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

(11) EP 2 088 111 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
12.08.2009 Bulletin 2009/33

(21) Application number: **06833448.1**

(22) Date of filing: **28.11.2006**

(51) Int Cl.:
B66B 5/28 *(2006.01)*

(86) International application number:
PCT/JP2006/323644

(87) International publication number:
WO 2008/065706 (05.06.2008 Gazette 2008/23)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR

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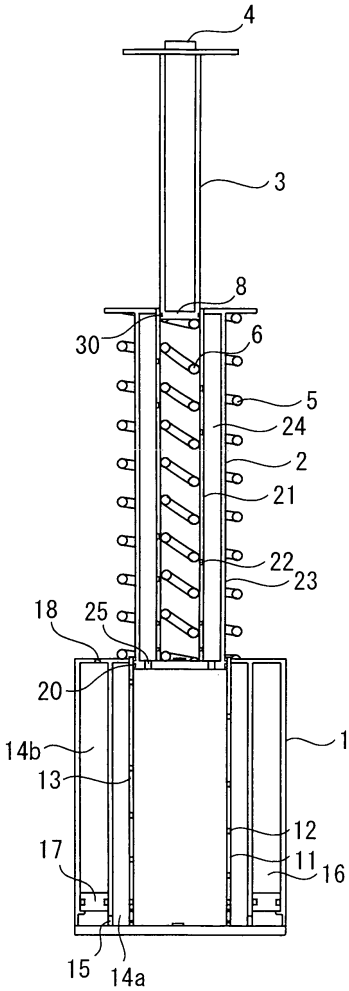
(54) BUFFER OF ELEVATOR

(57) Provided is a buffer of an elevator that enables the height dimension of the whole buffer to be shortened while ensuring a equivalent stroke, enables the cost to be reduced by the shortening of the total height of the buffer, and enables assemblability and installability to be improved. The buffer includes a base cylinder and plungers of a plurality of stages. Each of the plungers is provided with a return coil spring that returns each of the compressed plungers to an elongated condition before compression. A return coil spring that returns a plunger entering the base cylinder has a large diameter and is disposed on the outer side of the plunger between an upper portion of the plunger and an upper portion of the base cylinder. Another return coil spring that returns an upper-stage plunger entering a lower-stage plunger has a small diameter and is disposed on the inner side of the lower-stage plunger between a bottom portion of the upper-stage plunger and a bottom portion of the lower-stage plunger. When each of the plungers is in an elongated condition, on the inner side of the large-diameter return coil spring, there is disposed the other small-diameter return coil spring.

Fig. 1



Printed by Jouve, 75001 PARIS (FR)

Description

Technical Field

[0001] The present invention relates to a buffer of an elevator that is disposed in a pit bottom of a shaft and reduces impacts and ensures a safe stop when a car or a counterweight of an elevator passes a bottom floor for some abnormal reason and descends to a pit portion of the shaft.

Background Art

[0002] A buffer of an elevator is a safety device that reduces impacts and ensures a safe stop when a car or a counterweight of an elevator passes a bottom floor for some abnormal reason and descends to a pit portion of the shaft.
An orifice-control rod type hydraulic buffer has hitherto been used as a buffer of this kind. The stroke of this hydraulic buffer is defined by the rated speed of an elevator (stroke = (rated speed $\times$ 1.15)^2/2/9.80665). Because the axial length of the plunger is required to have a length that is not less than the stroke and also the cylinder, which must receive the entry of the plunger, is required to have an axial length substantially corresponding to the length of the plunger. Therefore, this hydraulic buffer had a construction that is long in the axial direction. When the total length of the device is long like this, it is necessary that the floor portion of the shaft be long by just that much, thereby posing the problem that the construction cost of the shaft becomes high. Furthermore, because the total height of the device is large, it was not easy to assemble the device and to carry the device to the construction site.

[0003] Therefore, as a hydraulic buffer of a super high-speed elevator, it is effective to apply a multistage hydraulic buffer capable of reducing the total height while ensuring the stroke by using plungers in a multistage manner as shown in Figures 4. A multistage hydraulic buffer comprises a base cylinder filled with a hydraulic oil and plungers of a plurality of stages that enter this base cylinder, which are formed to have gradually decreasing diameters and configured to be capable of expanding and contracting axially. This hydraulic buffer is configured to generate a buffering function due to a pressure difference resulting from the movement of the hydraulic oil upon entry of a plunger of each stage into the base cylinder or a lower-stage plunger. This hydraulic buffer is configured to ensure that plungers of at least two or more stages enter the base cylinder or the lower-stage plunger simultaneously, and to ensure that fluid resistance changes for the entry of the plungers of at least two or more stages according to the depth of entry of the plungers of at least two or more stages. As a return method of the plungers after the compression of the multistage buffer, This hydraulic buffer arrange a return coil spring in each stage (refer to Patent Document 1, for example).

[0004] Patent Document 1: Japanese Patent Laid-Open No. 2004-324879

Disclosure of the Invention

Problems to be Solved by the Invention

[0005] In a super high-speed region where a multistage hydraulic buffer is used, however, despite the multistage configuration of plungers, the length and stroke of a plunger of each stage are as large as several meters and, therefore, the tight contact height of the return coil springs of the plungers increases. Furthermore, naturally, it is necessary that the height of the return coil springs after the operation of the buffer (after compression) be not less than the tight contact height and hence the plunger length increased by just that much. As a result of this, the height dimension of the whole buffer increased and under the present circumstances the advantages of the multistage design were not taken advantage of to a maximum extent.

[0006] The present invention has been made to solve problems as described above, and provides a buffer of an elevator that enables the height of the whole buffer to be shortened while ensuring a equivalent stroke, enables the cost to be reduced by the shortening of the total height of the buffer, and enables assemblability and installability to be improved.

Means for Solving the Problems

[0007] A buffer of an elevator of the present invention is A buffer of an elevator comprising a base cylinder filled with a hydraulic oil and plungers of a plurality of stages, which are formed to have gradually decreasing diameters and configured to be capable of expanding and contracting axially, configured to generate a buffering function due to a pressure difference resulting from the movement of the hydraulic oil upon entry of a plunger of each stage into the base cylinder or a lower-stage plunger, disposed on a pit bottom of a shaft, and configured to ensure that plungers of at least two or more stages enter the base cylinder or the lower-stage plunger during compression operation, and to ensure that fluid resistance changes for the entry of the plungers of at least two or more stages according to the depth of entry of the plungers of at least two or more stages, each of the plungers being provided with a return coil spring that returns each of the compressed plungers to an elongated condition before compression, **characterized in that** a return coil spring that returns a plunger entering the base cylinder has a large diameter and is disposed on the outer side of the plunger between an upper portion of the plunger and an upper portion of the base cylinder, in that a return coil spring that returns an upper-stage plunger entering the lower-stage plunger has a small diameter and is disposed on the inner side of the lower-stage plunger between a bottom portion of an upper-stage plunger and a bottom portion of a lower-stage plunger, and in that when each of the plungers is in an elongated condition, on the inner side of the large-diameter return coil spring, there is disposed the small-diameter return coil spring.

Effect of the Invention

[0008] According to the present invention, it is possible to obtain a multistage hydraulic buffer that enables the height dimension of the whole buffer to be shortened while ensuring a equivalent stroke. The cost can be reduced by the shortening of the total height of the buffer and assemblability and installability can be improved. Furthermore, because the floor portion of the shaft can be made shallower than in conventional buffers, the construction cost of the shaft can be reduced.

Brief Description of the Drawings

[0009]

Figure 1 is a sectional block diagram showing the condition of a buffer of an elevator that is elongated in a first embodiment of the present invention.
Figure 2 is a sectional block diagram showing the condition of a buffer of an elevator that is compressed in a first embodiment of the present invention.
Figure 3 is a comparative diagram showing the positional relationship of a buffer of an elevator that is elongated and compressed in a first embodiment of the present invention.

Description of symbols

[0010]

1	base cylinder
2	first plunger
3	second plunger
4	cushion material
5	first return coil spring
6	second return coil spring
8	bottom plate
11	first control cylinder
12	first orifice group
13	base cylinder wall
14a	first oil chamber
14b	second oil chamber
15	oil passage
16	space area
17	piston
18	air hole
20	first sliding member
21	second control cylinder
22	second orifice group
23	peripheral wall of first plunger
24	oil chamber
25	oil passage
30	second sliding member

Best Method for Carrying Out the Invention

[0011] The present invention will be described in more detail with reference to the accompanying drawings.

First embodiment

[0012] Figure 1 is a sectional block diagram showing the condition of a buffer of an elevator that is elongated in a first embodiment of the present invention. Figure 2 is a sectional block diagram showing the condition of a buffer of an elevator that is compressed in a first embodiment of the present invention.

[0013] In the figures, the buffer is composed of a base cylinder 1 filled with a hydraulic fluid, a first plunger 2 that is fitted into a first control cylinder 11 provided within this base cylinder 1 and enters the first control cylinder 11 in a sliding manner, and a second plunger 3 that is fitted into a second control cylinder 21 provided within the first plunger 2 and enters the second control cylinder 21 in a sliding manner. In the first control cylinder 11, a plurality of first orifice groups 12 are appropriately provided in the axial direction of the cylinder. In the second control cylinder 21, a plurality of second orifice groups 22 are appropriately provided in the axial direction of the cylinder. In a top portion of the second plunger 3, a cushion material 4 is provided to prevent metal-to-metal contact between an ascending and descending body, such as an elevator car and a counterweight, and the plungers. An oil chamber 24 is formed between the second control cylinder 21 and a peripheral wall 23 of the first plunger 2. In a bottom portion of the first plunger 2, there is provided an oil passage 25 that provides communication between the oil chamber 24 and the base cylinder 1. A second sliding member 30 is provided in a lower part of a peripheral portion of the second plunger 3, and the second plunger 3 slides on an inner wall of the second control cylinder 21 while keeping oil tightness and enters the interior of the first plunger 2. The hydraulic oil within the first plunger 2 pressurized by the second plunger 3 passes through the second orifice group 22, whereby the pressure of the hydraulic oil is reduced, the hydraulic oil flows through the oil chamber 24 and is led to the oil passage 25. A first sliding member 20 is provided in a lower part of a peripheral portion of the first plunger 2, and the first plunger 2 slides on an inner wall of the first control cylinder 11 while keeping oil tightness and enters the interior of the base cylinder 1. The hydraulic oil within the base cylinder 1 pressurized by the first plunger 2 passes through the first orifice group 12, whereby the pressure of the hydraulic oil is reduced, the hydraulic oil is led to a first oil chamber 14a and a second oil chamber 14b, which are formed on the outer side of the first control cylinder 11. The first oil chamber 14a is provided in a peripheral portion of the first control cylinder 11, and the second oil chamber 14b is provided on the outer side of the first oil chamber 14a. A base cylinder wall 13 is provided between the first oil chamber 14a and the second oil chamber 14b, and the second oil chamber 14b provided in an outermost shell is in communication with the first oil chamber 14a via an oil passage 15 provided in a lower part of the base cylinder wall 13. The height of the first oil chamber 14a and the second oil chamber 14b is configured to be lower than the height of each of the plungers 2, 3 obtained when the plungers are fully compressed. Within the second oil chamber 14b, there is provided a piston 17 that slides along an inner wall. The piston 17 hermetically seals the hydraulic oil within the second oil chamber 14b, and the piston 17 gives a prescribed pressure to the hydraulic oil of the whole hydraulic buffer and has a weight sufficient for keeping a prescribed oil level. As a result of this, the second oil chamber 14b is flush with the first oil chamber 14a and is configured to be lower than the height of each of the plungers 2, 3 obtained when the plungers are fully compressed. However, a space area 16 is formed within the second oil chamber 14b. The hydraulic oil that has been led from the first oil chamber 14a to the second oil chamber 14b via the oil passage 15 pushes up the piston 17 to the space area 16 and is stored within the second oil chamber 14b. In a top portion of the second oil chamber 14b, an air hole 18 is provided so that the downward pressure acting on the piston 17 does not fluctuate due to the vertical motion of the piston 17.

[0014] The first plunger 2 and the second plunger 3 are separately provided with a first return coil spring 5 and a second return coil spring 6, respectively, for returning each of the compressed plungers 2, 3 to an elongated condition before compression. The weight of structural members constituting each of the plungers 2, 3 is supported by the above-described first return coil spring 5 and second return coil spring 6.

[0015] The first return coil spring 5 for returning the first plunger 2 to an elongated condition before compression has a large diameter and is disposed on the outer side of the peripheral wall 23 of the first plunger 2 between a flanged portion of a top end of the first plunger 2 and an upper surface of a top end portion of the base cylinder 1. The second return coil spring 6 for returning the second plunger 3 to an elongated condition before compression has a smaller diameter than the first return coil spring 5 and is disposed within the second control cylinder 21 provided on the inner side of the first plunger 2 between a bottom surface of a bottom plate 8 of the second plunger 3 and a top surface of the bottom of the first plunger 2. When the first plunger 2 and the second plunger 3 are in an elongated condition, as shown in Figure 1, the small-diameter second return coil spring 6 is disposed on the inner side of the large-diameter first return coil spring 5.

[0016] Next, a description will be given of a buffering action.

As shown in Figure 1, the hydraulic buffer is such that the space on the lower side of the second oil chamber 14b partitioned by the piston 17, and the interior of the first oil chamber 14a, the first control cylinder 11, the oil chamber 24 and the second control cylinder 21 are filled with a hydraulic oil. If the elevator car (or the counterweight) collides against the hydraulic buffer due to some abnormality, the second plunger 3 ascends within the second control cylinder 21 of the first plunger 2. Because at this time the space enclosed by the first control cylinder 21 and the second plunger 3 is hermetically sealed with the exception of the second orifice group 22, the hydraulic oil within the second control cylinder 21 is pressurized, supports the second plunger 3 upward, and pushes down the first plunger 2 while giving a decelerating force to the elevator car. The hydraulic oil spouts from the openings of the second orifice group 22 into the oil chamber 24 by just the volume of the second plunger 3 that has entered the second control cylinder 21, and the pressure of the hydraulic oil is reduced by fluid resistance. Incidentally, the total opening area of the second orifice group 22 provided in the second control cylinder 21 decreases as the second plunger 3 descends, and the fluid resistance increases gradually. The oil chamber 24 is in communication with the space within the first control cylinder 11 via the oil passage 25. Because the opening area of the oil passage 25 is set to be larger than the opening area of the second orifice group 22, the pressure within the oil chamber 24 and the pressure within the first control cylinder 11 are almost the same. The first plunger 2 is pushed down by the pressure within the second control cylinder 21, and at this time, the hydraulic oil flows into the first control cylinder 11 also from the oil passage 25 and the hydraulic oil within the first control cylinder 11 is pressurized, generating a force that supports the first plunger 2 upward. Because in this state the pressure within the second control cylinder 21 is higher than the pressure within the oil chamber 24 and the first control cylinder 11, the hydraulic oil does not flow back into the second control cylinder 21 and the hydraulic oil spouts from the openings of the first orifice group 12 to the first oil chamber 14a by just the volume of the first plunger 2 that has entered the first control cylinder 11 and by just the volume of the hydraulic oil that has passed through the oil passage 25 and entered the first control cylinder 11. The pressure of the hydraulic oil that spouts from the openings of the first orifice group 12 is reduced by fluid resistance and is reduced by the mass of the piston 17 to a pressure that is constantly given to the hydraulic oil of the oil chamber 14a. Also in this case, the total opening area of the first orifice group 12 provided in the first control cylinder 11 decreases as the first plunger 2 descends, and the fluid resistance increases. Because the first oil chamber 14a is in communication with the second oil chamber 14b via the oil passage 15 and the first oil chamber 14a is already filled with the hydraulic oil, the hydraulic oil that has spouted pushes up the piston 17 of the second oil chamber 14b. Because the opening area of the oil passage 15 is set to be larger than the opening area of the first orifice group 12, the pressure within the first oil chamber 14a and the pressure within the second oil chamber 14b are almost the same. This pressure is constantly maintained at the same level as a sum of the pressure due to the load of the piston and the atmospheric pressure when sliding resistance of the piston 17 is ignored. Because this pressure level is small compared to the pressure within the second control cylinder 21, the pressure within the first control cylinder 11 and the like when a large load is applied to the hydraulic buffer as at a buffering action, the hydraulic oil within the first oil chamber 14a and the second oil chamber 14b does not play a role in the deceleration performance any more. Because the above-described series of actions are changes associated with pressure change, in actuality, these actions hold simultaneously.

[0017] Next, a description will be given of a return action.

When the load applied to the second plunger 3 is removed from the condition of the hydraulic buffer that is fully compressed (Figure 2), movable parts, such as the first plunger 2 and the second plunger 3, become elongated gradually due to the workings of the return coil springs 5, 6 and the flow of the hydraulic oil, which is described below, and eventually returns to the initial condition. At this time, the hydraulic coil stored in the second oil chamber 14b is pushed in by the mass of the piston 17, passes from the oil passage 15 to the first oil chamber 14a, the first orifice group 12 of the first control cylinder 11, the oil passage 25, the oil chamber 24, and the second orifice group 22 of the second control cylinder 21 in a flow reverse to the flow at the buffering action, and gradually fills each space.

[0018] Next, with reference to Figures 3 and 4 a description will be given of a comparison between the hydraulic buffer of the present invention and a conventional hydraulic buffer in terms of positional relationship.

According to the construction of the hydraulic buffer of the present invention shown in Figures 3, the total height in an elongated condition (Figure 3a) is 10000 mm, the total height in a compressed condition (Figure 3b) is 4000 mm, the stroke from an elongated condition to a compressed condition is 6000 mm, the compressed height of the first return coil spring 5 is 1000 mm, and the compressed height of the second return coil spring 6 is 1000 mm.

On the other hand, according to the construction of the conventional hydraulic buffer shown in Figures 4, the total height in an elongated condition (Figure 3c) is 10500 mm, the total height in a compressed condition (Figure 3d) is 4500 mm, the stroke from an elongated condition to a compressed condition is 6000 mm, the compressed height of the first return coil spring is 1000 mm, and the compressed height of the second return coil spring is 1000 mm.

Therefore, it is apparent that by disposing the first return coil spring 5 for returning the first plunger 2 to an elongated condition before compression on the outer side of the peripheral wall 23 of the first plunger 2 between a flanged portion of a top end of the first plunger 2 and an upper surface of a top end portion of the base cylinder 1 and by disposing the second return coil spring 6 for returning the second plunger 3 to an elongated condition before compression within the second control cylinder 21 provided on the inner side of the first plunger 2 between a bottom surface of the bottom plate 8 of the second plunger 3 and a top surface of the bottom of the first plunger 2, it is ensured that the total height of the buffer is shortened by 500 mm, which is 1/2 of the compressed height (1000 mm) of the first return coil spring 5 and the second return coil spring 6 although the stroke from an elongated condition to a compressed condition is 6000 mm, which is equivalent, and also the compressed length of the first return coil spring 5 and the second return coil spring 6 is 1000 mm, which is equivalent. That is, according to the present invention, it is possible to shorten the total height of the buffer by approximately 1/2 of the compressed height of the first return coil spring 5 and the second return coil spring 6 although the base cylinder 1, the first plunger 2 and the second plunger 3 have different lengths.

[0019] As a result of this, by shortening the total height of the buffer, it is possible to reduce the cost of the buffer and assemblability and installability are also improved. Furthermore, the floor portion of the shaft can be made shallower than in conventional buffers and, therefore, it is possible to reduce the construction cost of the shaft.

Industrial Applicability

[0020] As described above, the buffer of an elevator related to the present invention can be applied to a multistage hydraulic buffer that is disposed in a pit bottom of a shaft and reduces impacts and ensures a safe stop when a car or a counterweight of an elevator passes a bottom floor for some abnormal reason and descends to a pit portion of the shaft.

Claims

1. A buffer of an elevator comprising a base cylinder filled with a hydraulic oil and plungers of a plurality of stages, which are formed to have gradually decreasing diameters and configured to be capable of expanding and contracting axially, configured to generate a buffering function due to a pressure difference resulting from the movement of the hydraulic oil upon entry of a plunger of each stage into the base cylinder or a lower-stage plunger, disposed on a pit bottom of a shaft, and configured to ensure that plungers of at least two or more stages enter the base cylinder or the lower-stage plunger during compression operation, and to ensure that fluid resistance changes for the entry of the plungers of at least two or more stages according to the depth of entry of the plungers of at least two or more stages, each

of the plungers being provided with a return coil spring that returns each of the compressed plungers to an elongated condition before compression,
characterized in that a return coil spring that returns a plunger entering the base cylinder has a large diameter and is disposed on the outer side of the plunger between an upper portion of the plunger and an upper portion of the base cylinder,
in that a return coil spring that returns an upper-stage plunger entering the lower-stage plunger has a small diameter and is disposed on the inner side of the lower-stage plunger between a bottom portion of an upper-stage plunger and a bottom portion of a lower-stage plunger, and
in that when each of the plungers is in an elongated condition, on the inner side of the large-diameter return coil spring, there is disposed the small-diameter return coil spring.

2. The buffer of an elevator according to claim 1, **characterized in that** the base cylinder has a plurality of orifices and is provided with a control cylinder that fits into an upper-stage plunger, and an oil chamber which is provided on the outer side of the control cylinder and whose height is configured to be lower than the height of the plunger of each stage obtained when the plungers are fully compressed.

3. The buffer of an elevator according to claim 2, **characterized in that at** least one plunger among the plungers of each stage except a topmost plunger has a plurality of orifices, and is provided with a control cylinder that fits into an upper-stage plunger, an oil chamber that is provided on the outer side of the control cylinder, and an oil passage that provides communication between the oil chamber and the base cylinder or a lower-stage plunger.

4. The buffer of an elevator according to claim 3, **characterized in that** a return coil spring that returns an upper-stage plunger entering a lower-stage plunger is disposed within the control cylinder that fits into an upper-stage plunger provided on the inner side of the lower-stage plunger.

Fig. 1

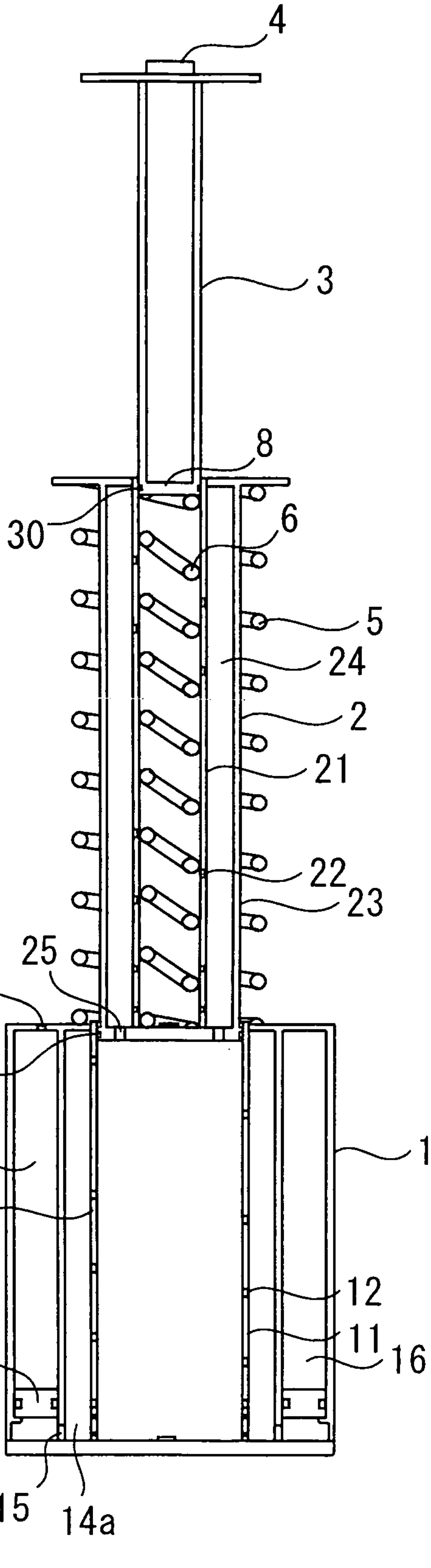


Fig. 2

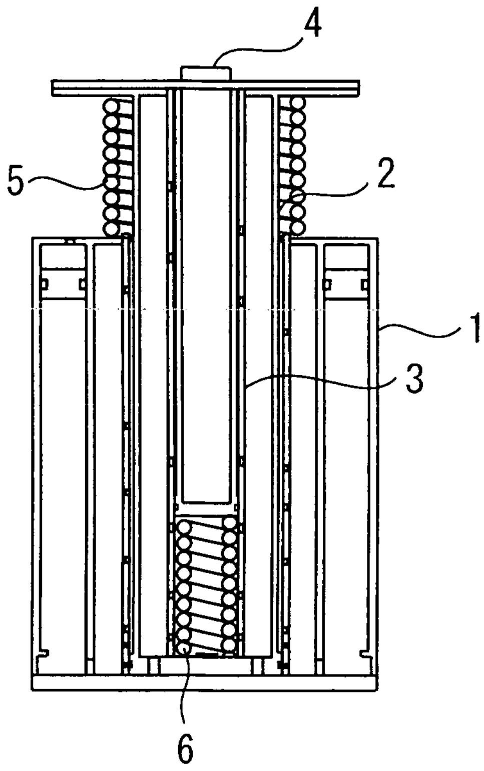
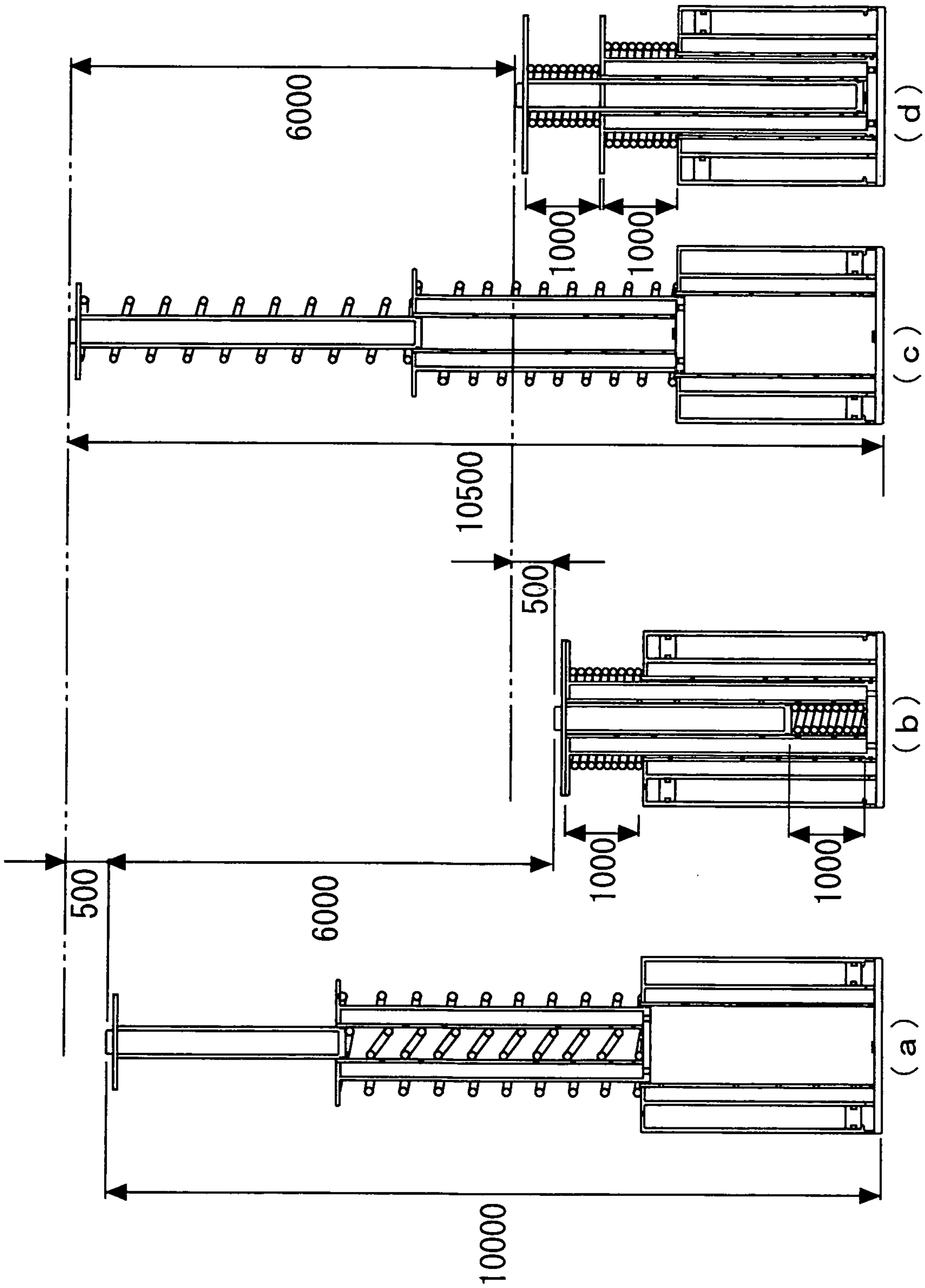


Fig. 3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/323644

A. CLASSIFICATION OF SUBJECT MATTER
B66B5/28(2006.01)i

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)
B66B5/28

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	1996-2007
Kokai Jitsuyo Shinan Koho	1971-2007	Toroku Jitsuyo Shinan Koho	1994-2007

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.
A	JP 2004-324879 A (Mitsubishi Electric Corp.), 18 November, 2004 (18.11.04), Par. Nos. [0014] to [0028], [0049]; Figs. 1 to 7, 17 (Family: none)	1-4
A	JP 2004-043177 A (Mitsubishi Electric Corp.), 12 February, 2004 (12.02.04), Par. Nos. [0037] to [0041]; Fig. 6 & US 2003/0217895 A1 & DE 10322743 A & CN 1460632 A	1-4
A	JP 32-010918 Y1 (Kanematsu HAGA), 13 September, 1957 (13.09.57), (Family: none)	1-4

☐ 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
03 August, 2007 (03.08.07)

Date of mailing of the international search report
14 August, 2007 (14.08.07)

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Patent documents cited in the description

- JP 2004324879 A **[0004]**