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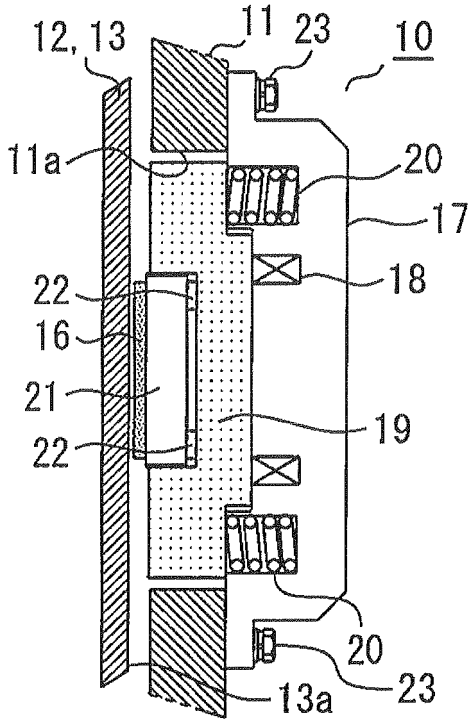
(54) ELECTROMAGNETIC BRAKE DEVICE FOR ELEVATOR

(57) Provided is an electromagnetic brake device for an elevator which can substantially reduce the noise generated when a braking piece collides with a rotary body.

This electromagnetic brake device 10 includes a movable piece 21 which is provided with a braking piece 16, a movable piece 19 disposed on the side opposite to the braking piece 16 with respect to the movable piece 21, an elastic body 22 provided between the movable pieces 21 and 19, and a spring 20 which pushes the movable piece 19 to the movable piece 21 side with a prescribed pushing force stronger than the pushing force of the elastic body 22. An electromagnet attracts the movable piece 19 against the pushing force of the spring 20, and causes the movable piece 19 to attract the movable piece 21 against the pushing force of the elastic body 22.

Fig. 4



EP 2 657 173 A1

Description

Technical Field

[0001] The present invention relates to an electromagnetic brake device provided in a traction machine of an elevator.

Background Art

[0002] Patent Literature 1 described below discloses an electromagnetic brake device provided in a traction machine of an elevator.
In the electromagnetic brake device described in Patent Literature 1, a rotary body which rotates in response to the rotation of a driving sheave is provided in the traction machine. The electromagnetic brake device pushes a braking piece against the rotary body with the force of a spring, generating a force for holding a car at a standstill (hereinafter also referred to simply as "a standstill retentive force"). On the other hand, during the ascent and descent of a car, in the electromagnetic brake device, attraction which resists the force of the spring is caused to be generated from an electromagnet, isolating the braking piece from the rotary body.

[0003] In an elevator, a great force is necessary for holding a car at a standstill. For this reason, the electromagnetic brake device described in Patent Literature 1 has the problem that, when the braking piece collides with the rotary body, that is, each time the car stops, a large noise is generated.

[0004] Patent Literature 2 described below discloses a technique for reducing the collision noise generated when the electromagnetic brake device operates.
Specifically, in the electromagnetic brake device described in Patent Literature 2, two springs are used to generate the standstill retentive force. In the case where the standstill retentive force is generated, the braking piece is pushed against the rotary body by operating first the spring of a larger pushing force.

Citation List

Patent Literature

[0005]

Patent Literature 1: Japanese Patent Laid-Open No. 2000-289954
Patent Literature 2: Japanese Patent Laid-Open No. 2003-2568

Summary of Invention

Technical Problem

[0006] The electromagnetic brake device described in Patent Literature 1 has the problem that because the spring of a larger pushing force is operated first in holding the car at a standstill, it is impossible to sufficiently reduce the above-described collision noise.

[0007] The present invention was made to solve the problem described above and an object of the invention is to provide an electromagnetic brake device for an elevator which can substantially reduce the noise generated when a braking piece collides with a rotary body.

Solution to Problem

[0008] An electromagnetic brake device for an elevator of the present invention is a device which holds a car of an elevator at a standstill by pushing a braking piece against a rotary body rotating in response to the rotation of a driving sheave of an elevator traction machine. The electromagnetic brake device comprises a first movable iron piece which is provided with the braking piece, the braking piece being disposed in such a manner as to be opposed to the rotary body, a second movable iron piece which is disposed on the side opposite to the braking piece with respect to the first movable iron piece, a first elastic body having a prescribed pushing force, which is provided between the first movable iron piece and the second movable iron piece, a second elastic body which pushes the second movable iron piece against the first movable iron piece side with a prescribed pushing force stronger than the pushing force of the first elastic body, and an electromagnet which attracts the second movable iron piece against the pushing force of the second elastic body and causes the second movable iron piece to attract the first movable iron piece against the pushing force of the first elastic body.

Advantageous Effect of Invention

[0009] With the electromagnetic brake device for an elevator of the present invention, it becomes possible to substantially reduce the noise generated when a braking piece collides with a rotary body.

Brief Description of Drawings

[0010]

Figure 1 is a diagram showing the general configuration of an elevator.
Figure 2 is a rear view showing a traction machine provided with an electromagnetic brake device for an elevator in a first embodiment according to the present invention.
Figure 3 is a view taken along the A-A line of Figure 2.
Figure 4 is an enlarged view of the part C of Figure 1.
Figure 5 is a diagram to explain the operation of the electromagnetic brake device for an elevator in the first embodiment according to the present invention.
Figure 6 is a diagram to explain the operation of the electromagnetic brake device for an elevator in the

first embodiment according to the present invention. Figure 7 is a diagram to explain the operation of the electromagnetic brake device for an elevator in the first embodiment according to the present invention.

Description of Embodiment

[0011] The present invention will be described in more detail with reference to the accompanying drawings. Incidentally, in each of the drawings, like numerals refer to like or corresponding parts and redundant descriptions of these parts are appropriately simplified or omitted.

First embodiment

[0012] Figure 1 is a diagram showing the general configuration of an elevator.
In Figure 1, reference numeral 1 denotes a shaft of an elevator, reference numeral 2 denotes a car of the elevator, and reference numeral 3 denotes a counterweight. The car 2 and the counterweight 3 are suspended by a main rope 4 in a well bucket manner in the shaft 1.
[0013] Reference numeral 5 denotes a thin-type traction machine provided in the upper space in the shaft 1. The traction machine 5 constitutes a driving device which drives the car 2. A driving sheave 6 is provided on the traction machine 5 in such a manner as to be rotatable in both directions. Part of the main rope 4 is wound on the driving sheave 6. Because the main rope 4 moves longitudinally in response to the rotation of the driving sheave 6, the car 2 ascends and descends in the shaft 1 according to the moving direction of the main rope 4.
In the figure, reference numeral 7 denotes a guide rail for guiding the ascent and descent of the car 2, and reference numeral 8 denotes a governor for detecting a prescribed overspeed condition.
[0014] While the car 2 of the elevator stops in a hall 9, in the traction machine 5 a prescribed standstill retentive force is generated by an electromagnetic brake device 10 (not shown in Figure 1).
Hereinafter, referring also to Figures 2 to 4, a concrete description will be given of each configuration of the traction machine 5 and the electromagnetic brake device 10 provided in this traction machine 5.
[0015] Figure 2 is a rear view showing the traction machine provided with the electromagnetic brake device for an elevator in a first embodiment according to the present invention, Figure 3 is a view taken along the A-A line of Figure 2, and Figure 4 is an enlarged view of the part C of Figure 1. Figure 2 shows a view taken along the B-B line of Figure 3.
[0016] Reference numeral 11 denotes a frame which constitutes the framework of the traction machine 5. The driving sheave 6 is rotatably provided in the frame 11 via a bearing. Reference numeral 12 denotes a rotary body provided integrally with the driving sheave 6. The rotary body 12 rotates in response to the rotation of the driving sheave 6.
[0017] A cylindrical part 13 in the shape of a short (a short width) cylinder is formed in part of the rotary body 12. The cylindrical part 13 has the same axis of rotation as the driving sheave 6, and is disposed in the interior of the frame 11. The cylindrical part 13 is supported by the frame 11 via other portions of the rotary body 12. A rotor iron core 14 is provided on an outer circumferential surface 13a of the cylindrical part 13.
Reference numeral 15 denotes a stator which constitutes the main part of the electric motor. The stator 15 is provided on an inner circumferential surface of the frame 11 in such a manner as to be opposed to the rotor iron core 14.
[0018] The electromagnetic brake device 10 generates the force for holding the car 2 at a standstill by pushing a braking piece 16 against the rotary body 12. During the ascent and descent of the car 2, the electromagnetic brake device 10 separates the braking piece 16 from the rotary body 12 and releases the standstill retentive force.
In the traction machine 5 shown in Figure 2, the electromagnetic brake device 10 is provided on both sides of the rotary body 12. In this case, the electromagnetic brake device 10 prevents the rotation of the rotary body 12 by pushing the braking piece 16 against the outer circumferential surface 13a of the cylindrical part 13 from the sides.
[0019] In this embodiment, the outer circumferential surface 13a of the cylindrical part 13 functions as a braking surface for generating the standstill retentive force. The operating direction of the electromagnetic brake device 10, i.e., the direction in which the braking piece 16 operates when the braking piece 16 comes into contact with the rotary body 12 (the braking surface) and moves away from the rotary body 12 (the braking surface), is a horizontal direction.
[0020] In addition to the braking piece 16, a field 17, a coil 18, a movable piece (an iron piece) 19, a spring (an elastic body) 20, a movable piece (an iron piece) 21, and an elastic body 22 constitute the main part of the electromagnetic brake device 10.
[0021] The field 17 and the coil 18 constitute an electromagnet. That is, an electromagnetic force is generated in the field 17 by applying a voltage to the coil 18. An opening 11a is formed on both side portions of the frame 11. The field 17 is placed onto the frame 11 in such a manner as to cover the opening 11a from outside and is attached to the frame 11 by bolts 23. The coil 18 is provided in the field 17 in such a manner that the axis thereof faces the above-described operating direction.
[0022] The movable piece 19 is supported by the field 17 in such a manner as to be able to move in the operating direction in a prescribed range. The movable piece 19 is disposed on the rotary body 12 side of the field 17 so that one side surface thereof is opposed to the field 17. That is, the movable piece 19 is attached to the field 17 in such a manner as to approach the rotary body 12 and move away from the rotary body 12.
[0023] The spring 20 is intended for use in pushing the

movable piece 19 with a prescribed pushing force in the direction in which the movable piece 19 moves away from the field 17 in the operating direction. That is, the movable piece 19 is constantly pushed by the spring 20 to the rotary body 12 side. The spring 20 is provided in the field 17 and the tip portion thereof is connected to the one side surface of the movable piece 19.

[0024] The movable piece 21 is supported by the movable piece 19 in such a manner as to be able to move in the operating direction in a prescribed range. The movable piece 21 is disposed on the rotary body 12 side of the movable piece 19 so that one side surface thereof is opposed to the other side surface of the movable piece 19. The braking piece 16 is provided on the other side surface of the movable piece 21 (the surface facing the side opposite to the one side surface) and is disposed so as to be opposed to the outer circumferential surface 13a of the cylindrical part 13. That is, the movable piece 19 is disposed on the side opposite to the braking piece 16 with respect to the movable piece 21, and the braking piece 16, the movable piece 21, the movable piece 19, and the electromagnet (the field 17) are disposed in series outside the rotary body 12 and in the operating direction.

[0025] The elastic body 22 is provided between the other side surface of the movable piece 19 and the one side surface of the movable piece 21. The elastic body 22 is a member formed from rubber, spring and the like, and is provided so as to expand and contract in the above-described operating direction in the same manner as the spring 20. The elastic body 22 has a prescribed pushing force weaker than the pushing force of the spring 20. The elastic body 22 causes a force to apply in the operating direction so that the movable piece 19 and the movable piece 21 move away from each other with the pushing force thereof. The spring 20 pushes the movable piece 19 to the movable piece 21 side with a prescribed pushing force stronger than the pushing force of the elastic body 22.

[0026] As shown in detail in Figure 4, the movable piece 19 is a member, for example, having a section in the shape of the letter C, which is open on the rotary body 12 side. That is, in the movable piece 19, a concavity is formed on the other side surface opposed to the movable piece 21. The movable piece 21 is configured in such a manner that when the elastic body 22 contracts, the whole is disposed in the concavity of the movable piece 19.

[0027] Next, referring also to Figures 5 to 7, a concrete description will be given of the operation of the electromagnetic brake device 10 having the above-described configuration. Figures 5 to 7 are diagrams to explain the operation of the electromagnetic brake device for an elevator in the first embodiment according to the present invention.

[0028] Figure 5 shows the condition of the electromagnetic brake device 10 acting when the car 2 is running in the shaft 1. During a run of the car 2, a prescribed voltage is applied to the coil 18. For this reason, electromagnetic attraction Fm1 is generated between the field 17 and the movable piece 19, and the field 17 attracts the movable piece 19 against the pushing force Fk1 of the spring 20. That is, the electromagnetic attraction Fm1 is set at a prescribed magnitude capable of overcoming the pushing force Fk1 of the spring 20.

[0029] Because of the application of the voltage to the coil 18, prescribed electromagnetic attraction Fm2 is generated also between the movable piece 19 and the movable piece 21. Although the electromagnetic attraction Fm2 is weaker than the electromagnetic attraction Fm1, the electromagnetic attraction Fm2 is set at a prescribed magnitude capable of overcoming the pushing force Fk2 (<Fk1) of the elastic body 22. For this reason, the movable piece 19 attracts the movable piece 21 against the pushing force Fk2 of the elastic body 22.

[0030] At this time, the movable piece 19 is attracted to the field 17 side, for example, until the one side surface thereof comes into contact with the field 17. This configuration can be realized, for example, by fitting the spring 20 in such a manner that the spring 20 can be disposed in the interior of the field 17. When the elastic body 22 is compressed, the movable piece 21 approaches the movable piece 19 and is disposed in the concavity of the movable piece 19.

As a result of this, a prescribed gap is formed between the braking piece 16 and the outer circumferential surface 13a of the cylindrical part 13, and the car 2 becomes capable of ascending and descending.

[0031] When the car 2 stops at any of the halls 9, a braking instruction is outputted from a prescribed control apparatus (not shown in Figures). Upon receipt of the braking instruction, the electromagnetic brake device 10 performs prescribed processing for reducing the voltage of the coil 18 by demagnetizing. As a result of this, the current flowing through the coil 18 decreases gradually, and the electromagnetic attractions Fm1 and Fm2 become small gradually.

[0032] When the current flowing through the coil 18 decreases to a given value I1, the electromagnetic attraction Fm2 becomes smaller than the pushing force Fk2 of the elastic body 22. Then, the movable piece 21 is moved by the pushing force Fk2 of the elastic body 22 to the rotary body 12 side, and the braking piece 16 collides with the outer circumferential surface 13a of the cylindrical part 13. Because the movable piece 19 is disposed in a position close to the field 17, the electromagnetic attraction Fm1 is larger than the electromagnetic attraction Fm2. For this reason, even when the current value of the coil 18 has decreased to I1, the electromagnetic attraction Fm1 is larger than the pushing force Fk1 of the spring 20, and the movable piece 19 remains in tight contact with the field 17.

[0033] Figure 6 shows the condition in which the current value of the coil 18 has decreased to I1. The elastic body 22 has a prescribed amount of elongation capable of bringing the braking piece 16 into contact with the ro-

tary body 12, with the movable piece 19 kept in tight contact with the field 17.

[0034] When time further elapses from the condition of Figure 6 and the current flowing through the coil 18 decreases to a given value I2 (< I1), the electromagnetic attraction Fm1 becomes smaller than the pushing force Fk1 of the spring 20. Then, the movable piece 19 is moved by the pushing force Fk1 of the spring 20 to the rotary body 12 (the movable piece 21) side, and the elastic body 22 is compressed. As a result of this, the pushing force Fk1 of the spring 20 acts on the braking piece 16 via the movable piece 19, the elastic body 22, and the movable piece 21, and the braking piece 16 is pushed against the outer circumferential surface 13a of the cylindrical part 13 with a prescribed force necessary for standstill holding of the car 2.

Figure 7 shows the condition in which the current value of the coil 18 has decreased to I2.

[0035] With the electromagnetic brake device 10 having the above-described configuration, it is possible to reduce the noise generated when the car 2 stops at the hall 9.

That is, in the electromagnetic brake device 10, when a braking instruction is outputted from the control apparatus, first, the movable piece 21 moves to the rotary body 12 side and the braking piece 16 collides with the cylindrical part 13. At this time, because the spring 20 of a large pushing force remains compressed, only the small pushing force of the elastic body 22 acts on the braking piece 16. That is, it is possible to control the energy during the collision of the braking piece 16 with the rotary body 12 to restrict to small values and the noise generated at this time can be substantially reduced.

[0036] In the electromagnetic brake device 10, after the braking piece 16 is brought into contact with the outer circumferential surface 13a of the cylindrical part 13, the braking piece 16 is pushed against the rotary body 12 with a large pushing force of the spring 20. For this reason, it is possible to generate a stable standstill retentive force after the above-described noise is prevented.

[0037] In order to generate a prescribed standstill retentive force, it is necessary that the movable piece 19 be moved by the spring 20 to the rotary body 12 side and that the pushing force of the spring 20 be caused to act on the braking piece 16. Because in this electromagnetic brake device 10 the elastic body 22 is provided between the movable pieces 19 and 21, it is possible to absorb the impact by the movement of the movable piece 19 by using the elastic body 22 and it becomes possible to reduce the collision noise of the movable piece 19 without the need to provide a new buffer material and the like.

[0038] Although in this embodiment the case where the thin-type traction machine 5 is provided in the shaft 1 was described as an example, the configuration and disposition of the traction machine 5 are not limited to this. The disposition and operating direction of the electromagnetic brake device 10 are not limited to the above description, either. The electromagnetic brake device 10 may be disposed on the inner side of the rotary body 12 and the operating direction of the electromagnetic brake device 10 may be set in the axial direction of the rotary body 12. Even in the case of such configurations, it is possible to produce the same effect as described above.

Industrial Applicability

[0039] The electromagnetic brake device according to the present invention can be applied to an electromagnetic brake device installed in a traction machine of an elevator.

Reference Signs List

[0040]

1	shaft
2	car
3	counterweight
4	main rope
5	traction machine
6	driving sheave
7	guide rail
8	governor
9	hall
10	electromagnetic brake device
11	frame
11a	opening
12	rotary body
13	cylindrical part
13a	outer circumferential surface
14	rotor iron core
15	stator
16	braking piece
17	field
18	coil
19, 21	movable piece
20	spring
22	elastic body
23	bolt

Claims

1. An electromagnetic brake device for an elevator which holds a car of an elevator at a standstill by pushing a braking piece against a rotary body rotating in response to the rotation of a driving sheave of an elevator traction machine, comprising:

a first movable iron piece which is provided with the braking piece, the braking piece being disposed in such a manner as to be opposed to the rotary body;

a second movable iron piece which is disposed on the side opposite to the braking piece with respect to the first movable iron piece;

a first elastic body having a prescribed pushing force, which is provided between the first movable iron piece and the second movable iron piece;

a second elastic body which pushes the second movable iron piece against the first movable iron piece side with a prescribed pushing force stronger than the pushing force of the first elastic body; and

an electromagnet which attracts the second movable iron piece against the pushing force of the second elastic body and causes the second movable iron piece to attract the first movable iron piece against the pushing force of the first elastic body.

2. The electromagnetic brake device for an elevator according to claim 1, wherein

the first movable iron piece, the second movable iron piece, and the electromagnet are disposed in series in an operating direction in which the braking piece contacts the rotary body and moves away from the rotary body, and

the first elastic body and the second elastic body are disposed in such a manner as to expand and contract in the operating direction.

3. The electromagnetic brake device for an elevator according to claim 1 or 2, wherein

the first movable iron piece is moved by the pushing force of the first elastic body when the voltage of a coil constituting the electromagnet is reduced by demagnetizing, whereby the braking piece comes into contact with the rotary body, and

thereafter the second movable iron piece is moved by the pushing force of the second elastic body, whereby the pushing force of the second elastic body acts on the braking piece.

4. The electromagnetic brake device for an elevator according to claim 1 or 2, wherein

a concavity is formed on a surface of the second movable iron piece which is opposed to the first movable iron piece, and

the first movable iron piece is disposed in the concavity when attracted by the electromagnet on the second movable iron piece.

Fig. 1

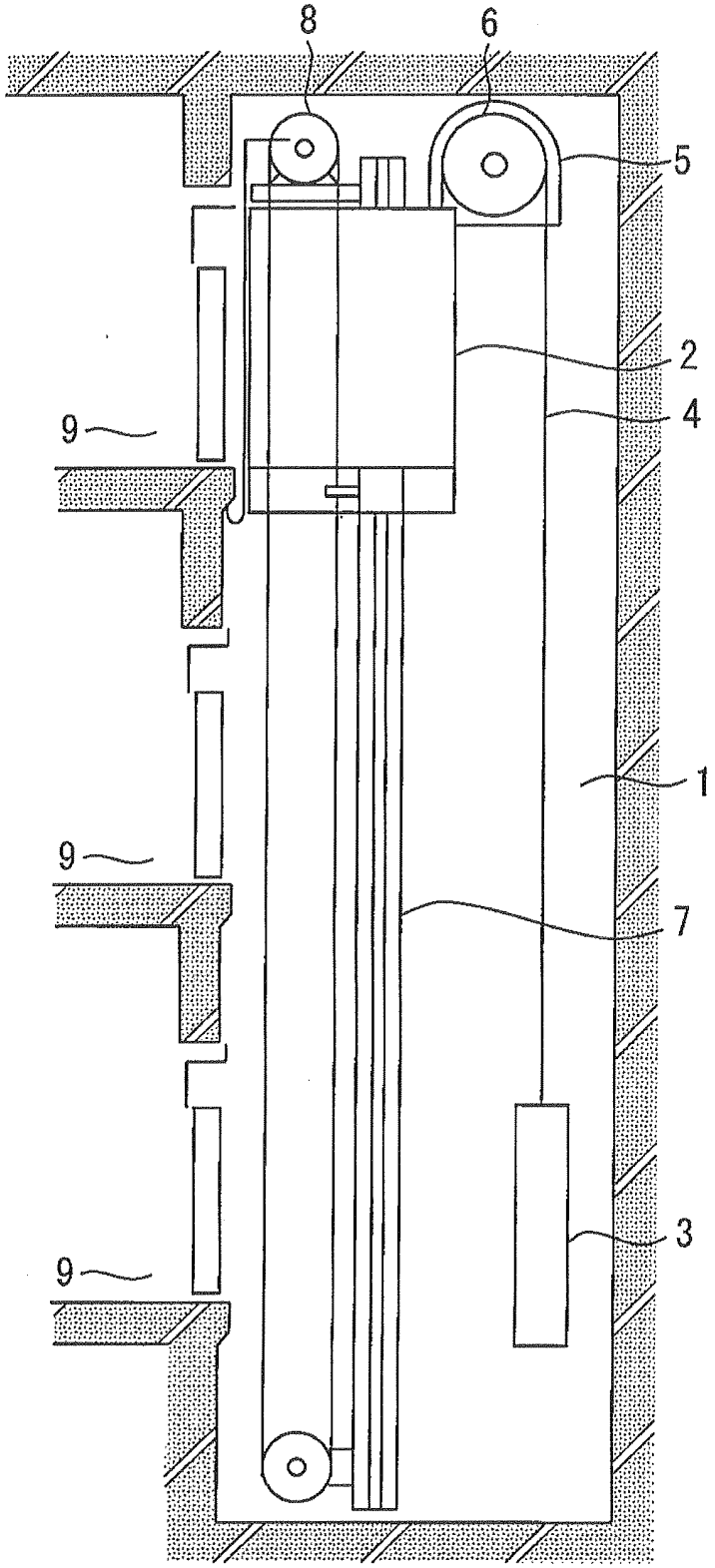


Fig. 2

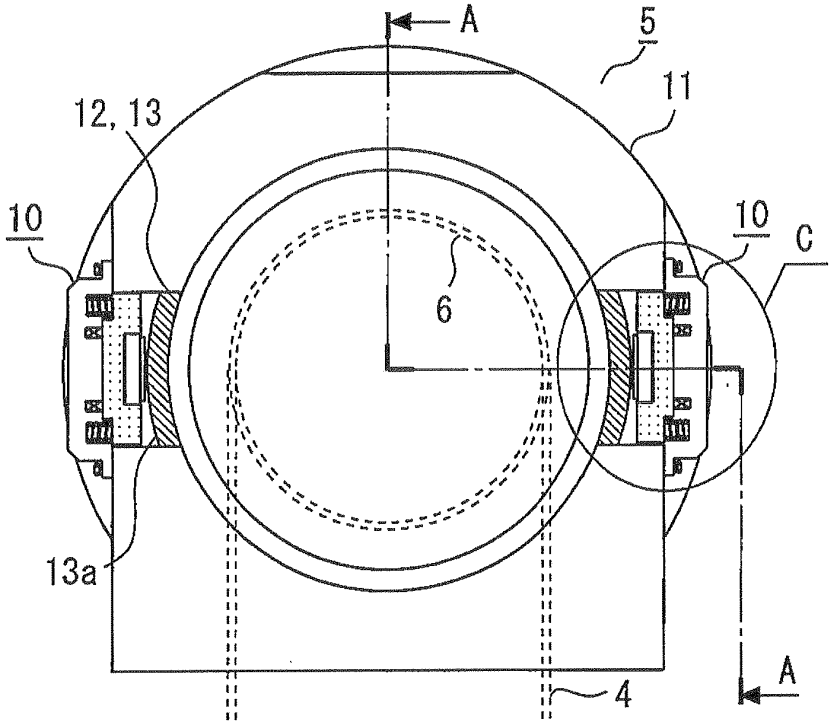


Fig. 3

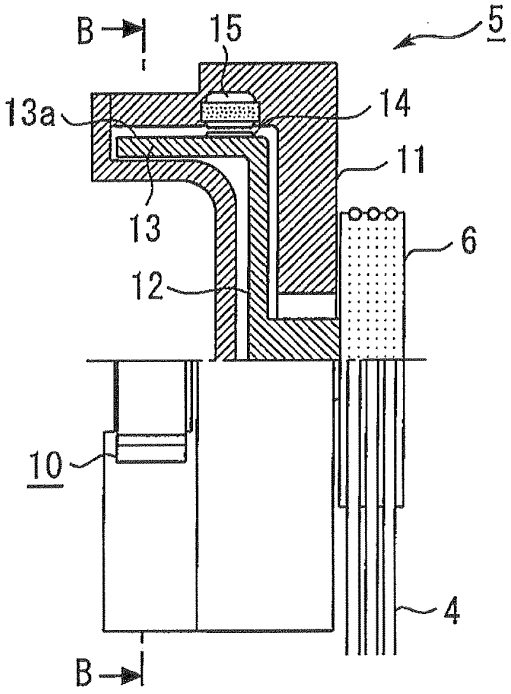


Fig. 4

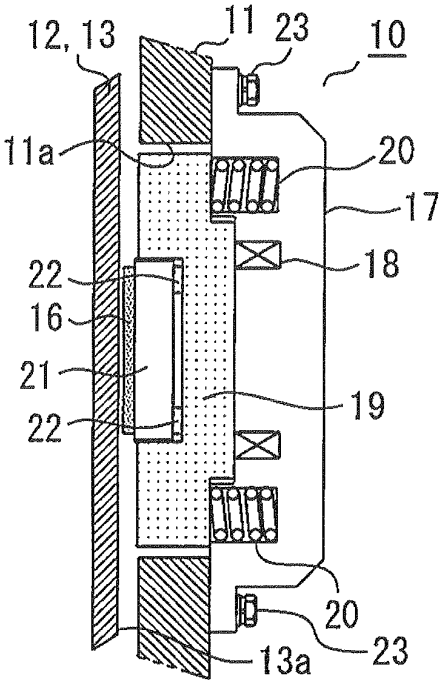

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Fig. 5

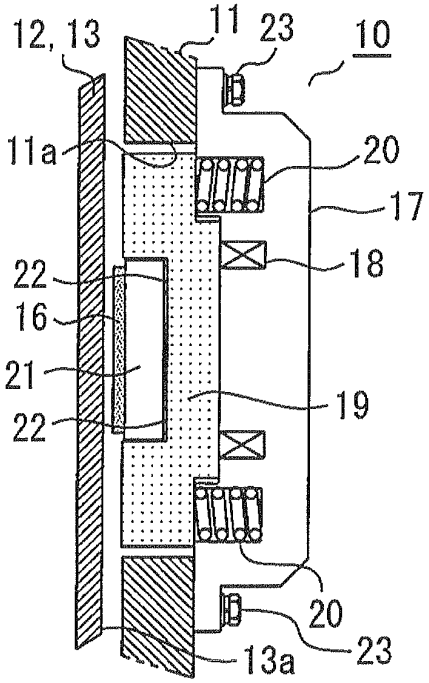
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Fig. 6

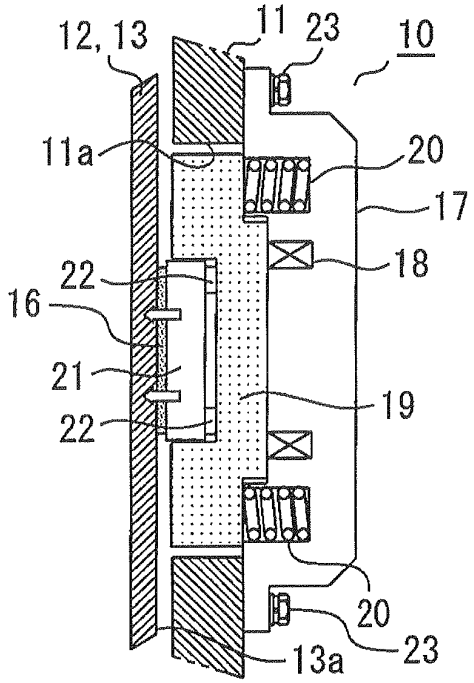
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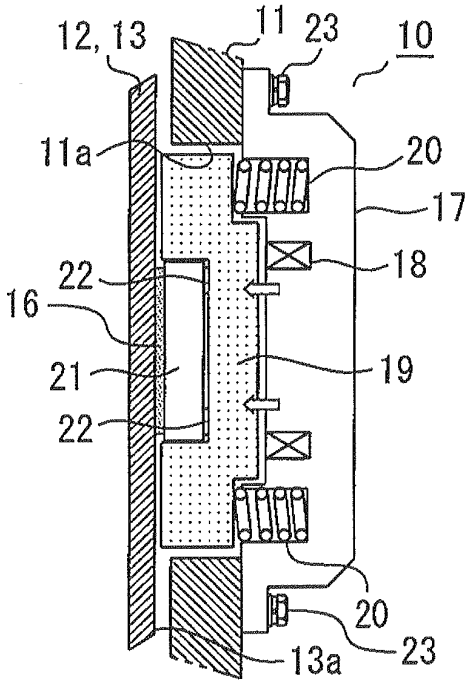
Fig. 7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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/073353

A. CLASSIFICATION OF SUBJECT MATTER
B66B11/08(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)
B66B11/08

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	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

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 2003-002568 A (Mitsubishi Electric Corp.), 08 January 2003 (08.01.2003), paragraphs [0025] to [0027]; fig. 1 (Family: none)	1-4
A	JP 2004-076899 A (Mitsubishi Electric Corp.), 11 March 2004 (11.03.2004), paragraphs [0007] to [0025]; fig. 1 (Family: none)	1-4

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
09 March, 2011 (09.03.11)	22 March, 2011 (22.03.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

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Patent documents cited in the description

- JP 2000289954 A **[0005]**
- JP 2003002568 A **[0005]**