against the brake spring 18 at a time of releasing the brake, while causing the brake spring 18 to be released at a time of braking.

[0012] For the brake releasing portion 19, an electromagnet or the like is used. In a case where an electromagnet is used for the brake releasing portion 19, when the car 10 travels normally, the electromagnet is energized to cause the brake shoes 17 to be spaced apart from the brake drum 20. In the case of emergency braking, the electromagnet is put in a non-energized state to cause the brake shoes 17 to press against the brake drum 20.

[0013] Fig. 3 is an enlarged perspective view showing the drive sheave 6 and the brake auxiliary device 8 of Fig. 1. In the figure, in the upper portion of the hoistway, sheave mounting pedestals 25 are fixed in position. In an upper portion of each of the sheave mounting pedestals 25, a rotating shaft 5a for the electric motor 5 is supported so as to be rotatable. The drive sheave 6 is fixed to the rotating shaft 5a. The drive sheave 6 is rotated integrally with the rotating shaft 5a about the rotating shaft 5a as a center thereof.

[0014] Further, a support frame 26 is fixed to the shaft mounting pedestals 25. The support frame 26 supports the brake auxiliary device 8. The brake auxiliary device 8 is arranged so as to be opposed to an outer peripheral surface of the drive sheave 6.

[0015] Fig. 4 is a front view of the brake auxiliary device 8 of Fig. 3, showing a normal state thereof. In the figure, a support arm 28 is fixed to an upper portion of the support frame 26. A lower portion of the support arm 28 is mounted with a pressing plate 29 and an auxiliary device releasing portion 30. The pressing plate 29 is fixed to the lower portion of the support arm 28. The auxiliary device releasing portion 30 is connected to a movable frame 31. The movable frame 31 is connected to the lower portion of the support arm 28 through an intermediation of the auxiliary device releasing portion 30 so as to be movable.

[0016] A pair of roller mounting arms 33 are fixed to an outer peripheral portion of the movable frame 31. Between tips of the roller mounting arms 33, a brake auxiliary roller 35 is attached so as to be rotatable. The brake auxiliary roller 35 is arranged so as to be opposed to a top portion of the drive sheave 6. Further, the brake auxiliary roller 35 includes a plurality of auxiliary roller portions 35a each corresponding to each of grooves 6a of the drive sheave 6. An outer periphery of each of the auxiliary roller portions 35a is provided with a roller groove 35b formed along a surface of each of the main ropes 9. Note that, all of the auxiliary roller portions 35a are formed so as to be integral with an outer peripheral portion of the brake auxiliary roller 35.

[0017] Between the pressing plate 29 and a bottom portion of the movable frame 31, there are arranged a plurality of auxiliary device springs 38. That is, the auxiliary device springs 38 are sandwiched by the pressing plate 29 and the bottom portion of the movable frame 31. The auxiliary device springs 38 biases the brake auxiliary roller 35 toward the main ropes 9 through intermediations of the movable frame 31 and the roller mounting arms 33. The brake auxiliary roller 35 is biased by the auxiliary device springs 38 to be pressed against the main ropes 9, thereby pressing the main ropes 9 against the drive sheave 6.

[0018] The auxiliary device releasing portion 30 moves the movable frame 31 in a direction in which the movable frame 31 is spaced apart from the outer periphery of the drive sheave 6 against the auxiliary device springs 38. That is, the auxiliary device releasing portion 30 causes the brake auxiliary roller 35 to be spaced apart from the main ropes 9 through the intermediation of the movable frame 31. Further, the auxiliary device releasing portion 30 releases the auxiliary device springs 38 at the time of emergency braking. Note that, the auxiliary device releasing portion 30 is operated in conjunction with an emergency braking operation of the brake device 7.

[0019] For the auxiliary device releasing portion 30, an electromagnet or the like is used as in the case of the brake releasing portion 19. For example, when an electromagnet is used for the auxiliary device releasing portion 30, by allowing the electromagnet to be energized, the brake auxiliary roller 35 is spaced apart from the drive sheave 6. On the other hand, by turning the electromagnet into a non-energized state, the auxiliary device springs 38 is released, so the main ropes 9 are pressed against the drive sheave 6 by the brake auxiliary roller 35.

[0020] Next, an operation will be described. When the car 10 is in a normal state (including a state of traveling and stopping), as shown in Fig. 4, the movable frame 31 is moved so as to be spaced apart from the outer periphery of the drive sheave 6 by the auxiliary device releasing portion 30. Thus, the brake auxiliary roller 35 is spaced apart from the outer periphery of the drive sheave 6 to be separated from the main ropes 9.

[0021] On the other hand, when emergency braking is applied to the car 10, the auxiliary device springs 38 are released. Accordingly, as shown in Fig. 5, the movable frame 31 is moved in a direction of approaching the outer periphery of the drive sheave 6, and the brake auxiliary roller 35 is pressed against the main ropes 9.

[0022] While being pressed against the main ropes 9, the brake auxiliary roller 35 rolls on the surfaces of the main

ropes 9 until the rotation of the drive sheave 6 stops and presses the main ropes 9 against the drive sheave 6.

[0023] Here, Fig. 6 is a view for illustrating the slip of the main ropes 9 with respect to the drive sheave 6 of Fig. 1. First, conditions of the slip between the drive sheave 6 and the main ropes 9 will be described. In the figure, on opposite ends of a portion of each of the main ropes 9 wound around the drive sheave 6, tensions T1 and T2 respectively acts due to the car 10 and the counter weight 11. In this case, conditions on which no slip of the main ropes 9 occurs can be represented as follows.

[0024]

$$T1/T2 \leq e^{\mu \cdot \theta} \quad \dots (1)$$

T1 = mc·g: static tension on the car 10 side

T2 = mw·g: static tension on the counterweight 11 side

mc: mass of the car 10 (deadweight of the car + load)

mw: mass of the counterweight 11

g: acceleration due to gravity

μ: apparent coefficient of static friction between the main ropes 9. and the drive sheave 6

θ: winding angle

e: base of natural logarithm

[0025] Note that, a value of μ varies to a large extent according to materials of the drive sheave 6 and the main ropes 9 and shapes of the grooves 6a of the drive sheave 6, so is represented by the following equation in general.

[0026]

$$\mu = \mu' \cdot k$$

μ': coefficient of static friction determined according to materials of the drive sheave 6 and the main ropes 9

k: coefficient (groove coefficient) determined according to shapes of the drive sheave 6 and grooves 6a

[0027] Further, when a speed of the car 10 and the counterweight 11 is changing, an inertial force has to be taken into consideration. Therefore, conditions on which no slip of the main ropes 9 occurs while the speed of the car 10 and the counterweight 11 is changing can be represented as follows.

[0028]

$$T1' / T2' \leq e^{\mu \cdot \theta} \quad \dots (2)$$

T1' = mc (g + a): dynamic tension on the car 10 side

T2' = mw (g-a): dynamic tension on the counterweight 11 side

a: acceleration of the car 10 and the counterweight 11 (or deceleration)

[0029] From the equation (2), it can be understood that when the braking by the brake device 7 is performed rapidly, thereby causing the value of a to be large, the slip of the main ropes 9 becomes liable to occur.

[0030] Further, when the main ropes 9 are being pressed against the drive sheave 6 by the brake auxiliary roller 35, the pressing force of the brake auxiliary roller 35 received by the main ropes 9 has to be taken into consideration, so the speed of the car 10 and the counterweight 11 changes. In this case, conditions on which no slip of the main ropes 9 occurs can be represented as follows.

[0031]

$$(T1' + P/\theta) / (T2' + P/\theta) \leq e^{\mu \cdot \theta} \quad \dots (3)$$

P: pressing force of the brake auxiliary roller 35 received by the main ropes 9

[0032] In the equation (3), a relationship of $P/\theta > 0$ is obtained, so even when the value of acceleration a of the car 10 and the counterweight 11 is larger as compared to the equation (2), it is possible to suppress the slip of the main ropes 9. That is, it is understood that a limit deceleration at which the slip of the main ropes 9 occurs becomes higher.

[0033] Note that, even if a coefficient of dynamic friction is substituted into μ of each of the equation (2) and the equation (3), the relations obtained by the equation (2) and the equation (3) are the same as in the case where μ is the coefficient of static friction. Therefore, it can be understood that even if the slip of the main ropes 9 occurs when the main ropes 9 are being pressed against the drive sheave 6, a larger braking force can be applied as compared to the case where the main ropes 9 are not pressed against the drive sheave 6.

[0034] In such the brake auxiliary device 8 for an elevator, at the time of emergency braking, the main ropes 9 are pressed against the drive sheave 6 by the brake auxiliary roller 35, so a frictional force between the drive sheave 6 and the main ropes 9 becomes larger, thereby making it possible to suppress, with a simpler structure, the slip of the main ropes 9.

[0035] Further, the brake auxiliary roller 35 is rotatable, so the friction between the brake auxiliary roller 35 and the main ropes 9 caused when the brake auxiliary roller 35 is pressed against the main ropes 9 can be reduced, thereby making it possible to prevent the main ropes 9 from being shortened in life.

[0036] Further, the auxiliary device releasing portion 30 causes the brake auxiliary roller 35 to be spaced apart from the main ropes 9 against the auxiliary device springs 38 when the car 10 is in the normal state. Therefore, in the normal state, it is possible to avoid putting more burden on the main ropes 9 than necessary, thereby preventing the main ropes 9 from being shortened in life due to contact with the brake auxiliary roller 35.

[0037] Note that, a sectional shape of each of the main ropes 9 is not limited. As a matter of course, main ropes each having a circular section or belt-like main ropes each having a flat section may also be used.

Further, the auxiliary roller portions 35a may be rotatable independently of one another.

Still further, while in the above-mentioned example, only one brake auxiliary roller is shown, a plurality of brake auxiliary rollers may be arranged at intervals therebetween in a circumferential direction of the sheave.

Yet further, while in the above-mentioned example, the brake auxiliary roller 35 is pressed against the main ropes 9 by the auxiliary device springs 38, an actuator may be used for pressing.

Further, an installation location of the drive device is not limited to the upper portion of the hoist way.

Still further, while in the above-mentioned example, an elevator apparatus employing a 1:1 roping system is shown, the roping system is not particularly limited. For example, the present invention may be applied also to an elevator apparatus employing a 2:1 roping system.

Yet further, while in the above-mentioned example, the drive device (hoisting machine) 1 is provided with the brake device 7 and the brake auxiliary device 8, the brake device 7 and the brake auxiliary device 8 may be provided to another sheave such as a suspension pulley, deflector sheave, or a return pulley.

Claims

1. A brake auxiliary device for an elevator, comprising a brake auxiliary roller, which is rotatable, for pressing a main rope against a sheave which is braked by a brake device at a time of emergency braking.

2. A brake auxiliary device for an elevator according to claim 1, further comprising:

a spring for pressing the brake auxiliary roller against the main rope; and

an auxiliary device releasing portion for causing the brake auxiliary roller to be spaced apart from the main rope against the spring in a normal state and releasing the spring at the time of emergency braking.

FIG. 1

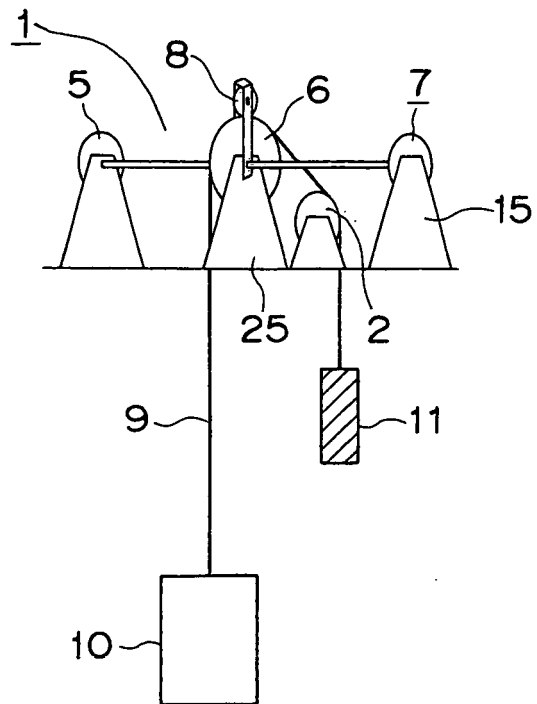


FIG. 2

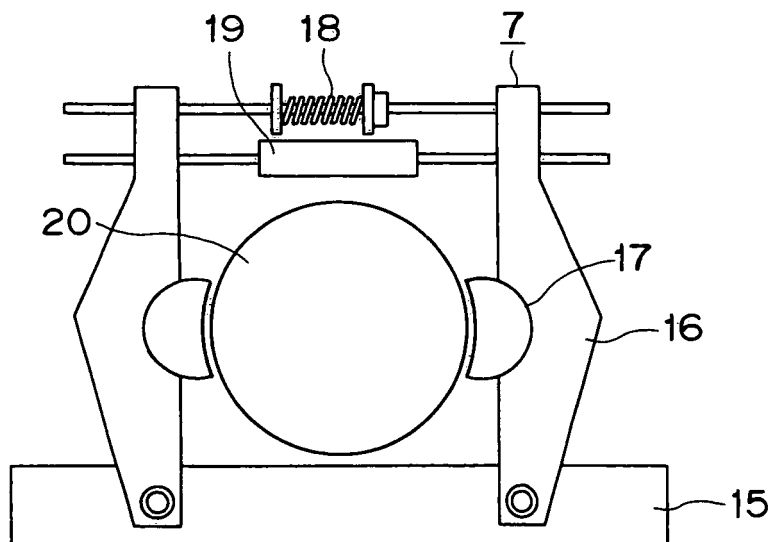


FIG. 3

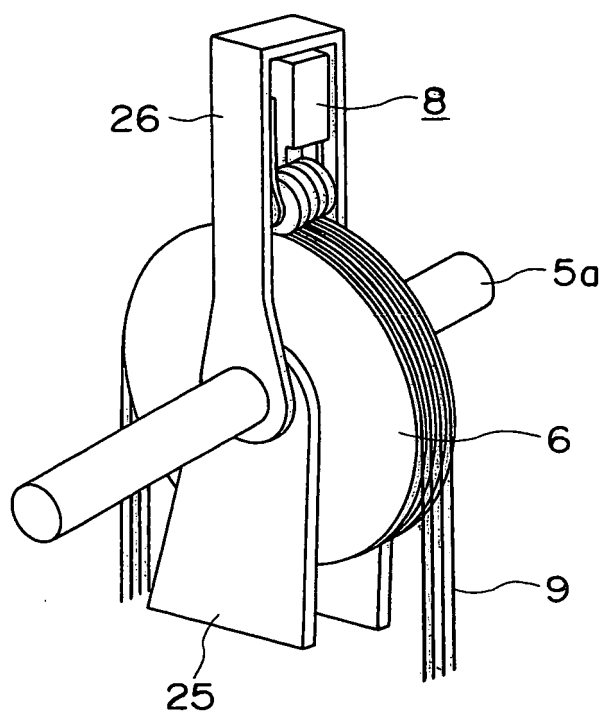


FIG. 4

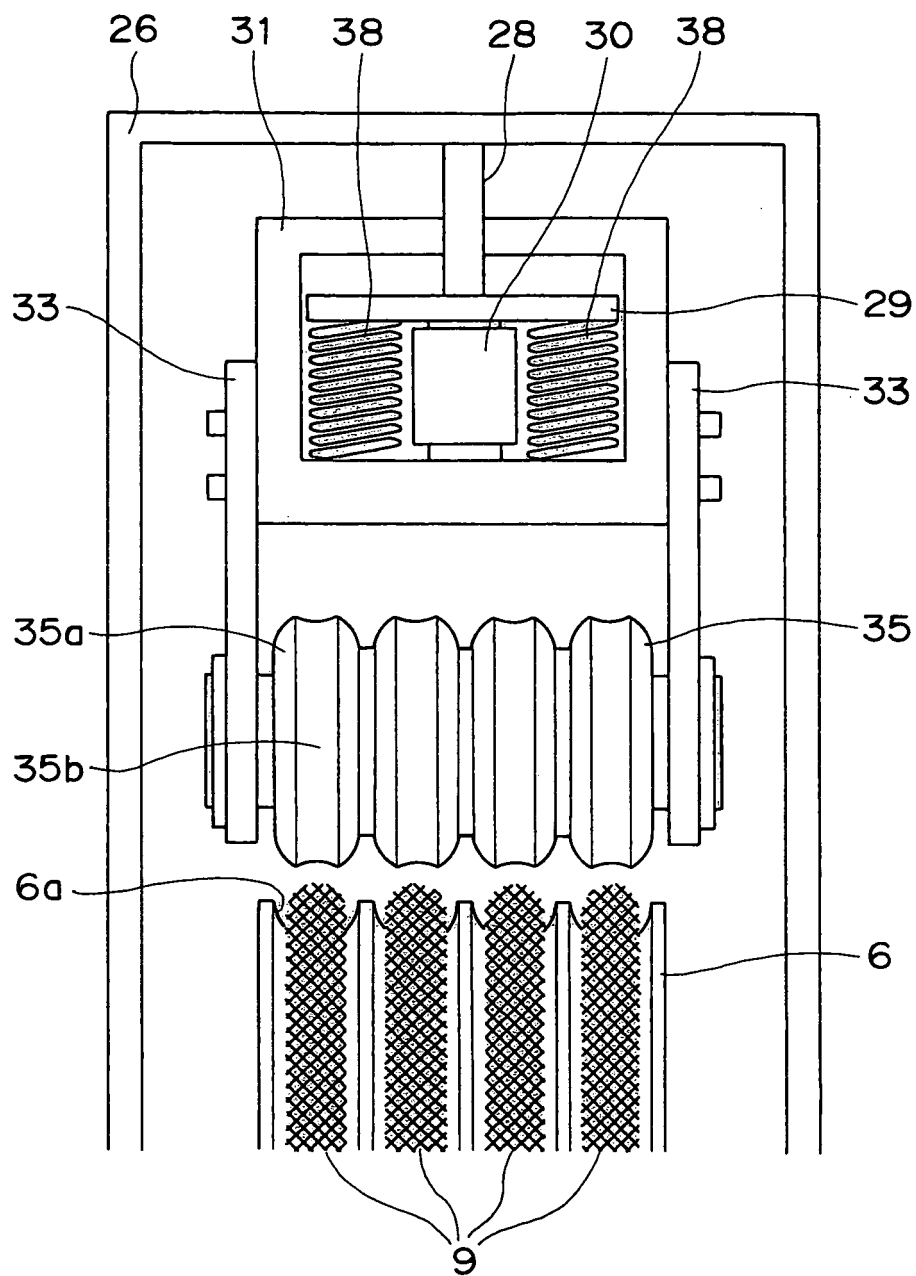


FIG. 5

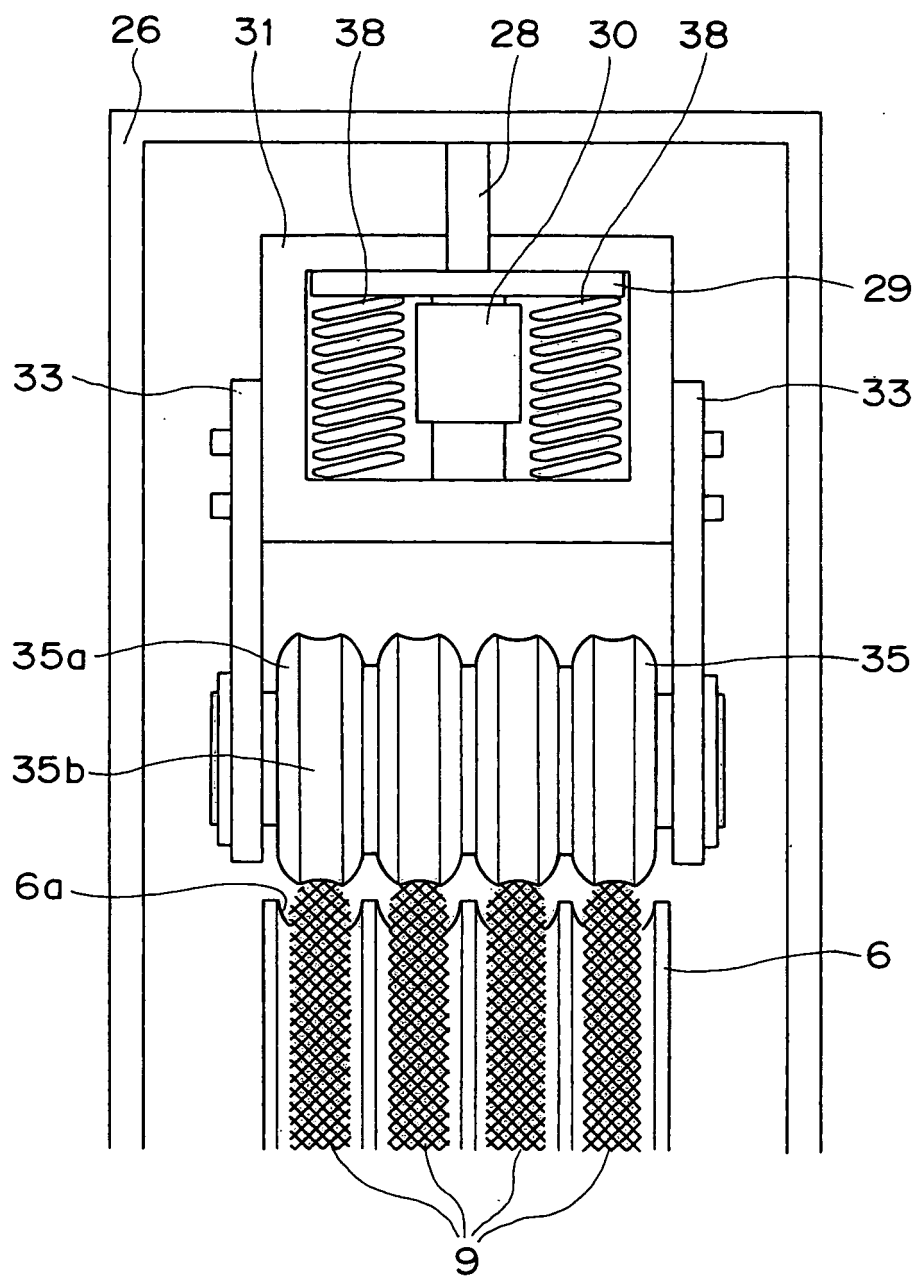
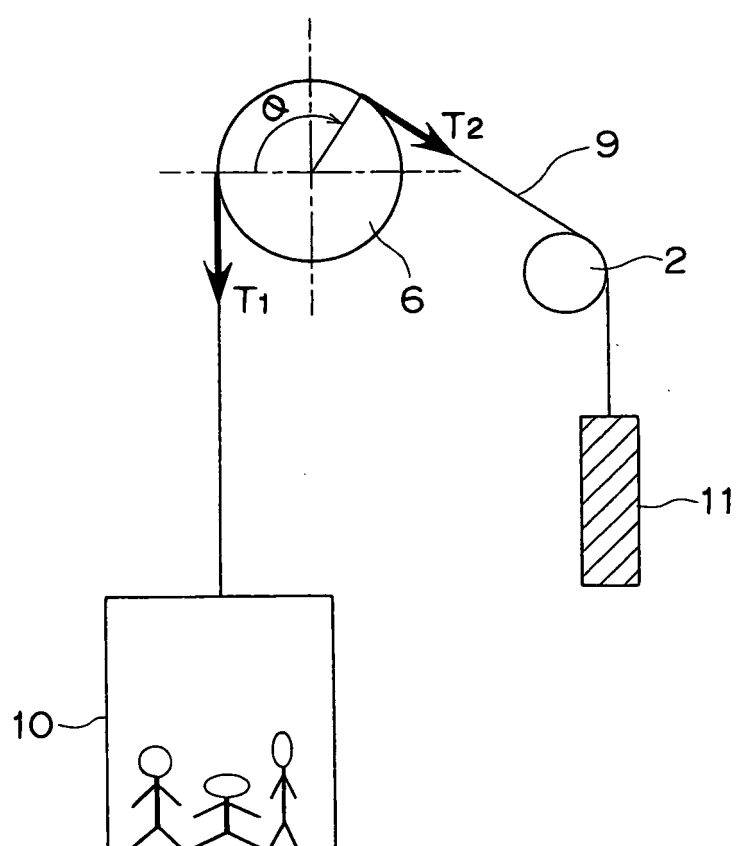


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/304090

A. CLASSIFICATION OF SUBJECT MATTER B66B11/08 (2006.01) , B66B5/02 (2006.01)		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) B66B1/00 (2006.01) - B66B11/08 (2006.01)		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2006 Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2004-231355 A (Mitsubishi Electric Corp.) , 19 August, 2004 (19.08.04) , Abstract; Fig. 6 & CN 1519187 A	1-2
Y	JP 50-24962 A (Hitachi, Ltd.) , 17 March, 1975 (17.03.75) , Page 2, lower left column, line 3 to page 3, lower left column, line 11; Figs. 1 to 6 (Family: none)	1-2
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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Date of the actual completion of the international search 09 June, 2006 (09.06.06)		Date of mailing of the international search report 20 June, 2006 (20.06.06)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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Patent documents cited in the description

- JP 2004231355 A [0003]