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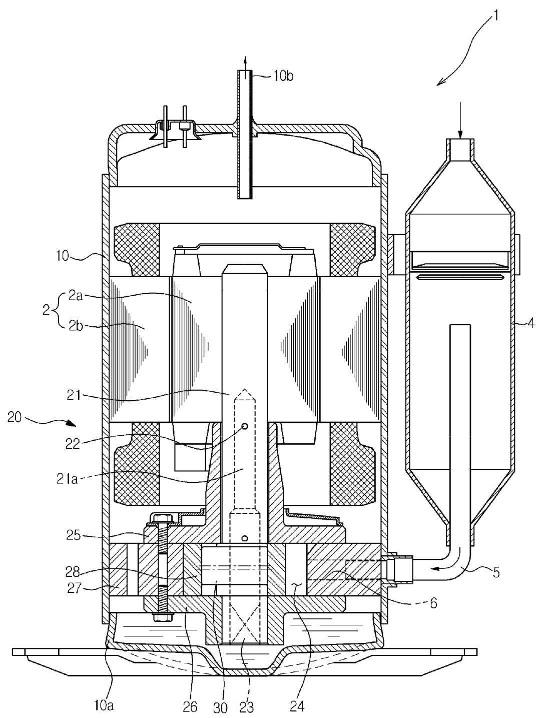
## (54) Rotary compressor

(57) A rotary compressor capable of reducing a maximum load applied to a rotary shaft (21), the rotary compressor including a casing (10), a cylinder (27) installed at an inside the casing (10) and configured to provide a space to compress gas, the rotary shaft (21) disposed while passing through the cylinder (27), a roller (28) configured to compress gas by rotating along an inner circumferential surface of the cylinder (27), and an eccentric cam (30) integrally formed with the rotary shaft (21) and disposed at an inside the roller (30), wherein the eccentric cam (30) is disposed at an eccentric position side in a shaft direction on an axial line of the rotary shaft (21).

FIG. 1

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**Description**

**[0001]** The present invention relates to a rotary compressor, and more particularly, to an eccentric cam of a rotary compressor capable of reducing a maximum load applied to a rotary shaft.

**[0002]** In general, a rotary compressor is configured to perform a function to compress a refrigerant into a high temperature and high pressure refrigerant at an air conditioner which is configured to compose a cooling cycle having a continuing process of a compression, a condensation, an expansion, and an evaporation by using a refrigerant as a medium.

**[0003]** Such rotary compressor is provided with a casing having an inlet configured to intake gas, such as air and refrigerant gas, and an outlet configured to discharge compressed gas, a rotating apparatus configured to generate rotary force at an inside of the casing, and a compression apparatus having a rotary shaft, an eccentric cam, a roller, and a cylinder and configured to compress the gas by use of the rotary force of the rotating apparatus.

**[0004]** In detail, a lower portion of the rotary shaft is configured to rotate while penetrating the cylinder and disposed in a longitudinal direction. The eccentric cam is integrally formed in an eccentric state at the rotary shaft at an inside of the cylinder, and a roller is configured to compress the gas while disposed at an outer circumferential surface of the eccentric cam and rotating along an inner circumferential surface of the cylinder by the electric cam.

**[0005]** At this time, an upper flange and a lower flange are installed at a top and a bottom of the cylinder, respectively, in order to rotatably support the rotary shaft.

An entire length of the upper flange and the lower flange may relatively differ according to an entire length and a cost of a compressor, thus, a pressure load may occur at the rotary shaft.

**[0006]** Therefore, it is an aspect of the present disclosure to provide a rotary compressor capable of reducing a maximum load applied to a rotary shaft.

**[0007]** It is another aspect of the present disclosure to provide a rotary compressor configured to reduce a maximum load applied to a rotary shaft as a position of an eccentric cam is eccentrically moved in the shaft direction.

**[0008]** Additional aspects of the disclosure will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the disclosure.

**[0009]** In accordance with an embodiment of the present disclosure, a rotary compressor includes a casing, a cylinder, a rotary shaft, a roller, and an eccentric cam. The cylinder may be installed at an inside the casing and configured to provide a space to compress gas. The rotary shaft may be disposed while passing through the cylinder. The roller may be configured to compress gas by rotating along an inner circumferential surface of the cylinder. The eccentric cam may be integrally formed with the rotary shaft and disposed at an inside the roller. The eccentric cam may be disposed at an eccentric position in a shaft direction on an axial line of the rotary shaft.

**[0010]** The eccentric cam may be eccentrically provided in a direction toward an upper side of the shaft direction.

**[0011]** The rotary compressor may include an upper flange and a lower flange provided at an upper portion and a lower portion of the cylinder, respectively, to rotatably support the rotary shaft. The eccentric cam may be eccentrically provided in a direction toward the upper flange.

**[0012]** In accordance with another aspect of the present disclosure, an eccentric cam includes a rotary shaft and an eccentric cam. The eccentric cam may be installed at the rotary shaft. The eccentric cam may be eccentrically provided in a shaft direction of the rotary shaft.

**[0013]** The eccentric cam may be eccentrically provided in a direction toward an upper side of the rotary shaft.

**[0014]** In accordance with another aspect of the present disclosure, a rotary compressor includes an airtight container, a cylinder, an upper flange, a lower flange, a rotary shaft, an eccentric cam and a roller. The cylinder may be installed at an inside the airtight container. The upper flange may be configured to form a compression room while coupled to an upper portion of the cylinder. The lower flange may be configured to form the compression room while coupled to a bottom portion of the cylinder. The rotary shaft may be disposed while passing through the cylinder. The eccentric cam may be configured to perform an eccentric rotation while integrally formed with the rotary shaft. The roller may be coupled to the eccentric cam and configured to compress gas by rotating along an inner circumferential surface of the cylinder. The eccentric cam may be disposed at an eccentric position toward the upper flange on an axial line of the rotary shaft.

**[0015]** As described above, a maximum load applied to a rotary shaft of a rotary compressor may be effectively reduced.

**[0016]** In addition, as a position of an eccentric cam is eccentrically moved in the shaft direction, a maximum load applied to a shaft is reduced, thereby effectively improving compression efficiency.

**[0017]** These and/or other aspects of the disclosure will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a cross-sectional view schematically illustrating a rotary compressor in accordance with an embodiment of the present disclosure;

FIG. 2 is an enlarged view schematically illustrating a compression unit of the rotary compressor in accordance with the embodiment of the present disclosure;

FIG. 3 is an enlarged view schematically illustrating an eccentric cam of the rotary compressor in accordance with the embodiment of the present disclosure;
FIG. 4 is a view schematically illustrating a simulation result indicating a load applied to a rotary shaft in case the eccentric cam is applied in accordance with the embodiment of the present disclosure;
FIG. 5 is a view schematically illustrating a simulation result indicating efficiency of the rotary compressor in case the eccentric cam is applied in accordance with the embodiment of the present disclosure; and
FIG. 6 is an enlarged view schematically illustrating an eccentric cam of a two-stage rotary compressor in accordance with another embodiment of the present disclosure.

**[0018]** Reference will now be made in detail to the embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout.

**[0019]** FIG. 1 is a cross-sectional view schematically illustrating a rotary compressor in accordance with an embodiment of the present disclosure, and FIG. 2 is an enlarged view schematically illustrating a compression unit of the rotary compressor in accordance with the embodiment of the present disclosure.

**[0020]** As illustrated on FIGS. 1 to 2, a rotary compressor 1 includes a casing 10, which forms an external appearance of the rotary compressor 1 while forming an airtight container. The case 10 is provided with a refrigerant inlet 6 configured to intake gas, such as air and refrigerant gas, and a refrigerant outlet 10b configured to discharge compressed gas.

**[0021]** At an inside the casing 10, a rotation apparatus 2 configured to generate a rotary force by a stator 2b and a rotor 2a, and a compression apparatus 20 configured to compress gas by using the rotary force of the rotation apparatus 2 through a rotary shaft 21, an eccentric cam 30, and a roller 28 are installed.

**[0022]** The rotary shaft 21 has an upper portion thereof inserted at an inside the rotor 2a, and a lower portion thereof passing through the cylinder 27 so as to be disposed in a longitudinal direction, thereby rotating along with the rotation of the rotor 2a The eccentric cam 30 is integrally formed in an eccentric state at the rotary shaft 21 at the inside the cylinder 27.

**[0023]** The roller 28 is disposed at an outer circumferential surface of the eccentric cam 30 and is configured to compress the gas while rotating along an inside surface of the cylinder 27 by the rotation of the eccentric cam 30.

**[0024]** An upper flange 25 and a lower flange 26 are installed at a top and a bottom of the cylinder 27 to form a compression room 24 by sealing the cylinder 27, and are provided to rotatably support the rotary shaft 21.

**[0025]** The refrigerant inlet 6 is provided at one side of the cylinder 27, connected to an accumulator 4 configured to store a liquefied refrigerant while interposing a refrigerant inlet tube 5 therebetween, so that the refrigerant introduced to the airtight container through the refrigerant inlet tube 5 is guided to the compression room 24.

**[0026]** The roller 28 is configured to eccentrically rotate by the eccentric cam 30 in close contact with the upper flange 25 and the lower flange 26.

**[0027]** The casing 10 is provided at a lower portion thereof with a lower portion cam 10a configured to store the oil to lubricate contact parts between the rotary shaft 21, the upper flange 25 and the lower flange 26, the eccentric cam 30 and the roller 28, and the cylinder 27. In order for lubricating a rotating part by raising the oil from the lower portion cam 10a, the rotary shaft 21 is insertedly provided with a hollow part 21a formed in a longitudinal direction from the bottom of the rotary shaft 21 to the upper portion of the upper flange 25, a plurality of oil discharging holes 22 formed in a radial direction while communicating with the hollow part 21a at several positions of the rotary shaft 21, and an oil pickup member 23 configured to supply the oil to an inner side of the cylinder 27 and the upper flange by raising the oil at the lower portion cam 10a.

**[0028]** Thus, as the oil at the lower portion cam 10a, by the centrifugal force of the rotation of the rotary shaft 21, ascends by the oil pickup member 23 inserted at the hollow unit 21a of the rotary shaft 21, and lubricates each rotating part while being discharged through the oil discharging holes 22.

**[0029]** Here, the load applied to the upper flange 25 and the lower flange 26 configured to rotatably support the rotary shaft 21 is calculated according to the following formulas.

Mathematical Formula 1

$$\Sigma F = 0, \rightarrow F cam = F\ upperjournal + F\ Lowerjournal$$

$$\Sigma M = 0, \rightarrow F\ upperjournal * L\ upper = F\ Lowerjournal * L\ lower$$

$$F\ Lowerjournal = (\ L\ upper\ /\ (\ L\ upper + L\ lower)) * F cam$$

$$F\ upperjournal = (\ L\ lower\ /\ (\ L\ upper + L\ lower)) * F cam$$

**[0030]** At this time, F upperjournal represents the pressure of the upper flange 25, F Lowerjournal represents the pressure of the lower flange 26, Fcam represents the pressure of the eccentric cam 30, L upper represents the length of the upper flange 25, and L lower represents the length of the lower flange 26.

**[0031]** As illustrated on FIG. 2, however, as the length of the lower flange 26 (L lower) is shorter than the length of the upper flange 25 (L upper), more loads are occurred at the lower flange 26 due to the reaction force of the pressure load.

**[0032]** Thus, in the embodiment of the present disclosure as illustrated on FIG. 3, the eccentric cam 30 is disposed at an eccentric position C' in the shaft direction from the center C of the axial line of the rotary shaft 21.

**[0033]** The eccentric position C' of the eccentric cam 30 is desired to be disposed at a side toward of the upper flange 25.

**[0034]** As shown in the mathematical formula 1, the maximum load received at the rotary shaft 21 is reduced as the eccentric cam 30 is provided at the eccentric position C' from the center C toward the side of the upper flange 25.

**[0035]** Thus, as the central position of the eccentric cam 30, which is configured to support the roller 28 that eccentrically rotates for the compression stroke of the rotary shaft 21 to take place, is moved to the side of the upper flange 25 having a relatively small reaction force of the upper flange 25 and the lower flange 26 occurred by the reaction force of the compression load, thereby reducing the maximum load received at the rotary shaft 21.

**[0036]** FIG. 4 is a view schematically illustrating a simulation result indicating a load applied to a rotary shaft in case the eccentric cam is applied in accordance with the embodiment of the present disclosure, and FIG. 5 is a view schematically illustrating a simulation result indicating efficiency of the rotary compressor in case the eccentric cam is applied in accordance with the embodiment of the present disclosure.

**[0037]** The loads applied to the upper flange 25 and the lower flange 26 are simulated when the central position of the eccentric cam 30 of the rotary compressor 1 is raised by about 3mm.

**[0038]** At this time, the rotary shaft 21 is provided with a diameter of about 14.325 mm and a length of about 134.1mm, and the eccentric cam 30 is provided with a diameter of about 23mm and a length of about 12.8mm.

**[0039]** As the result of FIG. 4 illustrates, in a case that the central position of the eccentric cam 30 is made to be eccentric by about 3mm, the load A of the lower flange 26 is reduced by about 11%.

**[0040]** Thus, it is determined that the entire load of the rotary shaft 21, may be reduced by applying the eccentric cam 30 of the embodiment of the present disclosure that is provided at the eccentric position C' in the shaft direction on the axial line.

**[0041]** FIG. 5 shows the result of the simulation on the by-frequency efficiency of the rotary compressor 1 when the type of the rotary shaft 21 are changed into a first type rotary shaft (a) and a second type rotary shaft (b) in a state the central position of the eccentric cam 30 is made to be eccentric about 3mm.

**[0042]** It is found that the rotary shafts (a') and (b') of the present disclosure, having the center of the eccentric cam 30 at the eccentric position by about 3mm toward the side of the upper flange 25 shows about 1% increase in the efficiency of the compressor when compared to conventional rotary shafts (a) and (b) that set the center of the eccentric cam 30 as the center C.

**[0043]** Thus, in a case that the eccentric cam 30 provided at the eccentric position C' in the shaft direction on the axial line of the rotary shaft 21 is applied, it is determined that the efficiency of the entire rotary compressor 1 may be improved.

**[0044]** FIG. 6 is an enlarged view schematically illustrating an eccentric cam of a two-stage rotary compressor in accordance with another embodiment of the present disclosure. Although not illustrated, each of a first eccentric cam 30a and a second eccentric cam 30b which are integrally formed at the rotary shaft 21 of the two-stage rotary compressor is disposed at the eccentric position C' in the shaft direction on the axial line of the rotary shaft 21, thereby capable of reducing the maximum load applied to the rotary shaft 21.

**[0045]** The motion and the effect of the first eccentric cam 30a and the second eccentric cam 30b eccentrically provided in the shaft direction on the axial line of the rotary shaft 21 of the two-stage rotary compressor may be implemented based on the description explained as above, and therefore, a repetitive description will be omitted.

**[0046]** Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles of the invention, the scope of which is defined in the claims.

## Claims

**1.** A rotary compressor, comprising:

a casing;
a cylinder installed inside the casing and configured to provide a space to compress gas;
a rotary shaft disposed while passing through the cylinder;
a roller configured to compress gas by rotating along an inner circumferential surface of the cylinder; and
an eccentric cam integrally formed with the rotary shaft and disposed inside the roller,

wherein the eccentric cam is disposed at an eccentric position in a shaft direction on an axial line of the rotary shaft.

**2.** The rotary compressor of claim 1, wherein:

the eccentric cam is eccentrically provided in a direction toward an upper side of the shaft direction.

**3.** The rotary compressor of claim 1 or 2, wherein:

the rotary compressor comprises an upper flange and a lower flange provided at an upper portion and a lower portion of the cylinder, respectively, to rotatably support the rotary shaft, and
the eccentric cam is eccentrically provided in a direction toward the upper flange.

**4.** An eccentric cam, comprising:

a rotary shaft; and
an eccentric cam installed at the rotary shaft,
wherein the eccentric cam is eccentrically provided in a shaft direction of the rotary shaft.

**5.** The eccentric cam of claim 4, wherein:

the eccentric cam is eccentrically provided in a direction toward an upper side of the rotary shaft.

**6.** A rotary compressor, comprising:

an airtight container;
a cylinder installed inside the airtight container;
an upper flange configured to form a compression room while coupled to an upper portion of the cylinder;
a lower flange configured to form the compression room while coupled to a bottom portion of the cylinder;
a rotary shaft disposed while passing through the cylinder;
an eccentric cam configured to perform an eccentric rotation while integrally formed with the rotary shaft; and
a roller coupled to the eccentric cam and configured to compress gas by rotating along an inner circumferential surface of the cylinder,
wherein the eccentric cam is disposed at an eccentric position toward the upper flange on an axial line of the rotary shaft.

**7.** The rotary compressor of claim 6, wherein the rotary shaft comprises:

a hollow part formed in a longitudinal direction of the rotary shaft from a bottom of the rotary shaft to an upper portion of the upper flange;
a plurality of oil discharging holes formed in a radial direction while communicating with the hollow part; and
an oil pickup member configured to supply oil to an inner side of the cylinder and the upper flange by raising oil stored in a lower portion cam of a casing of the rotary compressor.

FIG. 1

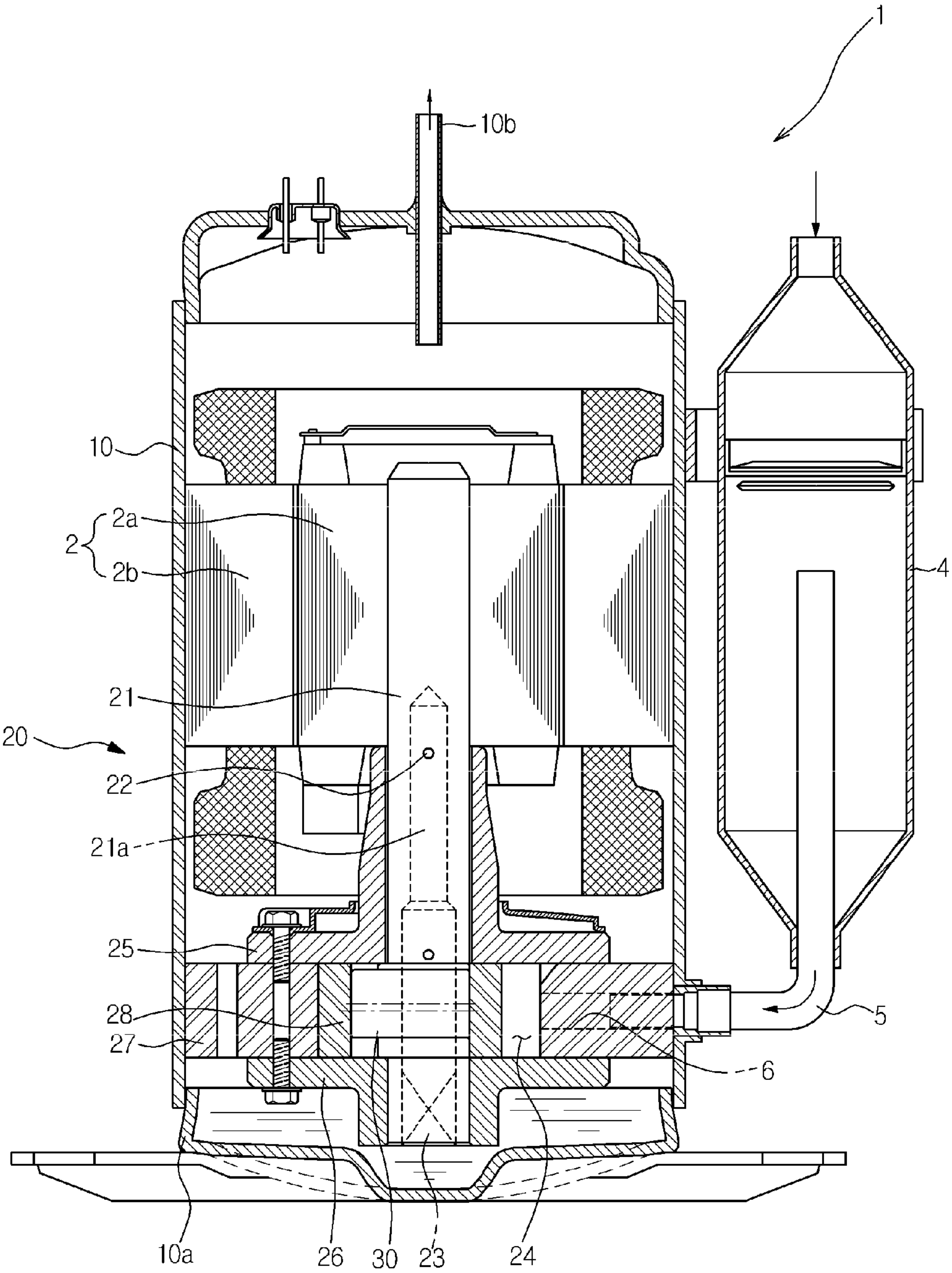


FIG. 2

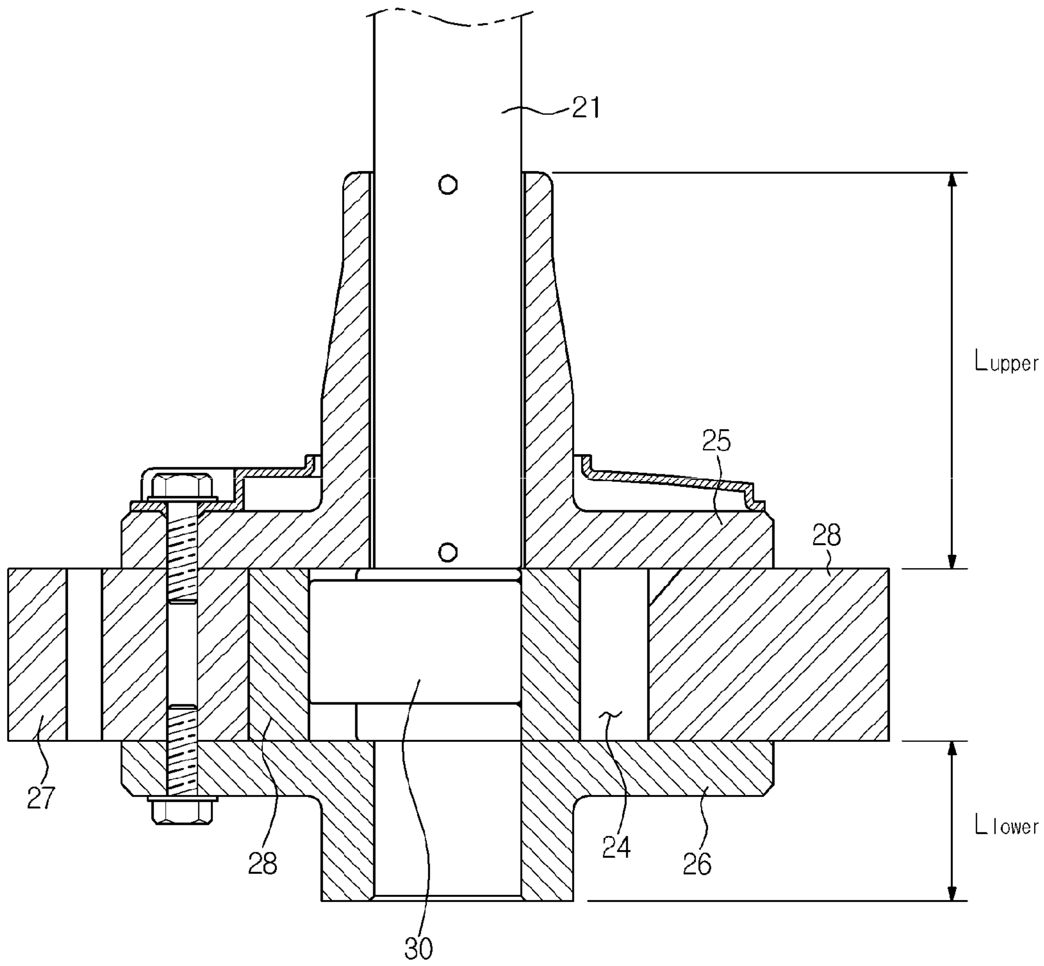


FIG. 3

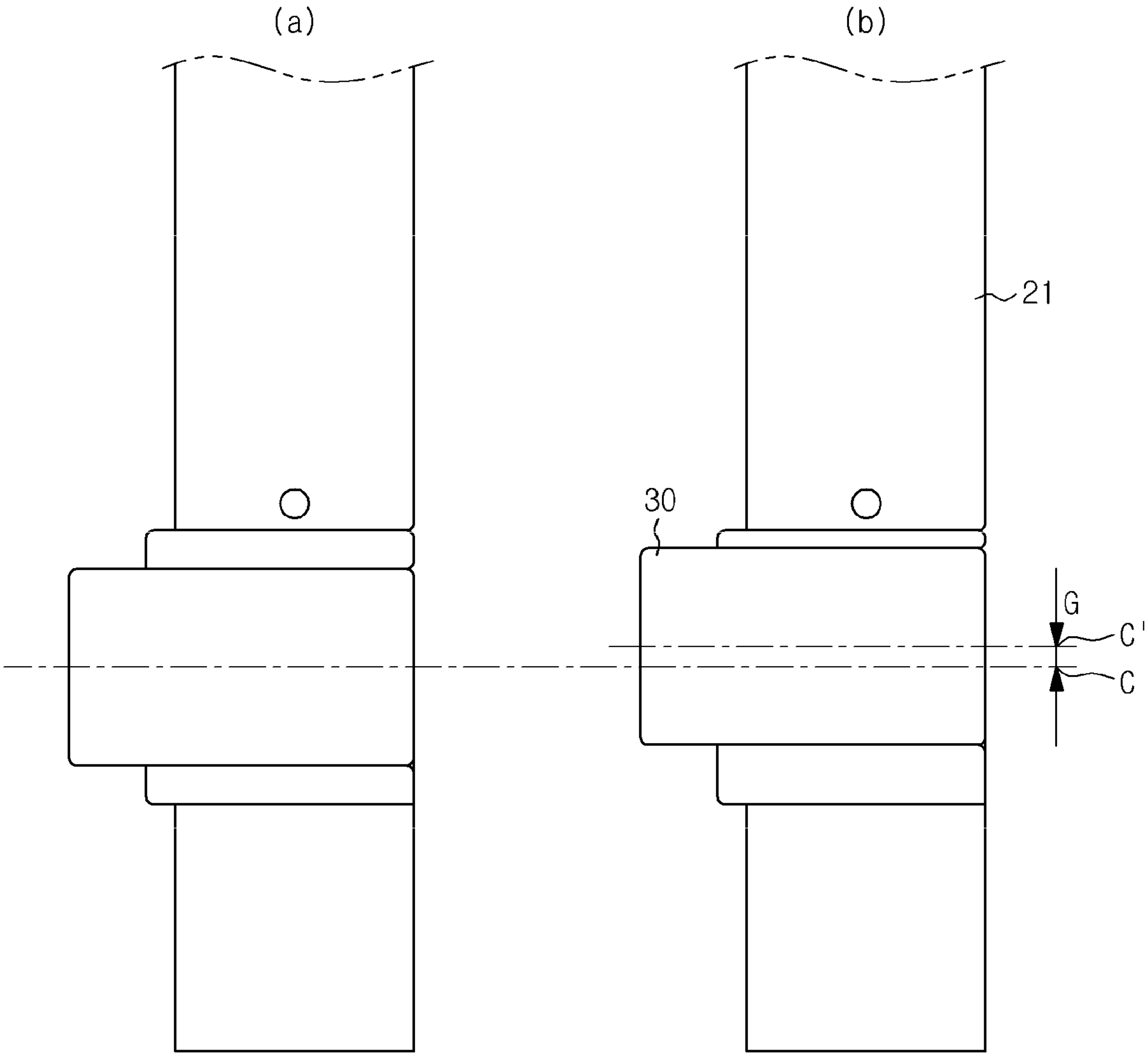
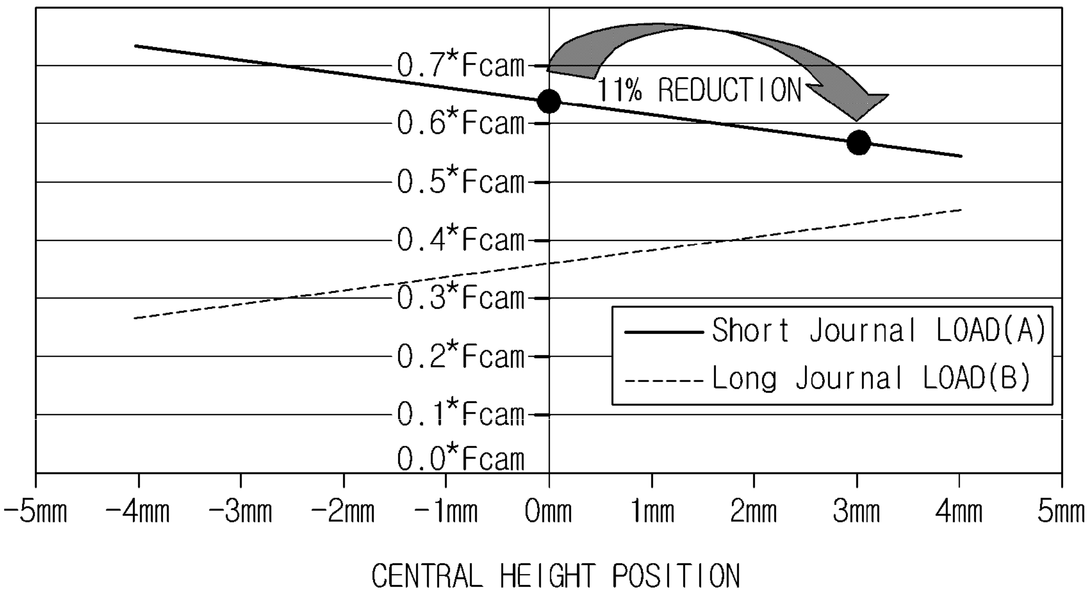


FIG. 4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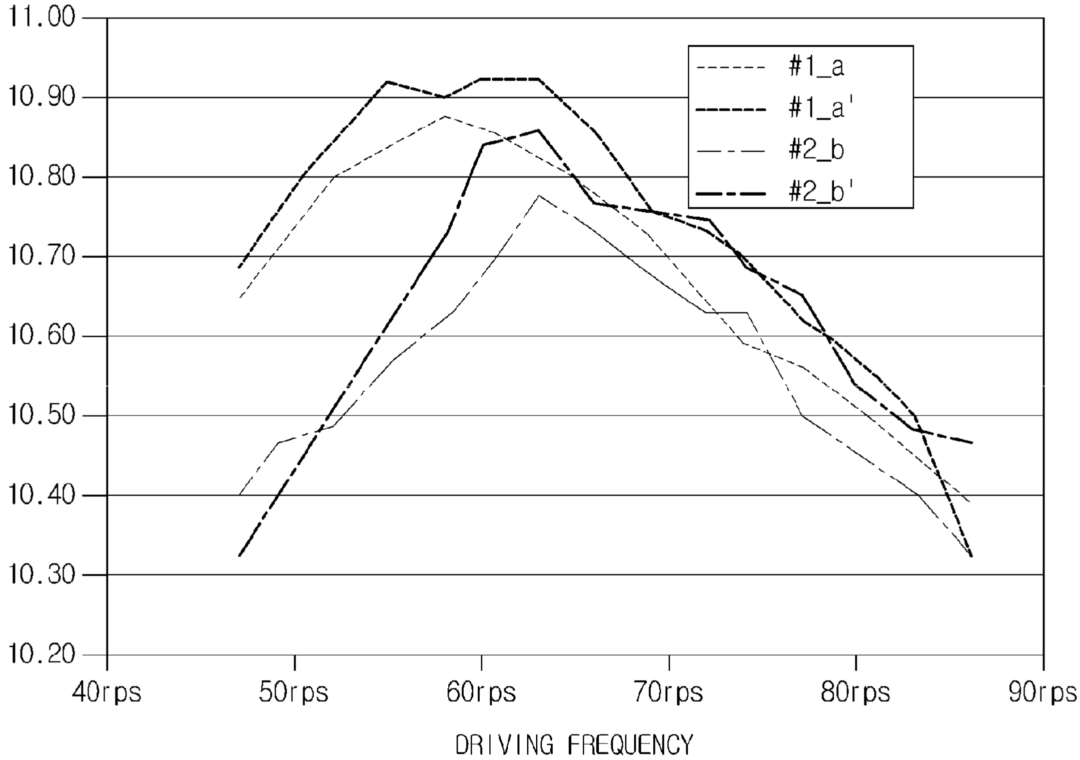
0.6*Fcam
0.5*Fcam
0.4*Fcam
0.3*Fcam
0.2*Fcam
0.1*Fcam
0.0*Fcam
11% REDUCTION
Short Journal LOAD(A)
Long Journal LOAD(B)
-5mm
-4mm
-3mm
-2mm
-1mm
0mm
1mm
2mm
3mm
4mm
5mm
CENTRAL HEIGHT POSITION

FIG. 5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10.80
10.70
10.60
10.50
10.40
10.30
10.20
40rps
50rps
60rps
70rps
80rps
90rps
DRIVING FREQUENCY
#1_a
#1_a'
#2_b
#2_b'

FIG. 6