(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 460 021 A1

(12) # EUROPEAN PATENT APPLICATION
published in accordance with Art. 158(3) EPC

(43) Date of publication:
22.09.2004 Bulletin 2004/39

(21) Application number: **01978950.2**

(22) Date of filing: **30.10.2001**

(51) Int Cl.[7]: **B66B 11/02**

(86) International application number:
PCT/JP2001/009515

(87) International publication number:
WO 2003/037773 (08.05.2003 Gazette 2003/19)

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(71) Applicant: **MITSUBISHI DENKI KABUSHIKI KAISHA**
Tokyo 100-8310 (JP)

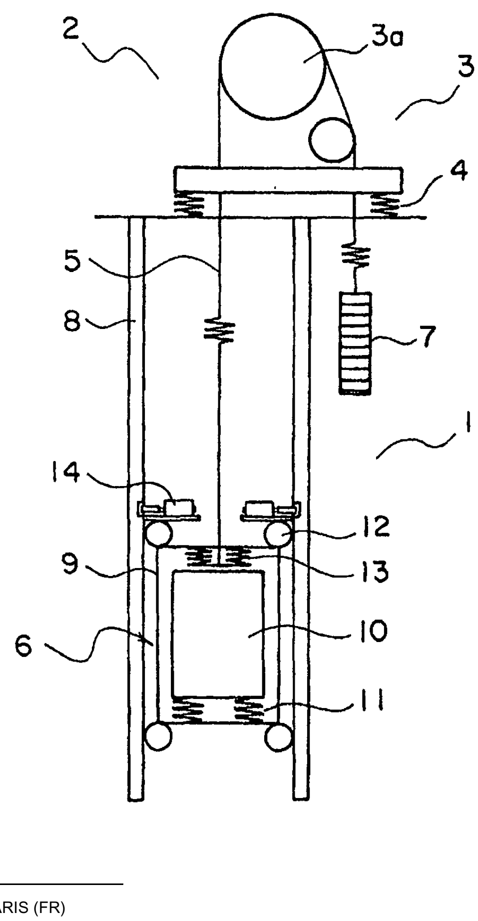
(72) Inventor: **FUNAI, Kiyoshi**
Chiyoda-ku, Tokyo 100-8310 (JP)

(74) Representative: **HOFFMANN - EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) **ELEVATOR DEVICE**

(57) Disclosed is an elevator apparatus having a car on which is mounted a vibration reducing device adapted to be engaged with a stationary portion in the hoistway when the car is at rest to attenuate vibration of the car. The vibration reducing device has a friction shoe to be pressed against a guide rail serving as the stationary portion and an electromagnetic actuator for bringing the friction shoe into and out of contact with the guide rail.

FIG. 1



EP 1 460 021 A1

Description

TECHNICAL FIELD

[0001] This invention relates to an elevator apparatus in which a car is raised and lowered in a hoistway while being guided by guide rails.

BACKGROUND ART

[0002] Generally, in an elevator apparatus, a car is guided by guide rails when the car is raised and lowered in a hoistway. That is, the car has on both sides of its upper and lower portions guide devices engaged with guide rails (roller guide devices or sliding guide devices).

[0003] In some cases, when a passenger gets in or out of the car at rest, the car lightly vibrates vertically due to fluctuations in the load. In particular, in a hydraulic elevator in which the superimposed load is supported by a hydraulic cylinder, working oil is used for the telescopic motion of the plunger, so that the car has rather low support rigidity (spring constant) and is easily subject to vibration. In a rope type elevator apparatus, in which the travel length is large and the elevator apparatus uses a 2:1 roping system, the rope length is large, so that the car also has rather low support rigidity and is easily subject to vibration.

[0004] In a case where a synthetic resin rope or a high strength wire rope is used, the relative modulus of elasticity is lower than that of currently-used ropes, so that it is to be expected that the car will be more easily subject to vibration.

[0005] Fig. 5 is an explanatory diagram illustrating how a car vibrates when at rest in a conventional rope-type elevator apparatus. Here, a case is assumed in which fluctuation in load occurs as a result of one passenger (75 kg) getting in a twelve-passenger car with a mass of approximately 2000 kg when the car is at rest, the drawing showing the results of the analysis of the changes in the vibration of the car floor.

[0006] In the drawing, when the passenger weighing 75 kg gets in the car at the time point of 1.0 sec., a vibration having an amplitude of approximately 10 mm is generated in the car floor. As can be seen from the drawing, this vibration carries on even five seconds thereafter, with the amplitude being only attenuated to approximately 5 mm. Note that in this case, only the rope attenuation is taken into account.

[0007] JP 2001-106456 A, for example, discloses a hydraulic elevator in which, when the car is at rest, friction shoes of high coefficient of friction are pressed against the guide rails by electromagnetic coils, thereby securing the car to the guide rails. However, when the car at rest is completely secured to the rails, the position of the car undergoes no change despite the fluctuations in load when a passenger gets in or out of the car, so that it is impossible to detect the fluctuation in load in the car at rest from a change in the car position.

[0008] In an ordinary elevator, the fluctuation in load when the car is at rest is detected from a change in the position of the car, and a motor torque corresponding to the fluctuation in load is imparted to the hoist, thereby preventing vibration due to the instantaneous fluctuation in load when starting the car. If, however, the car is secured when at rest, the fluctuation in load cannot be detected, so that it is impossible to prevent the vibration when starting the car.

[0009] Further, to completely secure the car, the increase in load due to the passenger has to be coped with by the frictional force of the friction shoes. The larger the car volume, the larger the requisite frictional force. For example, in a twelve-passenger elevator (with a mass of approximately 800 kg when filled to capacity), it is necessary to support the car with a force of approximately 8000 N to prevent the car from moving even when a full capacity of passengers (approximately 800 kg) board an empty car at one time. To support this load with the frictional force of friction shoes with a coefficient of friction . = 0.5, it is necessary for the friction shoes to be pressed with a force of approximately 16000 N.

[0010] In this way, to secure the car completely in position, the driving force of the actuators for pressing the friction shoes against the guide rails has to be very large, resulting in an overall increase in cost and apparatus size.

DISCLOSURE OF THE INVENTION

[0011] This invention has been made with a view toward solving the above-mentioned problem in the prior art. It is an object of this invention to provide an elevator apparatus capable of reducing the vibration in the car when at rest due to passengers getting on and off.

[0012] An elevator apparatus according to this invention is equipped with a hoistway and a car that is raised and lowered in the hoistway, in which mounted on the car is a vibration reducing device which is engaged with a stationary portion in the hoistway when the car is at rest to attenuate vibration of the car.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 is a schematic diagram showing the construction of an elevator apparatus according to an embodiment of this invention.

Fig. 2 is an enlarged view of a main portion of Fig. 1.

Fig. 3 is a plan view of the vibration reducing device of Fig. 1.

Fig. 4 is an explanatory diagram illustrating how a car vibrates when at rest in a rope type elevator apparatus to which the vibration reducing device of Embodiment 1 is applied.

Fig. 5 is an explanatory diagram illustrating how a car vibrates when at rest in a conventional rope type elevator apparatus.

BEST MODE FOR CARRYING OUT THE INVENTION

[0014] A preferred embodiment of this invention will now be described with reference to the drawings.

[0015] Fig. 1 is a schematic diagram showing the construction of an elevator apparatus according to an embodiment of this invention. In the drawing, a machinery room 2 is provided above a hoistway 1. On the floor of the machinery room 2, a hoist 3 having a drive sheave 3a is installed through the intermediation of a plurality of hoist vibration proof rubber members 4.

[0016] A rope (main rope) 5 is wrapped around the drive sheave 3a. The rope 5 can be regarded as a spring having a spring constant determined by the material thereof. In particular, when the ascent/descent travel is long, and the rope length is large, the spring constant of the rope 5 is small.

[0017] A car 6 is suspended at one end of the rope 5. At the other end of the rope 5, a balance weight 7 is suspended. In the hoistway 1, there are installed a pair of guide rails 8 serving as stationary portions for guiding the car 6 as it ascends and descends.

[0018] The car 6 has a car frame 9, a car chamber 10 supported by the car frame 9, a plurality of under-floor vibration proof rubber members 11 provided between the car frame 9 and the car chamber 10, and a plurality of roller guide devices (or sliding guide devices) 12 engaged with the guide rails 8. The car frame 9 is connected to the rope 5 through the intermediation of a shackle spring device 13.

[0019] Mounted on the car 6 are a pair of vibration reducing devices 14 adapted to be engaged with the guide rails 8 when the car 6 is at rest to attenuate the vibration of the car 6.

[0020] Fig. 2 is an enlarged view of a main portion of Fig. 1. Each vibration reducing device 14 is mounted to the upper portion of the frame 9 through the intermediation of a mounting member 15. Further, each vibration reducing device 14 is arranged above the roller guide device 12 so that it will not interfere with the guide roller of the roller guide device 12.

[0021] Fig. 3 is a plan view of one of the vibration reducing devices 14 of Fig. 1. In the drawing, the vibration reducing device 14 has an opening/closing mechanism 16, a pair of friction shoes 17, an electromagnetic actuator 18, and a return spring 19.

[0022] The friction shoes 17 are mounted on the opening/closing mechanism 16 so as to be opposed to the guide rail 8. Further, the friction shoes 17 are pressed against the guide rail 8 through the opening/closing mechanism 16 by the electromagnetic force of the electromagnetic actuator 18. When the electromagnetic actuator 8 is driven, the guide rail 8 is held between the pair of friction shoes 17. When the friction shoes 17 are pressed against the guide rail 8, vibration of the car 6 is attenuated by the frictional force.

[0023] Further, the opening/closing mechanism 16 is constantly urged by the return spring 19 so as to move the friction shoes 17 away from the guide rail 8. Thus, when the electromagnetic actuator 18 is not being driven, the friction shoes 17 are separated from the guide rail 8.

[0024] Connected to the electromagnetic actuator 18 is a vibration reducing control device 20 which drives the electromagnetic actuator 18 when the car 6 is at rest with its door being open to operate the vibration reducing device 14.

[0025] The friction shoes 17 are formed of a high-polymer material such as polyurethane or polyethylene.

[0026] Next, the operation of this elevator apparatus will be described. When the car 6 stops at a floor and passengers get in or out of the car with the door open, the position of the car 6 undergoes a vertical change due to the fluctuation in the load, and vibration is generated in the car 6. At this time, the car 6 is displaced according to the spring constant of all the spring elements supporting the car 6 (i.e., the spring constant obtained by synthesizing the spring constants of the hoist vibration proof rubber members 4, the under-floor vibration proof rubber members 11, the shackle springs 13, and the rope 5).

[0027] Meanwhile, when the car 6 reaches a floor and a door opening signal is output, the door of the car and the door of the hall are opened, and the electromagnetic actuators 18 are driven by the vibration reducing control devices 20. As a result, the friction shoes 17 are pressed against the guide rails 8 against the resilient force of the return springs 19, and a frictional force is generated in the sliding direction for the friction shoes 17 (the direction in which the car 6 vibrates). The vibration of the car 6 is also attenuated by the frictional force of the friction shoes 17.

[0028] The magnitude of the frictional force of the friction shoes 17 is substantially equal to the product of the pressurizing force P and the coefficient of friction . between the friction shoes 17 and the guide rails 8. Thus, by appropriately setting the pressurizing force P, it is possible to quickly attenuate the vibration of the car 6.

[0029] Further, while the car 6 is traveling, the electromagnetic actuators 18 are de-energized, so that the friction shoes 17 are separated from the slide surfaces of the guide rails 8 by the return springs 19.

[0030] Fig. 4 is an explanatory diagram illustrating how a car is vibrated when at rest in a rope type elevator apparatus to which the vibration reducing device 14 of Embodiment 1 is applied. Here, it is assumed that the fluctuation in load occurs as a result of one passenger (75 kg) getting into a twelve-passenger car with a mass of approximately 2000 kg when the car is at rest, the drawing showing the results of the analysis of the changes in the vibration of the car floor. It is assumed, further, that a vibration reducing device 14 capable of generating a frictional force of 150 N in the sliding direction is used.

[0031] In the drawing, when the passenger weighing 75 kg gets into the car at the time point of 1.0 sec., a vibration with an amplitude of approximately 10 mm is generated. As can be seen, this vibration is attenuated by the frictional force generated by the vibration reducing devices 14, to subside in a little less than two seconds.

[0032] To generate a frictional force of 150 N using friction shoes 17 with a coefficient of friction . of, for example, 0.3, it is necessary to impart a pressurizing force of 500 N. However, this pressurizing force is substantially smaller than the requisite force for completely securing the car 6 in position. Thus, the electromagnetic actuators 18 used may be small ones, thereby restraining increases in cost and size.

[0033] In the example described above, the vibration of the car 6 can be attenuated to a sufficient degree with the frictional force of 150 N. The optimum value of the frictional force for attenuating the vibration varies depending upon the rope spring constant determined by the number and thickness of the ropes 5 and the weight of the car 6.

[0034] When the frictional force provided by the vibration reducing devices 14 is too large, the fluctuation in load caused by a passenger getting in or out cannot be detected by a weighing device. Thus, when the total frictional force generated by the vibration reducing devices 14 is not more than 600 N (approximately 60 kgf), which corresponds to the weight of one passenger, the fluctuation in load can be detected by a weighing device, making it possible to prevent the vibration of the car 6 when it starts.

[0035] When the frictional force is too small, the effect of attenuating vibration is diminished, so that the frictional force is set so as to obtain a sufficient attenuation force.

[0036] Further, when there is a great change in the load on the car at rest as in the case in which many passengers get in or out at one time, a difference in height may be generated between the threshold of the car and the floor of the hall. However, since the car 6 is not secured to the guide rails 8, it is possible to move the car 6 by the hoist 3 so as to eliminate the difference in height (re-leveling operation) as in the case of an ordinary elevator apparatus.

[0037] As described above, by using the vibration reducing devices 14, it is possible to restrain the vibration of the car 6 due to fluctuation in load when the car is at rest, thus keeping passengers from experiencing unpleasant feelings. Further, as compared with the system in which the car 6 is completely secured in position, the requisite pressurizing force for reducing the vibration may be smaller, thus making it possible to achieve a reduction in the size of the electromagnetic actuator 18. Further, since it is possible to detect fluctuation in the load of the car 6 to endow the hoist 3 with an appropriate torque, it is also possible to prevent the vibration of the car 6 when it starts.

[0038] While in the above-described example the vibration reducing devices 14 are engaged with the guide rails 8, which are stationary portions, it is also possible to secure in the hoistway dedicated friction members with which the friction shoes are to be brought into and out of contact. In this case, a material suitable for vibration reduction can be freely selected, thus making it possible to reduce vibration more efficiently. Further, the friction members, which are only used when the car is at rest, need not be provided so as to extend throughout the hoistway but at intervals where necessary.

[0039] Further, it is also possible to use existing portions, such as the hoistway wall or the hall doors, as the stationary portions.

[0040] Further, while in the above example the vibration reducing devices 14 are arranged above the car 6, there are no limitations regarding the mounting positions for the vibration reducing devices; for example, they may be provided under the car 6.

[0041] Furthermore, while in the above example the vibration reducing device 14 is provided on either side of the car 6, it is also possible for the device to be provided on one side only.

[0042] Further, while in the above example the vibration reducing device 14 is constructed such that the guide rail 8 is held between a pair of friction shoes 17, it is also possible to press a single friction shoe against the guide rail.

[0043] Further, in the vibration reducing device 14 of the above example the friction shoes 14 are brought into frictional contact with the guide rail 8, this should not be construed restrictively. For example, it is also possible to bring a roller endowed with an appropriate resistive force against rotation into contact with the guide rail 8 when the car is at rest and cause it to roll thereon.

[0044] Furthermore, while in the above example the electromagnetic actuator 18 is used as the actuator for bringing the friction shoes 14 into and out of contact with the guide rail 8, it is also possible, for example, to use an actuator utilizing air pressure or oil pressure.

[0045] Further, while in the above example the invention is applied to a 1:1 roping type elevator apparatus, this invention is also applicable to an elevator apparatus with some other roping system, such as the 2:1 roping system.

[0046] Further, while in the above example the invention is applied to an elevator apparatus using the electric hoist 3, the invention is also applicable to a direct or indirect type (rope type) hydraulic elevator.

Claims

1. An elevator apparatus comprising: a hoistway, and a car that is raised and lowered in the hoistway,

wherein mounted on the car is a vibration reducing device adapted to be engaged with a stationary portion in the hoistway when the car is at rest to attenuate vibration of the car.

2. An elevator apparatus according to claim 1, further comprising a vibration reducing control device which operates the vibration reducing device when the car is at rest with its door being open.

3. An elevator apparatus according to claim 1, wherein the vibration reducing device has a friction shoe which is pressed against a guide rail serving as the stationary portion for guiding the raising and lowering of the car to attenuate vibration of the car by a frictional force.

4. An elevator apparatus according to claim 1, wherein the vibration reducing device has a friction member serving as the stationary portion secured in position in the hoistway separately from the guide rail for guiding the raising and lowering of the car and a friction shoe adapted to be pressed against the friction member to attenuate vibration of the car by a frictional force.

5. An elevator apparatus according to claim 1, wherein the vibration reducing device has a friction shoe to be pressed against the stationary portion to attenuate vibration of the car by a frictional force and an electromagnetic actuator which presses the friction shoe against the stationary portion by an electromagnetic force.

6. An elevator apparatus according to claim 1, wherein the vibration reducing device has a friction shoe to be pressed against the stationary portion to attenuate vibration of the car by a frictional force, and wherein the total frictional force generated by the friction shoe is not larger than 600 N.

FIG. 1

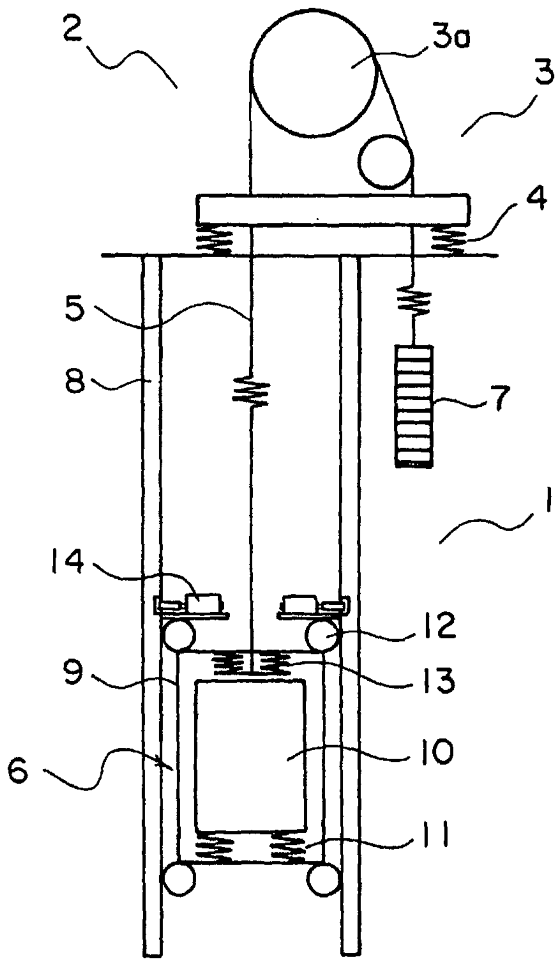


FIG. 2

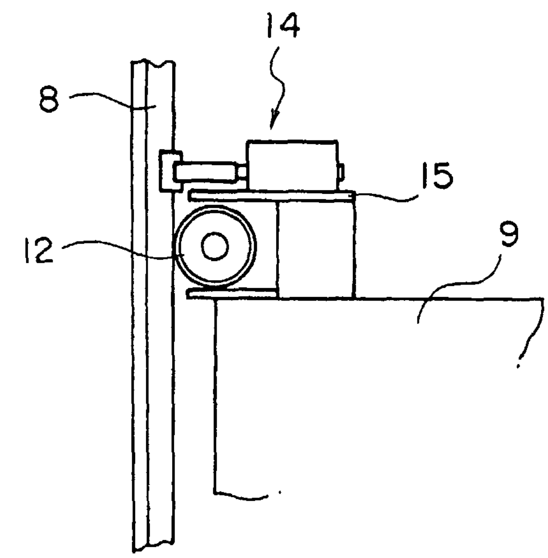


FIG. 3

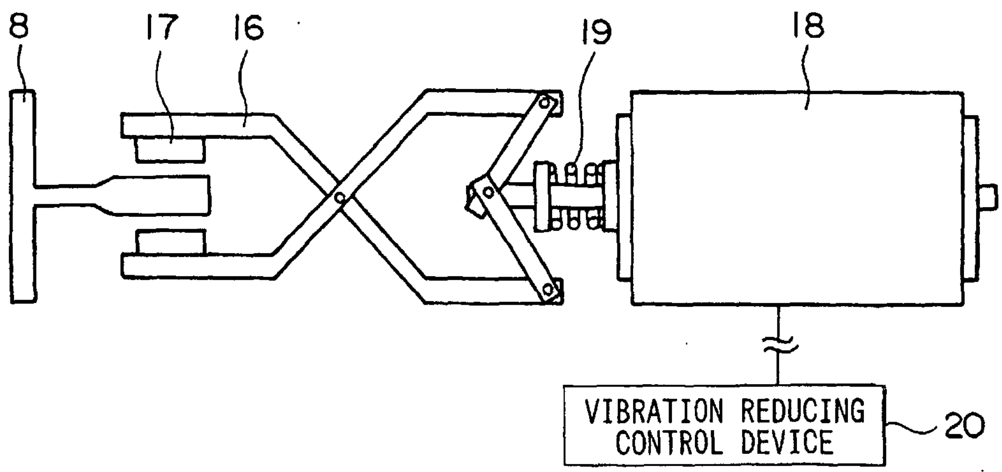


FIG. 4

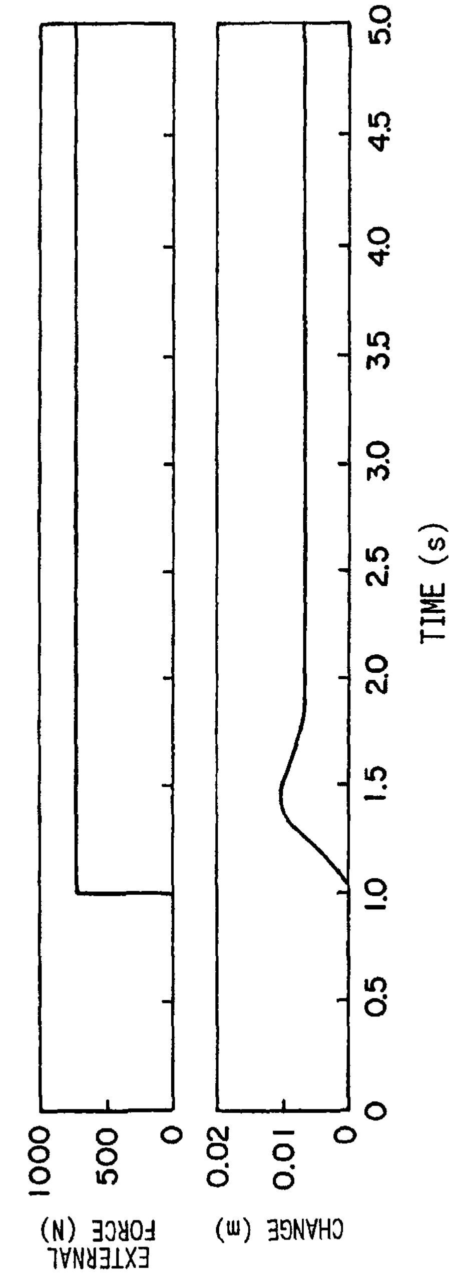
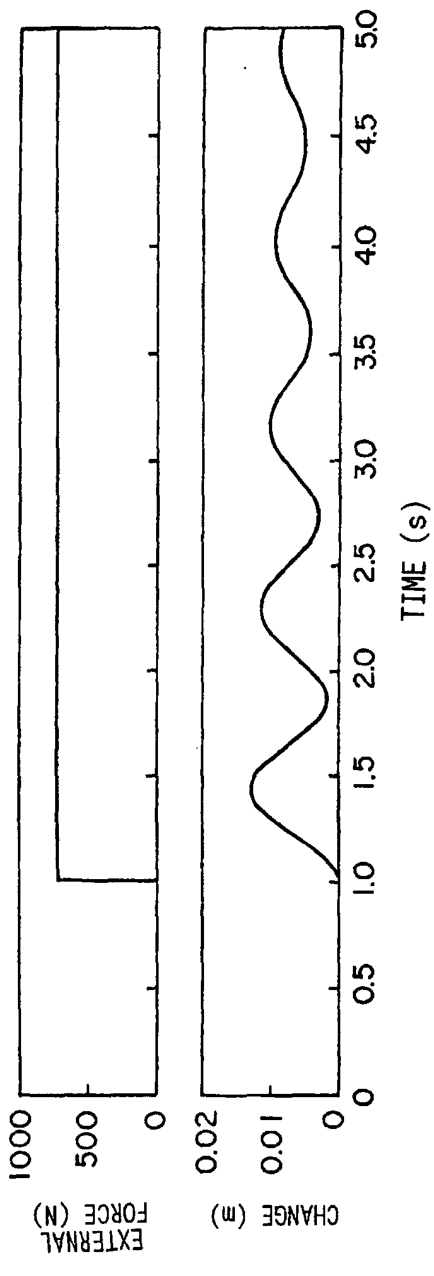

EXTERNAL FORCE (N)
1000
500
0
CHANGE (m)
0.02
0.01
0
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
TIME (s)

FIG. 5


EXTERNAL FORCE (N)
1000
500
0
CHANGE (m)
0.02
0.01
0
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
TIME (s)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/09515

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl^{7} B66B11/02

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^{7} B66B1/00-B66B19/06

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	1996-2002
Kokai Jitsuyo Shinan Koho	1971-2002	Toroku Jitsuyo Shinan Koho	1994-2002

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.
X Y	JP 3-18577 A (Mitsubishi Electric Corp.), 28 January, 1991 (28.01.91), (Family: none)	1,3,5,6 2,4
Y	JP 7-69558 A (Toshiba Corp.), 14 March, 1995 (14.03.95), (Family: none)	2
Y	JP 9-25065 A (Hitachi, Ltd.), 28 January, 1997 (28.01.97), (Family: none)	4

☐ 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
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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 24 July, 2002 (24.07.02)	Date of mailing of the international search report 06 August, 2002 (06.08.02)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)