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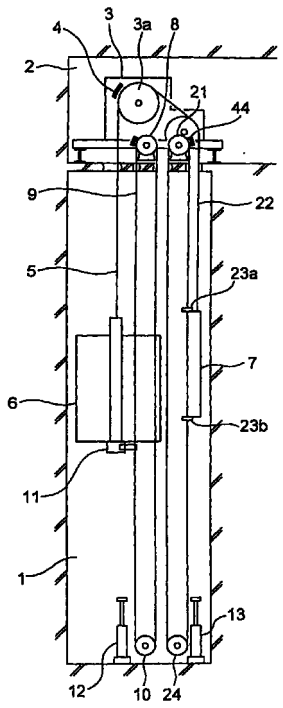
(54) SAFETY DEVICE OF ELEVATOR

(57) A car side speed governor for detecting overspeed of a car and a counterweight side speed governor for detecting overspeed of a counterweight are disposed in a machine room. A counterweight side speed governor rope is wound around the counterweight side speed governor. Both end portions of the counterweight side speed governor rope are connected to the counterweight so that the counterweight side speed governor rope is circulated in accordance with the up-and-down movement of the counterweight. When the lowering speed of the counterweight exceeds a preset value, the counterweight side speed governor rope is braked by the counterweight side speed governor to decelerate the counterweight.

FIG. 1



EP 1 086 921 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a safety device for a roped elevator, and more particularly, to a safety device for an elevator for suppressing an raising speed of a car when the car goes up at overspeed.

BACKGROUND ART

[0002] Fig. 5 is a schematic view showing a conventional elevator shown in Japanese Patent Application Laid-Open Nos. Hei 6-1561 and Hei 6-179585. In the figure, a machine room 2 is located on a hoistway 1. A hoisting machine 3 as a driving machine is provided in the machine room 2. The hoisting machine 3 is provided with a brake 4 for stopping the rotation of a driving sheave 3a.

[0003] A main rope 5 is wound around the driving sheave 3a of the hoisting machine 3. A car 6 is suspended at one end portion of the main rope 5 and a counterweight 7 is suspended at the other end portion of the main rope 5. The car 6 and the counterweight 7 are alternatively raised and lowered by a driving force of the hoisting machine 3.

[0004] A speed governor 8 for detecting overspeed of the car 6 is provided in the machine room 2. A speed governor rope 9 is wound around the speed governor 8. Both ends of the speed governor rope 9 are connected to an emergency stop device 11 which is provided at the lower portion of the car 6, , so that the speed governor rope 9 is circulated in accordance with the up-and-down movement of the car 6. A tension sheave 10 for imparting a tension to the speed governor rope 9 is provided at the lower end portion of the loop-like speed governor rope 9.

[0005] A car side damper 12 for receiving the car 6 when the car 6 is lowered down to a lowermost position below the movement range of the normal operation and a counterweight side damper 13 for receiving the counterweight 7 when the counterweight 7 is lowered down to the lowermost position are provided at the bottom of the hoistway 1.

[0006] Next, the operations will now be described. The car 6 and the counterweight 7 are raised and lowered within the hoistway 1 by the driving force of the hoisting machine 3. When the speed of the car 6 exceeds a rated speed due to a certain cause during the lowering operation of the car 6, the speed governor 8 detects increase in the circulation speed of the governor rope 9, so that the brake 4 works.

[0007] Thereafter, in the case where the lowering speed of the car 9 is further increased, the speed governor brake (not shown) provided in the speed governor 8 works to impart a mechanical braking force to the speed governor rope 9 to thereby operate the emergency stop device 11. Also, in the case where the car 6 collides with the car side damper 12 before the car 6 has been stopped by the emergency stop device 11, the impact from the collision is moderated with the car side damper 12.

[0008] On the other hand, when the speed of the car 6 exceeds the rated speed during the raising operation of the car 6, overspeed of the car 6 is detected by the speed governor 8 so that the car 6 is decelerated and stopped by the brake 4. Also, in the case where the counterweight 7 collides with the counterweight side damper 13 before the car 6 has been stopped, the impact from the collision is moderated with the counterweight side damper 13.

[0009] Thus, in the conventional elevator, the kind or the number of the means for reducing/stopping overspeed when the car 6 is raised is few in comparison with the means for reducing/stopping overspeed when the car 6 is lowered. Accordingly, there is a demand to further improve in safety aspect.

DISCLOSURE OF THE INVENTION

[0010] In order to solve the above-noted defects, an object of the present invention is to provide a safety device for making it possible to enhance the safety aspect for overspeed when the car is raised.

[0011] According to the present invention, there is provided a safety device for an elevator including a hoistway, a car and a counterweight that are moved up and down within the hoistway, a rope for suspending the car and the counterweight within the hoistway, a driving machine for raising and lowering the car and the counterweight through the rope, and a counterweight side damper for receiving the counterweight when the counterweight is lowered down to a lowermost position, the safety device comprising: a counterweight side speed governor rope being circulated in accordance with the up-and-down movement of the counterweight; and a counterweight side speed governor for mechanically applying a braking force to the counterweight side speed governor rope when the lowering speed of the counterweight reaches a preset overspeed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is a structural view showing an example of an elevator in accordance with an embodiment of the present invention;

Fig. 2 is a front view showing the counterweight side speed governor in Fig. 1;

Fig. 3 is an explanatory view showing a braking force required to the counterweight side speed governor in Fig. 1;

Fig. 4 is a flowchart showing the operation in the case where the counterweight side speed governor is provided with the stop switch; and

Fig. 5 is a structural view showing an example of a conventional elevator.

BEST MODE FOR CARRYING OUT THE INVENTION

[0013] A preferred embodiment of the present invention will now be described with reference to the accompanying drawings.

[0014] Fig. 1 is a structural view showing an example of an elevator in accordance with an embodiment of the present invention. In the figure, a machine room 2 is located on a hoistway 1. A hoisting machine 3 as a driving machine is provided in the machine room 2. The hoisting machine 3A is provided with a brake 4 for stopping the rotation of a driving sheave 3a.

[0015] A main rope 5 is wound around the driving sheave 3a of the hoisting machine 3. A car 6 is suspended at one end portion of the main rope 5, and a counterweight 7 is suspended at the other end portion of the main rope 5. The car 6 and the counterweight 7 are alternatively raised and lowered by a driving force of the hoisting machine 3.

[0016] A car side speed governor 8 for detecting overspeed of the car 6 is provided in the machine room 2. A car side speed governor rope 9 is wound around the speed governor 8. Both ends of the car side speed governor rope 9 are connected to an emergency stop device 11 provided at the lower portion of the car 6, so that the car side speed governor rope 9 is circulated in accordance with the up-and-down movement of the car 6. A tension sheave 10 for imparting a tension to the car side speed governor rope 9 is provided at the lower end portion of the loop-like car side speed governor rope 9.

[0017] A car side damper 12 for receiving the car 6 when the car 6 is lowered down to the lowermost position below the movement range of the normal operation and a counterweight side damper 13 for receiving the counterweight 7 when the counterweight 7 is lowered down to the lowermost position are provided at the bottom of the hoistway 1.

[0018] Also, a counterweight side speed governor 21 for detecting overspeed of the counterweight 7, which has substantially the same structure as that of the car side speed governor 8 is provided in the machine room 2. A counterweight side speed governor rope 22 is wound around the counterweight side speed governor 21. Both ends of the counterweight side speed governor rope 22 are connected to an upper and a lower end portions of the counterweight 7 through brackets 23a and 23b, respectively, so that the counterweight side speed governor rope 22 is circulated in accordance with the up-and-down movement of the counterweight 7. A tension sheave 24 for imparting a tension to the counterweight side speed governor rope 22 is provided at the lower end portion of the loop-like counterweight side speed governor rope 22.

[0019] Next, Fig. 2 is a frontal view showing the counterweight side speed governor 21 in Fig. 1. In the figure, a base 31 is fixed above the hoistway 1. A sheave 33 that is rotatable about a shaft 32 is supported by the base 31. A pair of flyweights 36 and 37 that are rotatable about shafts 34 and 35, respectively, are mounted on the sheave 33.

[0020] The flyweights 36 and 37 are coupled with each other through a link 38. A balance spring 39 is provided between one of the flyweights 37 and the sheave 33. The flyweights 36 and 37 are rotated about the shafts 34 and 35 against the balance spring 39 by a centrifugal force generated from the rotation of the sheave 33.

[0021] A ratchet 41 that is rotatable about the shaft 32 independently of the sheave 33 is supported by the base 31. Also, a brake arm 43 that is rotatable about a shaft 42 is supported by the base 31. A brake piece 44 that faces the counterweight side speed governor rope 22 wound around the sheave 33, is mounted on the brake arm 43.

[0022] One end of an operating rod 45 is rotatably coupled with the ratchet 41. A spring shaft 46 passing through the brake arm 43 is fixed to the other end of the operating rod 45. A spring seat 47 is provided through an end of a spring shaft 46 opposite to the operating rod 45, and a plurality of nuts 48 are screwed thereto. A compressing coiled spring 49 is provided between the spring seat 47 and the brake arm 43. One of the flyweights 37 is provided with a latch portion 37a for engaging with the teeth of the ratchet 41.

[0023] The detecting mechanism in this embodiment has the shafts 34 and 35, the flyweights 36 and 37, the link 38, the balance spring 39 and the ratchet 41. Also, the speed governor brake has the shaft 42, the brake arm 43, the brake piece 44, the operating rod 45, the spring shaft 46, the spring seat 47, the nuts 48 and the compression coiled spring 49.

[0024] It should be noted that the car side speed governor 8 and the counterweight side speed governor 21 have substantially the same structure but the car side speed governor 8 is further provided with a stop switch 51 and an operating member 52 in addition to the counterweight side speed governor 21 as indicated by a two-dot-and-dash line in Fig. 2. The stop switch 51 is mounted on the base 31 and output a signal for operating the brake 4. The operating member 52 is attached to the flyweight 37 and operates the stop switch 51 in accordance with the rotation of the flyweight 37.

[0025] Next, the operations will now be described. The car 6 and the counterweight 7 are moved up and down within the hoistway 1 by the driving force of the hoisting machine 3. When the speed of the car 6 exceeds the rated speed due to a certain cause during the lowering operation of the car 6, the increased circulation speed of the car side speed governor rope 9 is detected by the car side speed governor 8 so that the brake 4 works.

[0026] Thereafter, in the case where the lowering speed of the car 6 is further increased, a mechanical

braking force is applied to the car side speed governor rope 9 by the car side speed governor 8 so that the emergency stop device 11 works. Also, in the case where the car 6 collides with the car side damper 12 before the car 6 has been stopped by the emergency stop device 11, the car side damper 12 moderates the impact from the collision.

[0027] On the other hand, when the speed of the car 6 exceeds the rated speed and reaches a first overspeed set in advance when the car 6 is raised, overspeed of the car 6 is detected by the stop switch 51 provided in the car side speed governor 8, to thereby execute the brake 4. Also, in the case where the counterweight 7 collides with the counterweight side damper 13 before the car 6 is stopped, the counterweight side damper 13 moderates the impact from the collision.

[0028] Also, when the counterweight side damper 13 is fully compressed, the car 6 is caused to bounce at the uppermost portion of the hoistway 1. Accordingly, to avert the car 6 from colliding with the ceiling of the hoistway 1 due to the bounce of the car 6, a space called a top clearance is maintained at the uppermost portion of the hoistway 1.

[0029] The dimension (height) of the top clearance is determined in accordance with the set speed of the counterweight damper 13. Namely, when the counterweight 7 collides with the counterweight side damper 13 at lower speed than the set speed, the extent of the bounce of the car 6 is in the range of the top clearance, and therefore the car 6 is not collide with the ceiling of the hoistway 1. Also, the set speed of the counterweight side damper 13 is designed in accordance with the rated speed of the elevator.

[0030] However, when the raising speed of the car 6 exceeds the first overspeed before the counterweight 7 collides with the counterweight side damper 13 owing to an accident of the brake 4 or damage of a gear (not shown) of the hoisting machine 3, and reaches a second overspeed set in advance, the braking force is applied to the counterweight side speed governor rope 22 by the counterweight side speed governor 21. The second overspeed is set to be not higher than the set speed of the counterweight side damper 13.

[0031] More specifically, when the raising speed of the car 6, i.e., the lowering speed of the counterweight 7 reaches the second overspeed, the latch portion 37a engages with the teeth of the ratchet 41 so that the ratchet 41 is rotated in the same direction as that of the sheave 33. As a result, the operating rod 45 is shifted and the brake arm 43 is moved toward the sheave 33 so that the counterweight side speed governor rope 22 is depressed against the sheave 33 by the brake piece 44 and the counterweight side speed governor rope 22 is braked by the frictional force.

[0032] Thus, the counterweight side speed governor rope 22 is braked, so that the counterweight 7 is stopped or the lowering speed of the counterweight 7 is decelerated equal to or less than the set speed of the counterweight side damper 13. Accordingly, if the brake 4 should fail to work or the gear of the hoisting machine 3 is damaged, it is possible to prevent the car 6 from colliding with the ceiling of the hoistway 1 to thereby enhance the safety aspect for overspeed when the car 6 is raised.

[0033] Fig. 3 is an explanatory view showing a braking force required to the counterweight side speed governor 21 in Fig. 1. In Fig. 3, W1 is the weight of the car 6, W2 is the weight of the counterweight 7, F1 is the braking force by the counterweight side speed governor 21 and α is downward acceleration of the counterweight 7.

[0034] When the car 6 is raised at overspeed, it is possible to consider that the main rope 5 is connected between the car 6 and the counterweight 7. Also, it is not always necessary for the counterweight side speed governor 21 to stop the counterweight side speed governor rope 22, and it is sufficient to decelerate the acceleration below the set speed of the counterweight side damper 13.

[0035] For this reason, the braking force required for the counterweight side speed governor 21, i.e., the minimum braking force required for decelerating the car 6 and the counterweight 7 is only the difference between the weight of the counterweight 7 and the car 6 when no load is applied (α is less than zero when $F1 \geqq W2-W1$). This braking force is much smaller than a force needed for braking the car 6 accelerating as it moves down when the main rope is 5 is cut off. Accordingly, it is possible to enhance the safety aspect for overspeed when the car is raised by utilizing substantially the same structure as the structure of the car side speed governor 8.

[0036] Also, if the car 6 is raised at overspeed by the hoisting machine 3, the traction is not generated at the time the counterweight 7 collides with the counterweight side damper 13, and the car 6 is caused to bounce after the counterweight side damper 13 has been fully compressed. Accordingly, the extent of the bounce of the car 6 is within the range of the top clearance.

[0037] It should be noted that, while, in the foregoing embodiment, the counterweight side speed regulation 21 is not provided with the stop switch 51 and the operating member 52, it is also possible to apply the same structure as that of the speed governor 8 to the counterweight side speed governor 21. In this case, the set speed of the stop switch 51 of the counterweight side speed governor 21 is somewhat higher than the speed of the car side speed governor 8 or the output of the stop switch 51 of the counterweight side speed governor 21 is disabled.

[0038] Fig. 4 is a flowchart of the operation in the case where the counterweight side speed governor 21 is provided with the stop switch 51. When the car 6 is operated to be raised, the presence/absence of the output of the first overspeed detection signal from the stop

switch 51 of the car side speed governor 8 is always detected (step S1). When the output of the signal is detected, the brake 4 of the hoisting machine 3 is operated (step S2). Thereafter, the presence/absence of the output of overspeed detection signal from the stop switch 51 of the counterweight side speed governor 21 is detected (step S3).

[0039] Namely, When the lowering speed of the counterweight 7 exceeds the set value (somewhat greater than the first overspeed) due to a certain cause, the signal for operating the brake 4 of the hoisting machine 3 is outputted again (step S4). Thereafter, the counterweight side speed governor 21 mechanically detects whether or not the lowering speed of the counterweight 7 is equal to or less than the second overspeed speed (step S5). Then, when the lowering speed of the counterweight 7 exceeds the second overspeed, as described above, the counterweight side speed governor rope 22 is braked by the counterweight side speed governor 21.

[0040] Thus, the counterweight side speed governor 21 is provided with the stop switch 51 so that, even if the stop switch 51 of the car side speed governor 8 fails to work, the brake 4 is operated in accordance with the first set value to thereby further enhance the safety aspect.

Claims

1. A safety device for an elevator including a hoistway, a car and a counterweight that are moved up and down within the hoistway, a rope for suspending the car and the counterweight within the hoistway, a driving machine for raising and lowering the car and the counterweight through the rope, and a counterweight side damper for receiving the counterweight when the counterweight is lowered down to a lowermost position, said safety device comprising:

   a counterweight side speed governor rope being circulated in accordance with the up-and-down movement of the counterweight; and
   a counterweight side speed governor for mechanically applying a braking force to said counterweight side speed governor rope when the lowering speed of the counterweight reaches a preset overspeed.

2. The safety device for the elevator according to claim 1, wherein said counterweight side speed governor includes:

   a base provided above the hoistway;
   a sheave which is provided rotatably on said base and around which said counterweight side speed governor rope is wound;
   a detecting mechanism for detecting overspeed of the counterweight in accordance with a rotation of said sheave; and
   a speed governor brake for braking said counterweight side speed governor rope when overspeed of the counterweight is detected by said detecting mechanism.

3. The safety device for the elevator according to claim 1, wherein the braking force of said counterweight side speed governor is set at a difference between a weight of the counterweight and a weight of the car with no load, or more.

FIG. 1

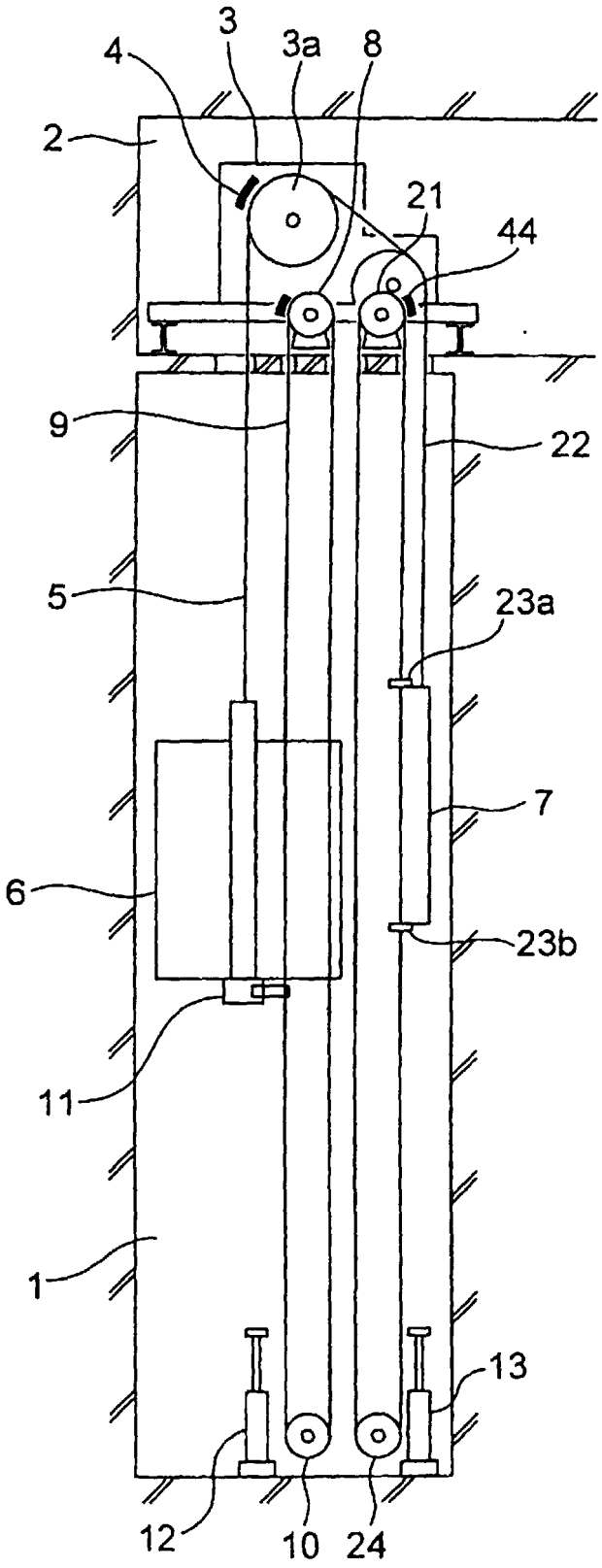


FIG. 2

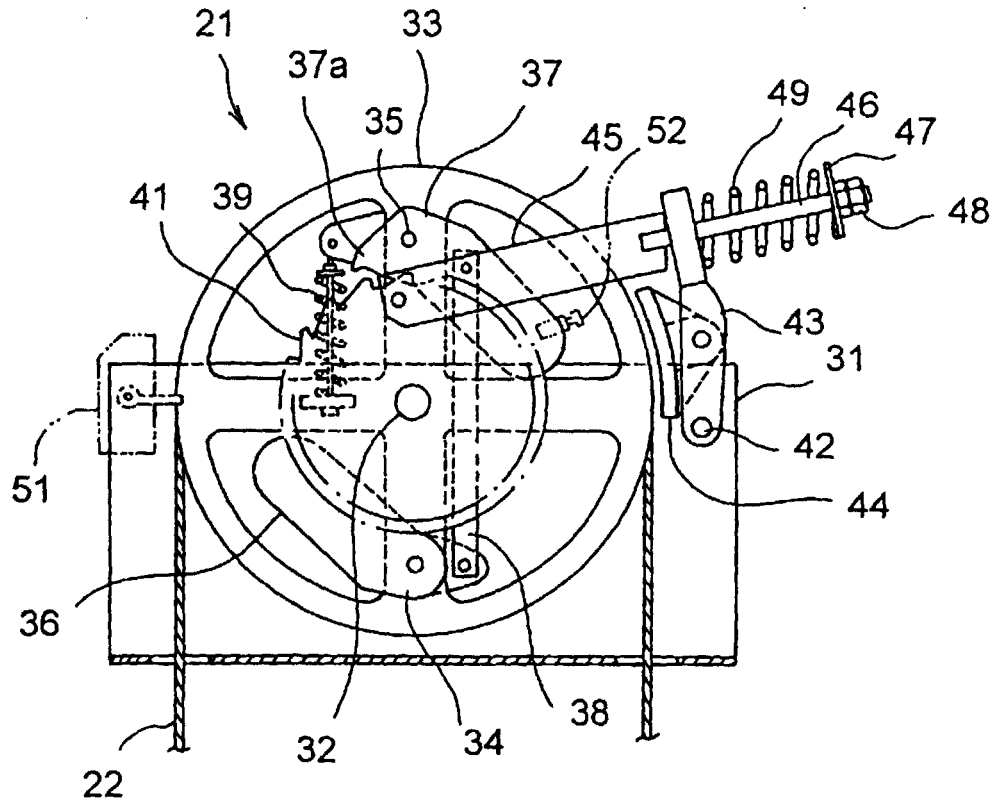


FIG. 3

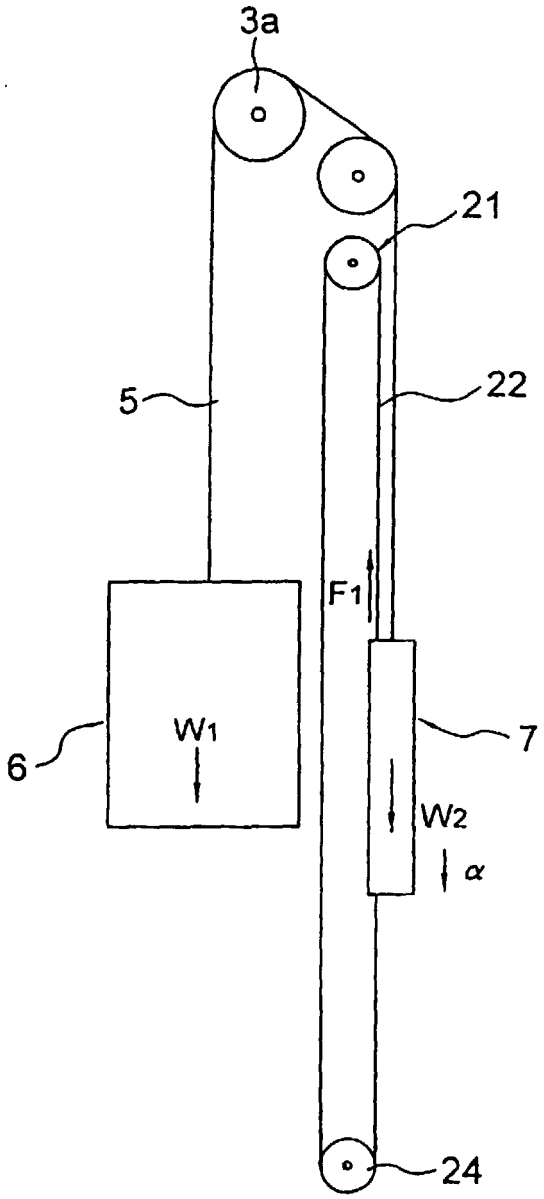


FIG. 4

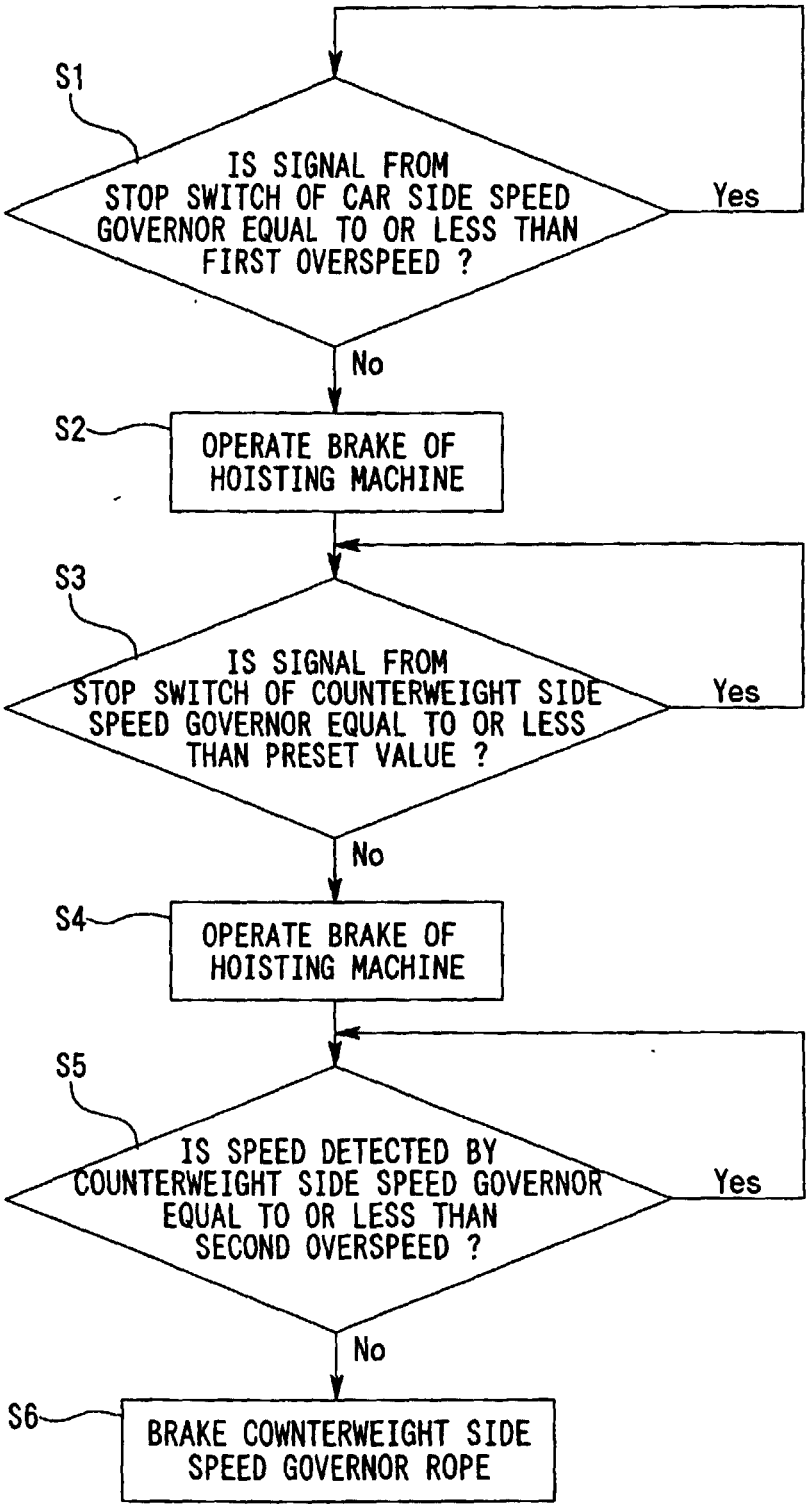
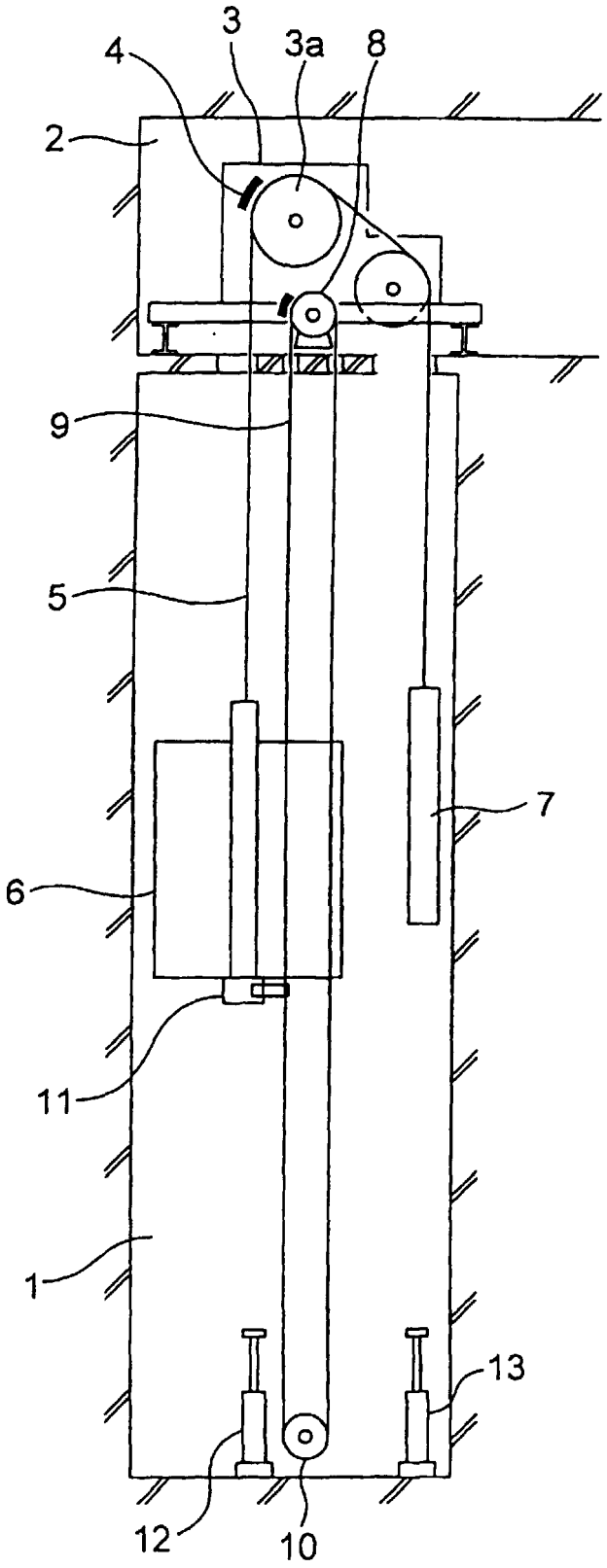

S1
IS SIGNAL FROM STOP SWITCH OF CAR SIDE SPEED GOVERNOR EQUAL TO OR LESS THAN FIRST OVERSPEED ?
Yes
No
S2
OPERATE BRAKE OF HOISTING MACHINE
S3
IS SIGNAL FROM STOP SWITCH OF COUNTERWEIGHT SIDE SPEED GOVERNOR EQUAL TO OR LESS THAN PRESET VALUE ?
Yes
No
S4
OPERATE BRAKE OF HOISTING MACHINE
S5
IS SPEED DETECTED BY COUNTERWEIGHT SIDE SPEED GOVERNOR EQUAL TO OR LESS THAN SECOND OVERSPEED ?
Yes
No
S6
BRAKE COWNTERWEIGHT SIDE SPEED GOVERNOR ROPE

FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/01325

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[6] B66B5/04, B66B5/28

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)
Int.Cl[6] B66B5/04, B66B5/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-1999
Kokai Jitsuyo Shinan Koho 1971-1999 Jitsuyo Shinan Toroku Koho 1996-1999

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, 55-074979, A (Shimizu Construction Co., Ltd.), 5 June, 1980 (05. 06. 80) (Family: none) Fig. 1 & JP, 61-169475, A (Mitsubishi Electric Corp.), 31 July, 1986 (31. 07. 86) (Family: none) Fig. 1 & JP, 09-136777, A (Mitsubishi Electric Bldg. Techno-Service Co., Ltd.), 27 May, 1997 (27. 05. 97) (Family: none) Fig. 10	1-3
Y	JP, 51-031445, A (Mitsubishi Electric Corp.), 17 March, 1976 (17. 03. 76) (Family: none) Fig. 1 & JP, 05-032384, A (Hitachi,Ltd.), 9 February, 1993 (09. 02. 93) (Family: none) Fig. 1 & JP, 05-319724, A (Mitsubishi Electric Corp.), 3 December, 1993 (03. 12. 93) (Family: none) Fig. 2	1-3

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 June, 1999 (23. 06. 99)	6 July, 1999 (06. 07. 99)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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