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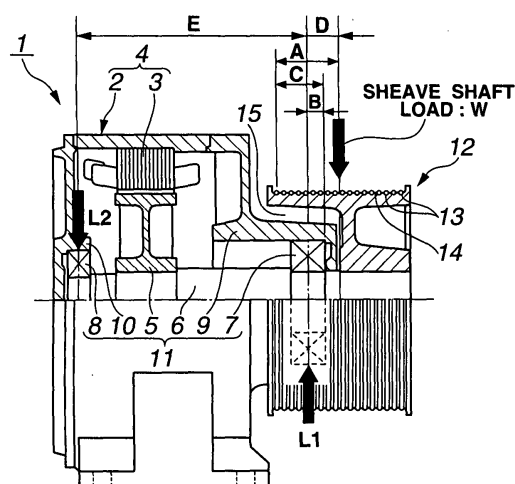
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(54) **ELEVATOR HOIST DEVICE**

(57) [Problem] A conventional hoist apparatus having a cantilever structure requires the use of a thick shaft of a larger shaft diameter when a sheave width and a sheave load are great.

[Means for solution] An elevator hoist apparatus 1 includes a stator 4 formed by attaching a stator core 3 to an internal periphery of a frame 2, a rotor 11 formed by supporting a shaft with a rotor core, rotatably, by first and second bearings 7, 8, on first and second brackets 9, 10 provided in the frame 2, and a sheave 12 mounted on a projecting end portion of the shaft 6 projecting to an outer side of the first bearing 7. The sheave 12 includes a wire rope wind-up surface 14 which is formed on an external peripheral side of the sheave 12 and which includes a plurality of wire rope grooves 13 arranged in a row. The sheave 12 further includes a bearing insertion portion 15 which is formed on an internal peripheral side of the wire rope wind-up surface 14 and which is arranged to receive the first bearing 7. The first bearing 7 is inserted in the bearing insertion portion 15.

FIG.1A



Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to an elevator hoist device or apparatus used for moving an elevator car up and down in an elevator, and more specifically to a hoist device or apparatus including a sheave supported by a shaft in a manner of cantilever.

BACKGROUND ART

10 **[0002]** FIG. 6 shows an elevator hoist apparatus in which a sheave is supported on a shaft in the form of a cantilever. The elevator hoist apparatus 101 includes a stator 104 and a rotor 111. The stator 104 includes a stator core 103 attached to an internal periphery of a frame 102. The rotor 111 includes a rotor core 105 attached to a shaft 106 which is supported rotatably by a first bearing 107 (referred to as a sheave's side bearing hereinafter) and a second bearing 108 (referred to as an anti-sheave's side bearing hereinafter), on first and second brackets 109 and 110 installed in the frame. The elevator hoist apparatus further includes a sheave 112 which is mounted on a projecting end portion of the shaft 106 projecting outwards to an outer side of the sheave's side bearing 107.

15 **[0003]** The external periphery of the sheave 112 is formed with a wire rope wind-up surface 114 including a plurality of wire rope grooves 113 arranged in a row. (cf. patent document 1, as an example)

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PRIOR ART LITERATURE

Patent Document(s)

25 **[0004]** Patent Document 1: JP 53-5963 U

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

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[0005] In the conventional elevator hoist apparatus having the above-mentioned cantilever sheave support structure, an overhang dimension or length D of the shaft 106 is expressed by a following equation 1 by using a dimension A from an end of the wire rope wind-up surface 114 toward the sheave's side bearing 107, to a sheave shaft load center (the middle of the wire rope wind-up surface 114), a dimension B from a sheave's side end face of the sheave side bearing 107 to the middle of the sheave side bearing 107, and a distance or spacing C from the sheave's side end face of the sheave's side bearing 107 to the end of the wire rope wind-up surface 1 14 toward the sheave side bearing 107.

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$$D=A+B+C \dots\dots\dots \text{Equation 1}$$

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[0006] Following equations 2 and 3 are obtained by using a distance E between the middle of the sheave's side bearing 107 and the middle of the anti-sheave's side bearing 108, a force L1 applied to the sheave's side bearing 107 by a sheave shaft load W and a force L2 applied to the anti-sheave's side bearing 108.

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$$L1=W \cdot (D+E)/E=W \cdot (A+B+C+E)/E \dots\dots\dots \text{Equation 2}$$

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$$L2=W \cdot D/E=W \cdot (A+B+C)/E \dots\dots\dots \text{Equation 3}$$

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As expressed by the equations 2 and 3, in the structure of the existing hoist apparatus, when the sheave 12 having a great width is required, the dimension A becomes greater, the overhang dimension D becomes greater, and hence the forces L1 and L2 increase. As a result, the hoist apparatus requires the bearings, shaft and frame of greater sizes, resulting in disadvantage of weight increase and cost increase of the hoist apparatus.

[0007] Even when the sheave width is increased, it is possible to increase the dimension E in proportion to an increase of the dimension D of FIG. 6, and thereby to avoid the need for greater bearings and shaft. However, in this case, the

lengths of the frame and shaft are increased by the increase of dimension E. As a result, the overall size and installation space of the hoist apparatus are increased, and the hoist apparatus encounters the problem of weight increase and cost increase.

[0008] Furthermore, the shaft receives a bending moment M due to the sheave shaft load W.

[0009]

$$M = W \cdot D = W \cdot (A+B+C) \quad \dots \dots \dots \text{Equation 4}$$

In the case of the sheave having a greater width, the dimension A is greater, and the bending moment M becomes greater, as evident from the equation 4. Therefore, to solve the problem of inclination of the sheave caused by deflection of the shaft due to the sheave shaft load W, the hoist apparatus requires the use of a thick shaft having a greater shaft diameter, and hence encounters the disadvantage of weight increase and cost increase.

[0010] When the sheave width and the sheave load are great, an existing system employs a hoist apparatus 120 of a dual support structure having a sheave 124 between bearings 122 and 123 supporting a shaft 121, as shown in FIG. 7. However, this structure supporting the sheave on both sides is disadvantageous in that installation and replacement of the sheave are difficult after the assembly of the hoist apparatus.

[0011] It is an object of the present invention to provide hoist apparatus of a cantilever structure suitable for a greater sheave width and a greater sheave load.

MEANS FOR SOLVING THE PROBLEM

[0012] In an elevator hoist apparatus comprising a stator including a stator core attached to an internal periphery of a frame, a rotor including a rotor core attached to a shaft supported rotatably, by a first bearing and a second bearing, on first and second brackets provided in the frame, and a sheave mounted on a projecting end portion of the shaft projecting to an outer side of the first bearing, the invention of Claim 1 is arranged so that the sheave includes a wire rope wind-up surface which is formed on an external peripheral side of the sheave and which includes a plurality of wire rope grooves arranged in a row, and a bearing insertion portion which is formed on an internal peripheral side of the wire rope wind-up surface and which is arranged to receive the first bearing, the first bearing is inserted in the bearing insertion portion, and an end face of the first bearing on a side toward a sheave shaft load center is located on an inner side of the sheave shaft load center (on a side toward the second bearing).

[0013] In an elevator hoist apparatus comprising a stator including a stator core attached to an internal periphery of a frame, a rotor including a rotor core attached to a shaft supported rotatably, by a first bearing and a second bearing, on first and second brackets provided in the frame, and a sheave mounted on a projecting end portion of the shaft projecting to an outer side of the first bearing, the invention of Claim 2 is arranged so that the sheave includes a wire rope wind-up surface which is formed on an external peripheral side of the sheave and which includes a plurality of wire rope grooves arranged in a row, and a bearing insertion portion which is formed on an internal peripheral side of the wire rope wind-up surface and which is arranged to receive the first bearing, the first bearing is inserted in the bearing insertion portion, and a widthwise middle of the first bearing is positioned at the sheave shaft load center.

[0014] In an elevator hoist apparatus comprising a stator including a stator core attached to an internal periphery of a frame, a rotor including a rotor core attached to a shaft supported rotatably, by a first bearing and a second bearing, on first and second brackets provided in the frame, and a sheave mounted on a projecting end portion of the shaft projecting to an outer side of the first bearing, the invention of Claim 3 is arranged so that the sheave includes a wire rope wind-up surface which is formed on an external peripheral side of the sheave and which includes a plurality of wire rope grooves arranged in a row, and a bearing insertion portion which is formed on an internal peripheral side of the wire rope wind-up surface and which is arranged to receive the first bearing, the first bearing is inserted in the bearing insertion portion, and a widthwise middle of the first bearing is positioned on an outer side of the sheave shaft load center (on a side opposite to an anti-sheave's side bearing with respect to the sheave shaft load center).

Effect of the Invention

[0015]

(1) In the elevator hoist apparatus of Claim 1, the first bearing is inserted in the bearing insertion portion formed on the internal peripheral side or radial inner side surrounded by the wire rope wide-up surface, and the end face of the first bearing facing toward the sheave shaft load center is positioned on the side of the sheave shaft load center which is the side closer to the second bearing. Therefore, it is possible to decrease the overhang dimension D, as

compared to the hoist apparatus of the earlier technology shown in FIG. 6. As a result, the force L1 acting on the sheave side bearing 7 and the force L2 acting on the anti-sheave side bearing 8 become smaller in magnitude, and hence it becomes possible to reduce the sizes and weights of these bearings, the shaft and the frame and to reduce the cost. Moreover, the bending moment M due to the sheave shaft load W becomes smaller. Accordingly, even in the case of a thinner shaft, it is possible to decrease the deflection of the shaft due to the sheave shaft load W, and to decrease the inclination of the sheave.

(2) In the elevator hoist apparatus of Claim 2, the widthwise middle of the sheave side bearing is positioned at the sheave shaft load center. Therefore, it is possible to decrease the overhang dimension D to zero. As a result, the force L1 become equal to the sheave shaft load W, so that it is possible to decrease the radial load applied on the sheave side bearing as compared to the construction of Claim 1. Furthermore, the force L2 applied on the anti-sheave side bearing becomes equal to zero, so that it is possible to reduce the size of the bearing further as compared to the construction of Claim 1. Moreover, the bending moment M due to the sheave shaft load W is eliminated, so and the shaft undergoes no deflection, and it is possible to eliminate the inclination of the sheave due to deflection of the shaft. In addition, it is possible to make the shaft thinner in size and lighter in weight.

(3) In the hoist apparatus of Claim 3, the sheave shaft load W is supported between the first bearing and second bearing. Therefore, this hoist apparatus can restrain the deflection of the shaft, eliminate the inclination of the sheave, and support the sheave in a stable state like the hoist apparatus of the dual support type as shown in FIG. 7. In addition, this hoist apparatus can maintain the superior usability of the cantilever type hoist apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1A is a sectional view of a hoist apparatus according to a first embodiment. FIG. 1B is a side view.

FIG. 2A is a sectional view of a hoist apparatus according to a second embodiment. FIG. 2B is a side view.

FIG. 3A is a sectional view of a hoist apparatus according to a third embodiment. FIG. 3B is a side view.

FIG. 4 is a view illustrating a joining method of joining a shaft and a sheave.

FIG. 5 is a view illustrating a joining method of joining the shaft and the sheave.

FIG. 6A is a sectional view of a cantilever type hoist apparatus of earlier technology. FIG. 6B is a side view.

FIG. 7A is a sectional view of a dual support type hoist apparatus of earlier technology. FIG. 7B is a side view.

MODE(S) FOR CARRYING OUT THE INVENTION

[0017] FIG. 1 shows an elevator hoist apparatus or device 1 according to a first embodiment. The elevator hoist apparatus 1 includes a stator 4 and a rotor 11. The stator 4 is formed by attaching or fixing a stator core 3 to an internal periphery of a frame 2. The rotor 11 is formed by supporting a shaft 6 to which a rotor core 5 is attached or fixed, by a first bearing 7 (hereinafter referred to as a sheave's side bearing) and a second bearing 8 (hereinafter referred to as an anti-sheave's side bearing), rotatably on first and second brackets 9 and 10 installed in the frame 2. The elevator hoist apparatus 1 further includes a sheave 12 (wheel with a groove for a rope to run on) mounted on a projecting end portion of the shaft 6 which projects to an outer side of the sheave bearing 7.

[0018] The sheave 12 includes a wire rope wind-up surface 14 which is formed in an external periphery of the sheave 12, and which is formed with a plurality of wire rope grooves 13 arranged in a row.

[0019] The sheave 12 includes a bearing insertion portion 15 which is formed on an internal peripheral side of the wire rope wind-up surface 14 or radial inner side surrounded by the wire rope wind-up surface 14, and adapted to receive the sheave side bearing 7 inserted into the bearing insertion portion 15. Thus, the sheave side bearing 7 is inserted in the bearing insertion portion 15.

[0020] In the first embodiment, the sheave's side bearing 7 is located between the position at which the sheave's side bearing 7 is inserted, and covered, entirely in the bearing insertion portion 15, and the position at which the end face of the sheave's side bearing 7 facing toward the sheave shaft load center is located at the position of the sheave shaft load center. This relationship between the position of the sheave's side bearing 7 and the position of the sheave 12 is expressed by a following mathematical expression, $2B < C < A$.

[0021] By placing the sheave's side bearing 7 within the bearing insertion portion 15 as explained above, it is possible to decrease the overhang dimension D, as compared to the hoist apparatus of the earlier technology shown in FIG. 6. As a result, the force L1 acting on the sheave's side bearing 7 and the force L2 acting on the anti-sheave side bearing 8 become smaller in magnitude, and hence it becomes possible to reduce the sizes and weights of these bearings, the shaft and the frame, and to reduce the cost. Moreover, the bending moment M due to the sheave shaft load W becomes smaller, too. Accordingly, even in the case of a thinner shaft, it is possible to decrease the deflection of the shaft due to the sheave shaft load W, and to decrease the inclination of the sheave.

[0022] FIG. 2 shows an elevator hoist apparatus 1 according to a second embodiment. In the second embodiment, the sheave's side bearing 7 inserted in the bearing insertion portion 15 is so positioned that the widthwise middle or middle in the widthwise direction, of the sheave's side bearing 7 is located at the sheave shaft load center. This relationship between the position of the sheave side bearing 7 and the position of the sheave 12 is expressed by a following mathematical expression, $C=A+B$. In the other respects, the second embodiment is the same as the first embodiment, and repetitive explanation is omitted.

[0023] By positioning the widthwise middle of the sheave side bearing 7 at the sheave shaft load center as explained above, it is possible to decrease the overhang dimension D to zero. As a result, the force L1 become equal, in magnitude, to the sheave shaft load W, so that it is possible to decrease the radial load applied on the sheave's side bearing 7 as compared to the construction of Claim 1. Furthermore, the force L2 applied on the anti-sheave's side bearing 8 becomes equal to zero, so that it is possible to reduce the size of the bearing further as compared to the construction of Claim 1. Moreover, the bending moment M due to the sheave shaft load W is eliminated, so and the shaft undergoes no deflection, and it is possible to eliminate the inclination of the sheave due to deflection of the shaft. In addition, it is possible to make the shaft thinner in size and lighter in weight.

[0024] FIG. 3 shows an elevator hoist apparatus 1 according to a third embodiment. In the third embodiment, the sheave's side bearing 7 is so positioned that the widthwise middle or middle in the widthwise direction of the sheave's side bearing 7 is positioned on the outer side of the sheave shaft load center (on the opposite side of the sheave shaft load center, opposite to the side on which the anti-sheave's side bearing 8 is located). This relationship between the position of the sheave's side bearing 7 and the position of the sheave 12 is expressed by a following mathematical expression, $0<D$.

[0025] As explained above, the sheave shaft load W is supported between the sheave's side bearing 7 and anti-sheave's side bearing 8. Therefore, this arrangement can restrain the deflection of the shaft, eliminate the inclination of the sheave, and support the sheave in a stable state like the hoist apparatus of the dual support type as shown in FIG. 7. In addition, this arrangement can maintain the superior usability of the cantilever type hoist apparatus.

[0026] In the examples of the first through third embodiments shown in FIGS. 1~3, the sheave 12 is fixedly mounted on the end portion of the shaft 6 by shrink fitting. However, it is optional to employ arrangements shown in FIGS. 4 and 5. In these arrangement of FIGS. 4 and 5, the end portion of shaft 6 is inserted into a shaft insertion portion 16 formed in the sheave 12, and fixed to the sheave 12 by nut 17 or bolts 18. These arrangements can facilitate operations such as replacement of the sheave.

EXPLANATION OF REFERENCE NUMERALS

[0027]

- 1 elevator hoist apparatus
- 2 frame
- 3 stator core
- 4 stator
- 5 rotor core
- 6 shaft
- 7 first bearing (sheave's side bearing)
- 8 second bearing (anti-sheave side bearing)
- 9 first bracket
- 10 second bracket
- 11 rotor
- 12 sheave (wheel for rope)
- 13 wire rope groove
- 14 wire rope wind-up surface
- 15 bearing insertion portion

Claims

1. In an elevator hoist apparatus comprising a stator including a stator core attached to an internal periphery of a frame, a rotor including a rotor core attached to a shaft supported rotatably, by a first bearing and a second bearing, on first and second brackets provided in the frame, and a sheave mounted on a projecting end portion of the shaft projecting to an outer side of the first bearing, the elevator hoist apparatus **characterized in that** the sheave includes a wire rope wind-up surface which is formed

on an external peripheral side and which includes a plurality of wire rope grooves arranged in a row, and a bearing insertion portion which is formed on an internal peripheral side of the wire rope wind-up surface and which is arranged to receive the first bearing, the first bearing being inserted in the bearing insertion portion, and
an end face of the first bearing on a side toward a sheave shaft load center is located on an inner side of the sheave shaft load center.

2. In an elevator hoist apparatus comprising a stator including a stator core attached to an internal periphery of a frame, a rotor including a rotor core attached to a shaft supported rotatably, by a first bearing and a second bearing, on first and second brackets provided in the frame, and a sheave mounted on a projecting end portion of the shaft projecting to an outer side of the first bearing,
the elevator hoist apparatus **characterized in that** the sheave includes a wire rope wind-up surface which is formed on an external peripheral side and which includes a plurality of wire rope grooves arranged in a row, and a bearing insertion portion which is formed on an internal peripheral side of the wire rope wind-up surface and which is arranged to receive the first bearing, the first bearing being inserted in the bearing insertion portion, and
a widthwise middle, in a widthwise direction, of the first bearing inserted in the bearing insertion portion is positioned at the sheave shaft load center.
3. In an elevator hoist apparatus comprising a stator including a stator core attached to an internal periphery of a frame, a rotor including a rotor core attached to a shaft supported rotatably, by a first bearing and a second bearing, on first and second brackets provided in the frame, and a sheave mounted on a projecting end portion of the shaft projecting to an outer side of the first bearing,
the elevator hoist apparatus **characterized in that** the sheave includes a wire rope wind-up surface which is formed on an external peripheral side and which includes a plurality of wire rope grooves arranged in a row, and a bearing insertion portion which is formed on an internal peripheral side of the wire rope wind-up surface and which is arranged to receive the first bearing, the first bearing being inserted in the bearing insertion portion, and
a widthwise middle, in a widthwise direction, of the second bearing is positioned on an outer side of the sheave shaft load center.

FIG. 1B

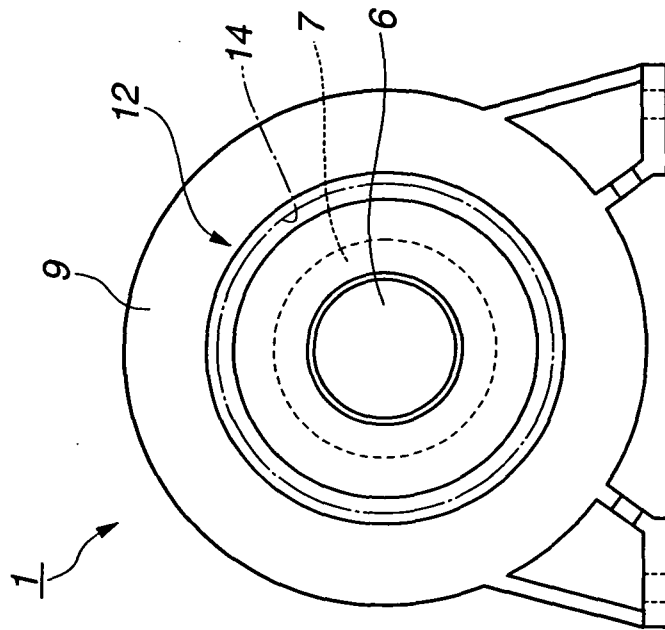


FIG. 1A

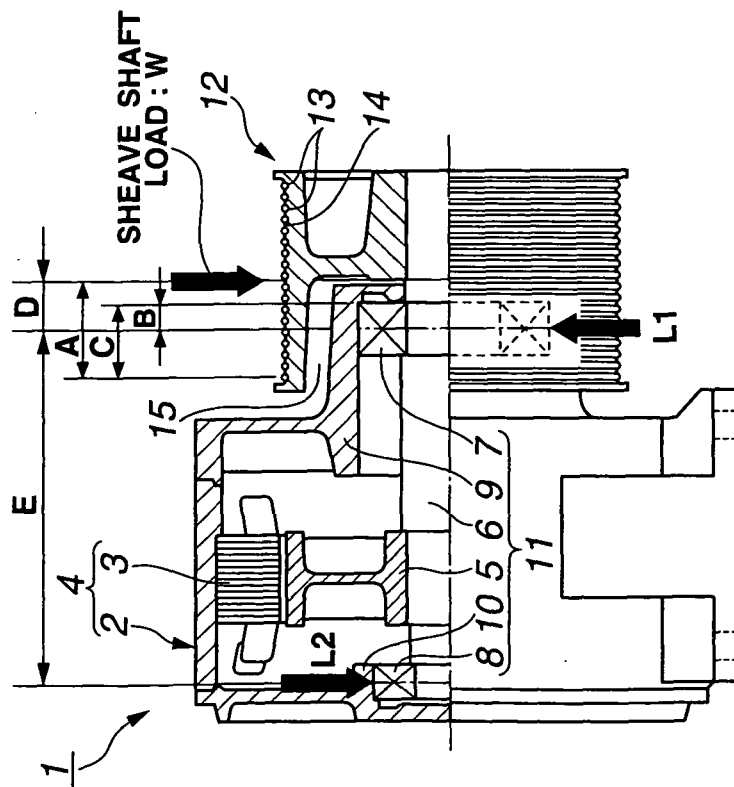


FIG.2B

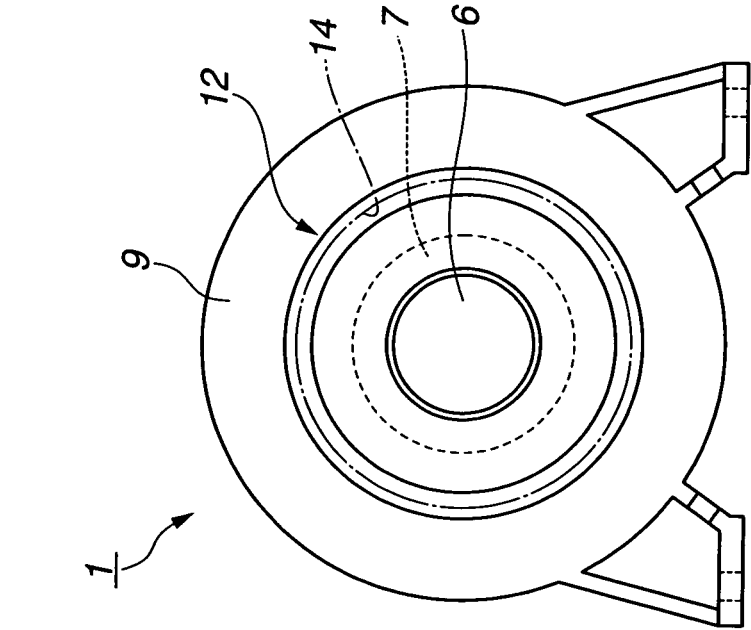


FIG.2A

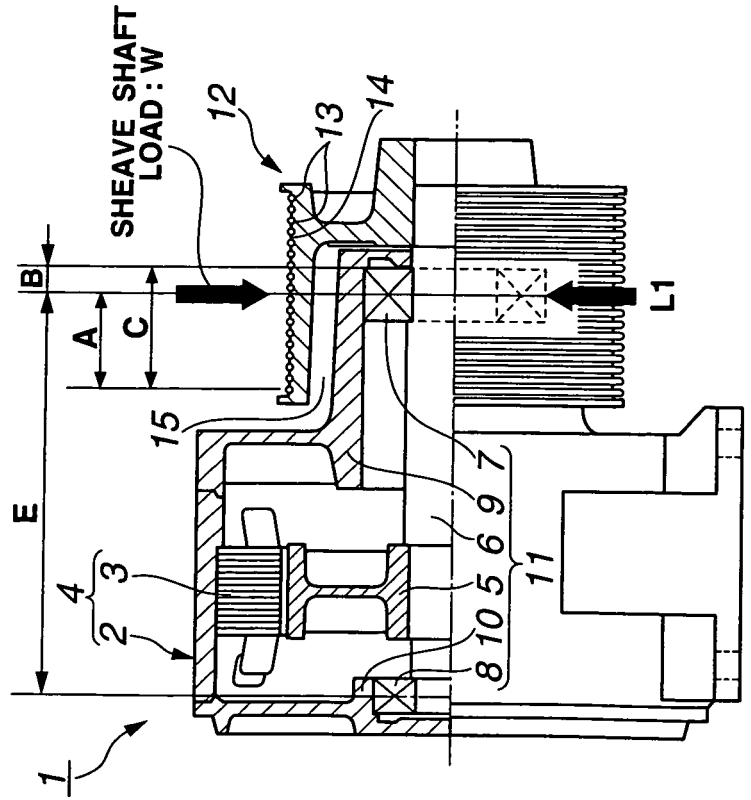


FIG.3B

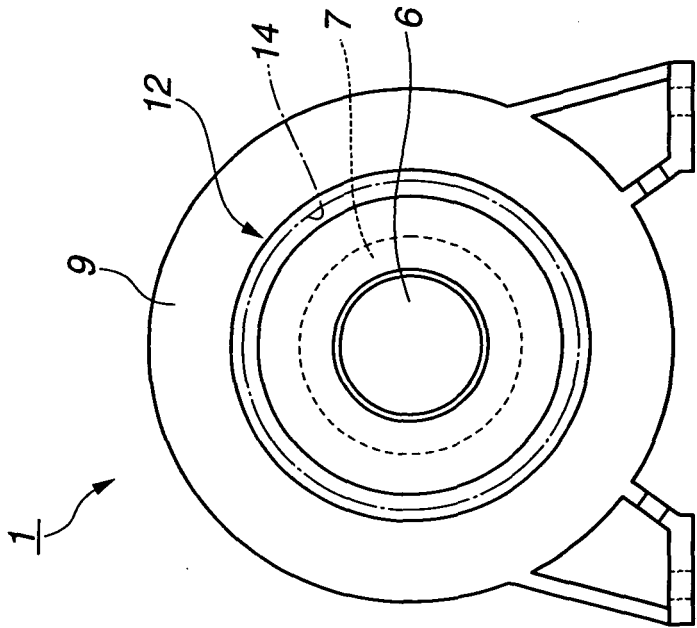


FIG.3A

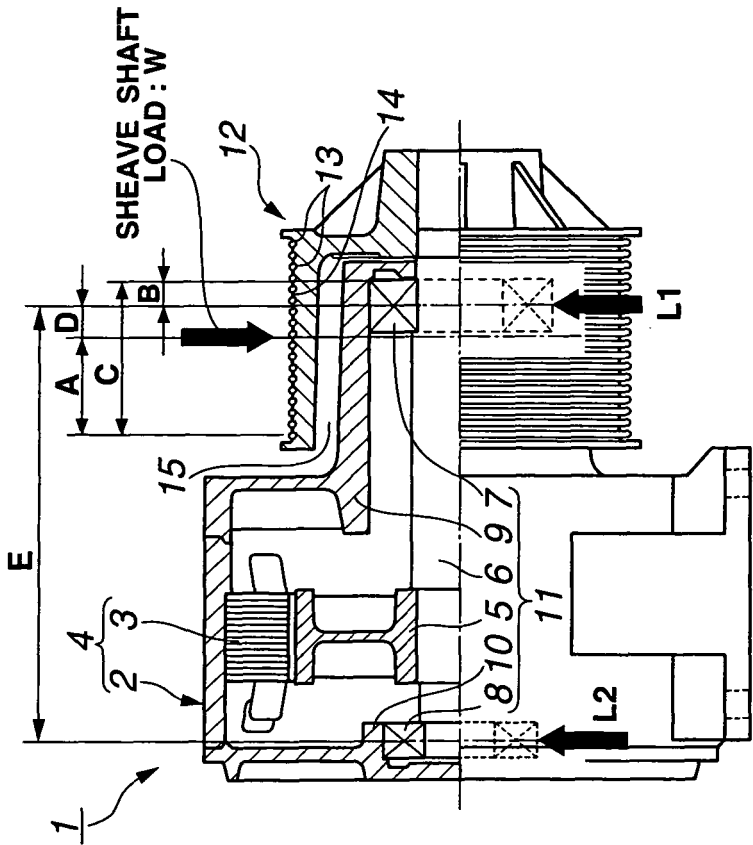


FIG.4

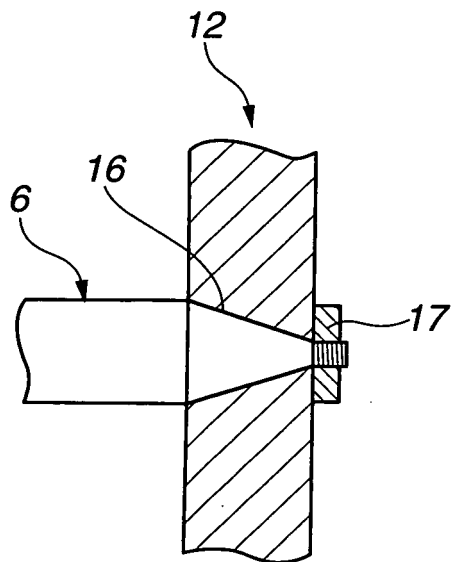


FIG.5

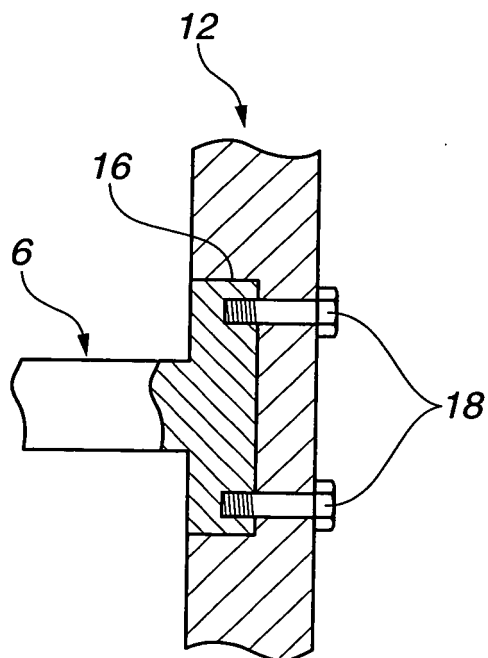


FIG.6A

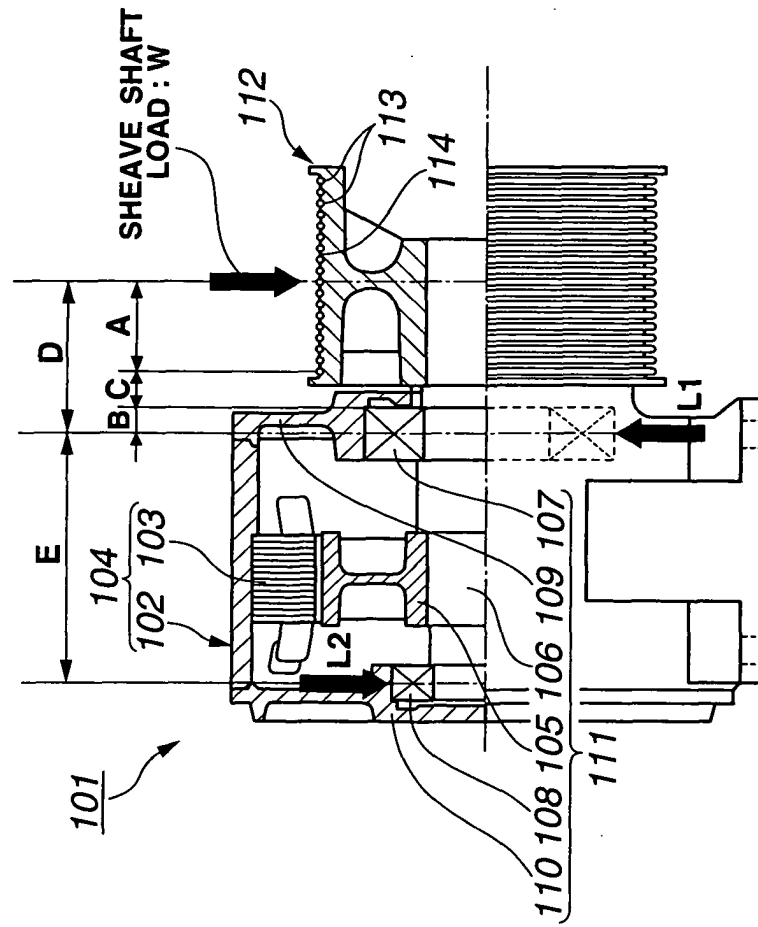


FIG.6B

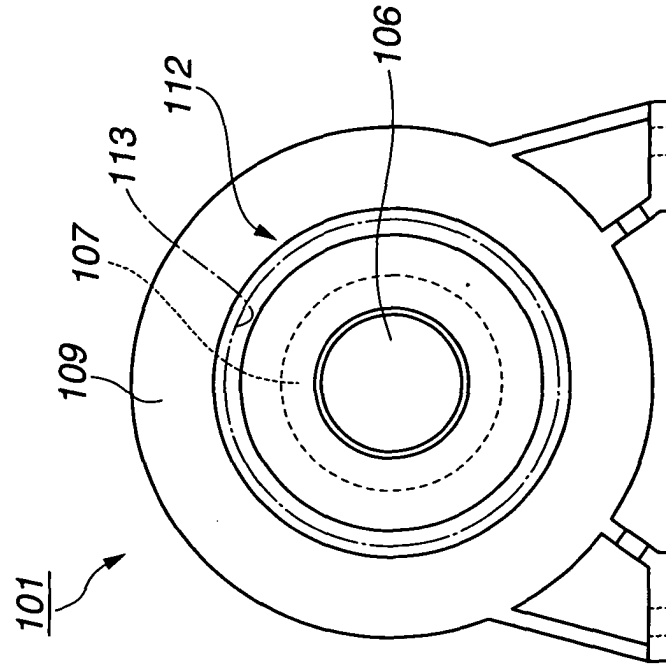


FIG.7A

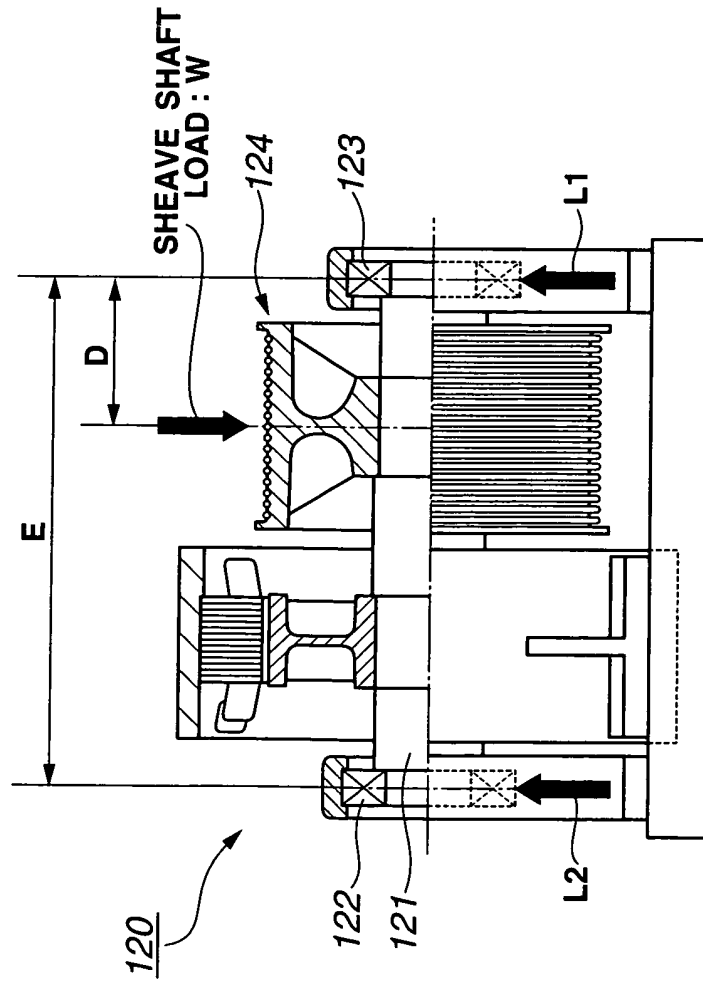
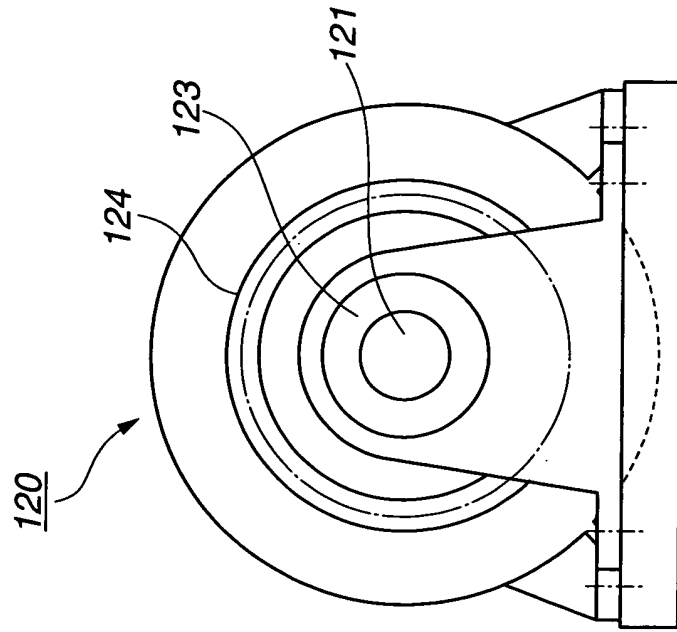


FIG.7B



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/064028

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	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

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	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 87979/1976 (Laid-open No. 5963/1978) (Mitsubishi Electric Corp.), 19 January 1978 (19.01.1978), fig. 1 (Family: none)	1, 3
X	JP 62-222991 A (Otis Elevator Co.), 30 September 1987 (30.09.1987), fig. 2 & US 4679661 A1 & GB 2187700 A & DE 3705752 A & FR 2594816 A & CN 87100969 A	1, 3

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

* Special categories of cited documents:	"I" 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
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"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	

Date of the actual completion of the international search
22 October, 2009 (22.10.09)Date of mailing of the international search report
02 November, 2009 (02.11.09)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/064028

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 28260/1990 (Laid-open No. 133170/1990) (Westinghouse Electric Corp.), 05 November 1990 (05.11.1990), description, page 9, lines 13 to 16; fig. 2 & US 4355785 A1 & GB 2096407 A & FR 2500688 A & BE 892244 A & ES 509789 A & BR 8200910 A	2-3
A	JP 62-111889 A (Hitachi, Ltd.), 22 May 1987 (22.05.1987), fig. 1 (Family: none)	2

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 53005963 U [0004]