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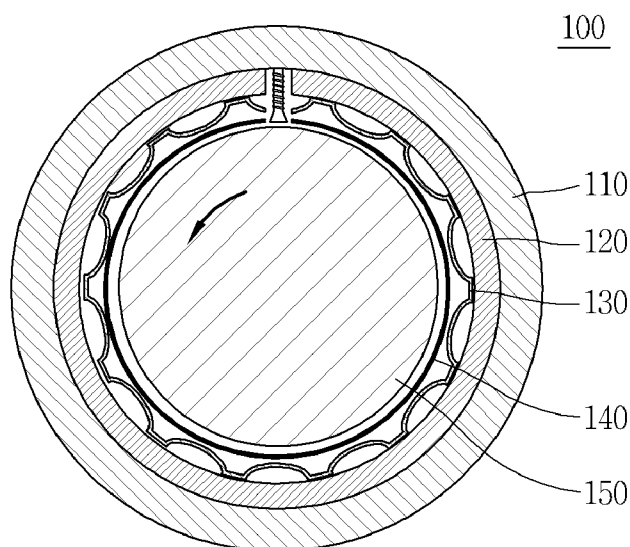
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(54) **Title:** GAS FOIL JOURNAL BEARING



(57) **Abstract:** Disclosed is a gas foil journal bearing including a bearing housing, a journal rotated within the bearing housing according to driving of a motor, a top foil provided between the bearing housing and the journal, a bump foil provided between the bearing housing and the top foil, and a fiber member provided to be tightly attached to an inner circumferential surface of the bearing housing to alleviate impact applied to the bearing housing through the journal.

Description

Title of Invention: GAS FOIL JOURNAL BEARING

Technical Field

- [1] The present invention relates to gas foil journal bearing, and more particularly, to a gas foil journal bearing having enhanced durability and stability by using a fiber member.

[2]

Background Art

- [3] In general, a gas bearing is a bearing supporting a rotational shaft of a high speed rotary devices such as a compressor, a turbine, a turbo charger, and the like, which uses a fluid in an air or gas state without using a lubricant, as an operating fluid. The gas bearing is classified as a static pressure bearing and a kinetic pressure bearing.
- [4] In the static pressure bearing, air or a gas pressed by an external compressor is forcibly supplied to the bearing to obtain load support capability. The static pressure bearing requires a separate pressure source (external pressing device) is required, but since a shaft can be supported even when the shaft is not rotated, damage to the bearing due to solid friction may be avoided.
- [5] In contrast, in the kinetic pressure bearing, ambient air or gas is drawn to the bearing according to rotation of a shaft to increase pressure to obtain load capability. The kinetic pressure bearing does not require a separate pressure source, but when a rotor starts and is stopped, solid friction inevitably occurs, shortening bearing lifespan. Thus, in order to prevent the problem, a bearing surface is required to be coated with a solid lubricant.
- [6] Among kinetic pressure bearings, a gas foil journal bearing, which implements a bearing surface by overlapping bent type thin plates, simplifies a structure of a turbomachine system, reduces maintenance cost of the system, and minimizes power loss.
- [7] In addition, unlike an existing oil lubrication bearing, the gas foil journal bearing uses air as a lubricant, and as such, the gas foil journal bearing has come to prominence as a most appropriate bearing in terms of an eco-friendly issue, and commonly used in order to reduce power loss of highly efficient turbomachine and simplify a structure of a system.
- [8] FIG. 1 is a schematic cross-sectional view illustrating a related art gas foil journal bearing.
- [9] As illustrated in FIG. 1, the related art gas foil journal bearing includes a bearing housing 1, a bump foil 3 installed on an inner surface of the bearing housing 1, and a top foil 5 installed on an inner surface of the bump foil 3 and supporting a journal (not

shown) driven by a motor.

[10] The gas foil journal bearing is configured such that, when driving of a motor is stopped and a load of the journal is applied to the bump foil 3 and the top foil 5, the wavy bump foil 3 is elastically compressed with respect to the load of the journal to attenuate impact.

[11] However, the related art gas foil journal bearing has a problem in which, when impact is applied in a radial direction, or the like, plastic deformation easily occurs to increase a gap between the journal and the bearing housing 1 and deforms a shape to change rigidity.

[12] Also, since the shape is deformed due to the plastic deformation caused by external impact, the bearing malfunctions, significantly degrading stability during an operation.

[13]

Disclosure of Invention

Technical Problem

[14] Therefore, an object of the present invention is to provide a gas foil journal bearing having enhanced durability and stability by using a fiber member in addition to a bump foil.

[15]

[16]

Solution to Problem

[17] According to an aspect of the present invention, there is provided a gas foil journal bearing including: a bearing housing; a journal rotated within the bearing housing according to driving of a motor; a top foil provided between the bearing housing and the journal; a bump foil provided between the bearing housing and the top foil; and a fiber member provided to be tightly attached to an inner circumferential surface of the bearing housing to alleviate impact applied to the bearing housing through the journal.

[18] An interior of the fiber member may be filled with spongy or cotton.

[19] According to an aspect of the present invention, there is also provided a gas foil journal bearing including: a bearing housing; a journal rotated within the bearing housing according to driving of a motor; a top foil provided between the bearing housing and the journal; and a plurality of fiber members provided between the bearing housing and the top foil and having a fiber portion provided to cover the exterior and a plurality of threads provided within the fiber portion to alleviate impact applied to the bearing housing through the journal.

[20] The plurality of fiber members may have a cylindrical shape and may be in contact with each other through thread.

[21] The thread may have a plurality of knots formed thereon in a length direction.

- [22] According to an aspect of the present invention, there is also provided a gas foil journal bearing including: a bearing housing; a journal rotated within the bearing housing according to driving of a motor; a top foil provided between the bearing housing and the journal; a fiber member provided on an inner circumferential surface of the bearing and configured to alleviate impact applied to the bearing housing through the journal; and a plurality of buffer members provided between the fiber member and the top foil and configured to alleviate impact applied to the bearing housing through the journal, wherein the plurality of buffer members may each have a fiber portion having a cylindrical shape and covering the exterior and thread provided within the fiber portion, and the plurality of buffer members are positioned on an inner circumferential surface of the bearing housing and spaced apart from one another at a predetermined interval in a length direction of the journal.
- [23] The plurality of buffer members may be connected to each other through thread.
- [24] According to an aspect of the present invention, there is also provided a gas foil journal bearing including: a bearing housing; a journal rotated within the bearing housing according to driving of a motor; a top foil provided between the bearing housing and the journal; and a fiber member provided between the bearing housing and the top foil and configured to alleviate impact applied to the bearing housing through the journal, wherein the fiber member includes a first fiber portion positioned to be tightly attached to an inner circumferential surface of the bearing housing and a plurality of second fiber portions protruding from the first fiber portion toward the journal and having spongy or cotton filling an interior thereof.
- [25] The plurality of second fiber portions may be connected to each other through thread.
- [26]

Advantageous Effects of Invention

- [27] According to embodiments of the present invention, since the fiber member is further provided in addition to the bump foil within the gas foil journal bearing, impact applied to the bearing housing through the journal can be absorbed dually by using the bump foil and the fiber member, thus significantly enhancing durability of the bearing.
- [28] Also, since the interior of the fiber member is filled with cotton or knotted thread to absorb impact applied through the journal, as well as dually using the bump foil and the fiber member, the bearing is prevented from being deformed due to impact and occurrence of an accident due to deformation of the bearing during an operation is prevented, enhancing stability of the bearing.
- [29] In addition, since impact applied to the bearing housing through the journal is absorbed by using the fiber member and the cotton or knotted thread within the fiber member, stress may be enhanced, compared with a case in which only the bump foil is

used, to prevent plastic deformation due to impact to facilitate restoration into the original shape, and thus, durability and stability of the bearing may be significantly enhanced.

[30]

Brief Description of Drawings

[31] FIG. 1 is a schematic cross-sectional view illustrating a related art gas foil bearing.

[32] FIG. 2 is a cross-sectional view illustrating a gas foil journal bearing according to a first embodiment of the present disclosure.

[33] FIG. 3 is another cross-sectional view illustrating a gas foil journal bearing according to the first embodiment of the present disclosure.

[34] FIG. 4 is a cross-sectional view illustrating a gas foil journal bearing according to a second embodiment of the present disclosure.

[35] FIG. 5 is another cross-sectional view illustrating a gas foil journal bearing according to the second embodiment of the present disclosure.

[36] FIG. 6 is a schematic perspective view illustrating a fiber member used in a gas foil journal bearing according to the second embodiment of the present disclosure.

[37] FIG. 7 is a cross-sectional view illustrating a gas foil journal bearing according to a third embodiment of the present disclosure.

[38] FIG. 8 is another cross-sectional view illustrating a gas foil journal bearing according to the third embodiment of the present disclosure.

[39] FIG. 9 is a cross-sectional view illustrating a gas foil journal bearing according to a fourth embodiment of the present disclosure.

[40] FIG. 10 is another cross-sectional view illustrating a gas foil journal bearing according to the fourth embodiment of the present disclosure.

[41] FIG. 11 is a cross-sectional view illustrating a gas foil journal bearing according to a fifth embodiment of the present disclosure.

[42] FIG. 12 is another cross-sectional view illustrating a gas foil journal bearing according to the fifth embodiment of the present disclosure.

[43]

[44]

Best Mode for Carrying out the Invention

[45] Hereinafter, a gas foil journal bearing according to an embodiment of the present disclosure will be described in detail with reference to the accompanying drawings.

[46] FIG. 2 is a cross-sectional view illustrating a gas foil journal bearing according to a first embodiment of the present disclosure, FIG. 3 is another cross-sectional view illustrating a gas foil journal bearing according to the first embodiment of the present disclosure, FIG. 4 is a cross-sectional view illustrating a gas foil journal bearing

according to a second embodiment of the present disclosure, FIG. 5 is another cross-sectional view illustrating a gas foil journal bearing according to the second embodiment of the present disclosure, and FIG. 6 is a schematic perspective view illustrating a fiber member used in a gas foil journal bearing according to the second embodiment of the present disclosure.

- [47] FIG. 7 is a cross-sectional view illustrating a gas foil journal bearing according to a third embodiment of the present disclosure, FIG. 8 is another cross-sectional view illustrating a gas foil journal bearing according to the third embodiment of the present disclosure, FIG. 9 is a cross-sectional view illustrating a gas foil journal bearing according to a fourth embodiment of the present disclosure, FIG. 10 is another cross-sectional view illustrating a gas foil journal bearing according to the fourth embodiment of the present disclosure, FIG. 11 is a cross-sectional view illustrating a gas foil journal bearing according to a fifth embodiment of the present disclosure, and FIG. 12 is another cross-sectional view illustrating a gas foil journal bearing according to the fifth embodiment of the present disclosure.
- [48] As illustrated in FIGS. 2 and 3, a gas foil journal bearing according to a first embodiment of the present disclosure includes a bearing housing 110, a journal 150, a top foil 140, a bump foil 130, and a fiber member 120.
- [49] The bearing housing 110 has a cylindrical shape forming an external appearance of the bearing 100 and includes the journal 150, the top foil 140, the bump foil 130, and the fiber member 120 therein.
- [50] The journal 150 rotates within the bearing housing 110 according to driving of a motor, and the top foil 140 is provided between the bearing housing 110 and the journal 150 and elastically compressed by a load of the journal 150 to thus attenuate a load applied to the bearing housing 110 through the journal 150.
- [51] The bump foil 130 is provided between the bearing housing 110 and the top foil 140 and attenuates a load applied to the bearing housing 110 through the journal 150 together with the top foil 140.
- [52] The fiber member 120 is tightly attached to an inner circumferential surface of the bearing housing 110 to dually alleviate impact applied to the bearing housing 110 through the journal 150 together with the top foil 140 and the bump foil 130.
- [53] Thus, since the fiber member 120 is additionally provided in the bearing 100 in addition to the bump foil 130, impact applied to the bearing housing 110 through the journal 150 may be dually alleviated, enhancing durability and stability of the bearing 100.
- [54] Also, since the fiber member 120 is used, the fiber member 120 may be used at room temperature or a middle temperature or even at a high temperature, and thus, the bearing 100 may be extensively used in various environments.

- [55] Meanwhile, as illustrated in FIGS. 4 through 6, a gas foil journal bearing 200 according to a second embodiment of the present disclosure includes a bearing housing 210, a journal 240, a top foil 230, and a fiber member 220.
- [56] The bearing housing 210 has a cylindrical shape forming an external appearance of the bearing 200 and includes the journal 240, the top foil 230, and the fiber member 220 therein.
- [57] The journal 240 rotates within the bearing housing 210 according to driving of a motor, and the top foil 230 is provided between the bearing housing 210 and the journal 240 and elastically compressed by a load of the journal 240 to thus attenuate a load of the journal 240.
- [58] The fiber member 220 is provided between the bearing housing 210 and the top foil 230, includes a fiber portion 221 formed to cover the exterior and a plurality of threads 223 provided within the fiber portion 221, and alleviates impact applied to the bearing housing 210 through the journal 240.
- [59] Here, as the threads 223, the same type of threads of various types of threads may be used.
- [60] Also, the thread 223 may have knots formed in a length direction of the fiber member 220, and thus, even through the fiber member 220 is elastically compressed due to a load of the journal 240, the thread 223 is easily restored to the original form.
- [61] Thus, in the related art, since the single foil rubs against the bearing housing, Coulomb damping is not greatly generated, but in the present disclosure, since the fiber member 220 is additionally provided and the plurality of knotted threads 223 are provided within the fiber member 220, a generation rate of Coulomb damping may be increased by friction between knots as well as friction between the threads 223, whereby impact applied through the journal 240 may be effectively absorbed.
- [62] Meanwhile, as illustrated in FIGS. 7 and 8, a gas foil journal bearing 300 according to a third embodiment of the present disclosure includes a bearing housing 310, a journal 350, a top foil 340, a fiber member 320, and a buffer member 330.
- [63] The bearing housing 310 has a cylindrical shape forming an external appearance of the bearing 300 and includes the journal 350, the top foil 340, the fiber member 320, and the buffer member 330.
- [64] The journal 350 rotates within the bearing housing 310 according to driving of a motor, and the top foil 340 is provided between the bearing housing 310 and the journal 350 and elastically compressed by a load of the journal 350 to thus attenuate a load of the journal 350.
- [65] The fiber member 320 is provided on an inner circumferential surface of the bearing 300 to alleviate impact applied to the bearing housing 310 through the journal 350 together with the top foil 340.

- [66] The buffer member 330 is provided between the fiber member 320 and the top foil 340 to alleviate impact applied to the bearing housing 310 through the journal 350 together with the top foil 340 and the fiber member 320.
- [67] Here, the buffer member 330 is formed in plurality and has a cylindrical shape. The plurality of buffer members 330 are positioned on an inner circumferential surface of the bearing housing 310 and spaced apart from one another at a predetermined interval in a length direction of the journal 350.
- [68] Also, the buffer member 330 includes a fiber portion 331 covering the exterior of the buffer member 330 and thread 333 provided within the fiber portion 331. The buffer members 330 are connected to be in contact with each other through the threads 333. Here, the thread 333 may have a plurality of knots formed in a length direction of the buffer member 330, and the same type of thread or different types of threads may be used.
- [69] Thus, even though a load is applied to the housing 310 through the journal 350, since impact is alleviated through the fiber member 320 and the buffer member 330, durability and stability of the bearing 300 may be enhanced.
- [70] Meanwhile, as illustrated in FIGS. 9 and 10, a gas foil journal bearing 400 according to a fourth embodiment of the present disclosure includes a bearing housing 410, a journal 450, a bump foil 430, a top foil 440, and a fiber member 420, and the interior of the fiber member 420 is filled with spongy or cotton 421, as in the second embodiment.
- [71] Since the interior of the fiber member 420 is filled with spongy or cotton 421, even though it is compressed due to a load of the journal 450, the fiber member 420 may be easily restored to the original form and impact applied to the bearing housing 410 through the journal 450 may be alleviated.
- [72] Meanwhile, as illustrated in FIGS. 11 and 12, a gas foil journal bearing 500 according to a fifth embodiment of the present disclosure includes a bearing housing 510, a journal 540, a top foil 530, and a fiber member 520.
- [73] The bearing housing 510 has a cylindrical shape forming an external appearance of the bearing 500 and includes the journal 540, the top foil 530, and the fiber member 520 therein.
- [74] The journal 540 rotates within the bearing housing 510 according to driving of a motor, and the top foil 530 is provided between the bearing housing 510 and the journal 540 and elastically compressed by a load of the journal 540 to thus attenuate a load applied to the bearing housing 510 through the journal 540.
- [75] The fiber member 520 is provided between the bearing housing 510 and the top foil 530 to alleviate impact applied to the bearing housing 510 through the journal 540.
- [76] Here, the fiber member 520 includes a first fiber portion 521 and a second fiber

portion 523 formed to protrude toward the journal 540 from the first fiber portion 521.

[77] The first fiber portion 521 is tightly attached to be positioned on an inner circumferential surface of the bearing housing 510, and the second fiber portion 523 is formed to protrude from the first fiber portion 521 toward the journal 540 and has a quadrangular lattice shape overall.

[78] Here, a shape of the second fiber portion 523 is not limited to the quadrangular shape and the second fiber portion 523 may have various shapes to alleviate impact of the journal 540.

[79] Also, the interior of the second fiber portion 523 may be filled with spongy or cotton 524, and here, the second fiber portions are connected through threads.

[80] In the present disclosure configured as described above, since the fiber member 120, 220, 320, 420, or 520 is further provided within the gas foil journal bearing in addition to the bump foil, impact applied to the bearing housing 110, 210, 310, 410, or 510 through the journal 150, 240, 350, 450, or 540 may be dually absorbed by using the bump foil 130 or 430 and the fiber member 120, 220, 320, 420, or 520, thus enhancing durability of the bearing.

[81] Also, since an amount of Coulomb damping generated through friction between a single bump foil, or the like, and the bearing housing is increased through the fiber member 120, 220, 320, 420, or 520, cotton and a plurality of threads 223, 250, 333, 335, or 525 provided therein, and the knots formed on the threads, impact applied to the bearing housing 110, 210, 310, 410, or 510 through the journal 150, 240, 350, 450, or 540 may be effectively alleviated.

[82] In addition, since the bump foil 130 or 430 and the fiber member 120, 220, 320, 420, or 520 are dually used and the interior of the fiber member 120, 220, 320, 420, or 520 is filled with cotton or threads to absorb impact applied through the journal 150, 240, 350, 450, or 540, the bearing is prevented from being deformed by impact and occurrence of an accident due to deformation during an operation may be prevented, enhancing stability of the bearing.

[83] In addition, since the fiber member 120, 220, 320, 420, or 520 is provided and cotton 421 or 524 or knotted thread 223 or 333 is provided within the fiber member 120, 220, 320, 420, or 520 to absorb impact applied to the bearing housing 110, 210, 310, 410 or 510 through the journal 150, 240, 350, 450, or 540, stress may be enhanced to prevent plastic deformation, compared with a case of using the bump foil 130 or 430, whereby the fiber member 120, 220, 320, 420, or 520 may be easily restored to the original shape thereof, whereby durability and stability of the bearing can be enhanced.

[84] The exemplary embodiments of the present invention will now be described with reference to the accompanying drawings, in which like numbers refer to like elements throughout. In describing the present invention, if a detailed explanation for a related

known function or construction is considered to unnecessarily divert the gist of the present invention, such explanation has been omitted but would be understood by those skilled in the art. The accompanying drawings of the present invention aim to facilitate understanding of the present invention and should not be construed as limited to the accompanying drawings. The technical idea of the present invention should be interpreted to embrace all such alterations, modifications, and variations in addition to the accompanying drawings.

[85]

[86]

[87]

[88]

Claims

- [Claim 1] A gas foil journal bearing comprising:
a bearing housing;
a journal rotated within the bearing housing according to driving of a motor;
a top foil provided between the bearing housing and the journal;
a bump foil provided between the bearing housing and the top foil; and
a fiber member provided to be tightly attached to an inner circumferential surface of the bearing housing to alleviate impact applied to the bearing housing through the journal.
- [Claim 2] The gas foil journal bearing of claim 1, wherein an interior of the fiber member is filled with spongy or cotton.
- [Claim 3] A gas foil journal bearing comprising:
a bearing housing;
a journal rotated within the bearing housing according to driving of a motor;
a top foil provided between the bearing housing and the journal; and
a plurality of fiber members provided between the bearing housing and the top foil and having a fiber portion provided to cover the exterior and a plurality of threads provided within the fiber portion to alleviate impact applied to the bearing housing through the journal.
- [Claim 4] The gas foil journal bearing of claim 3, wherein the plurality of fiber members have a cylindrical shape and are in contact with each other through thread.
- [Claim 5] The gas foil journal bearing of claim 3, wherein the thread has a plurality of knots formed thereon in a length direction.
- [Claim 6] A gas foil journal bearing comprising:
a bearing housing;
a journal rotated within the bearing housing according to driving of a motor;
a top foil provided between the bearing housing and the journal;
a fiber member provided on an inner circumferential surface of the bearing and configured to alleviate impact applied to the bearing housing through the journal; and
a plurality of buffer members provided between the fiber member and the top foil and configured to alleviate impact applied to the bearing housing through the journal,

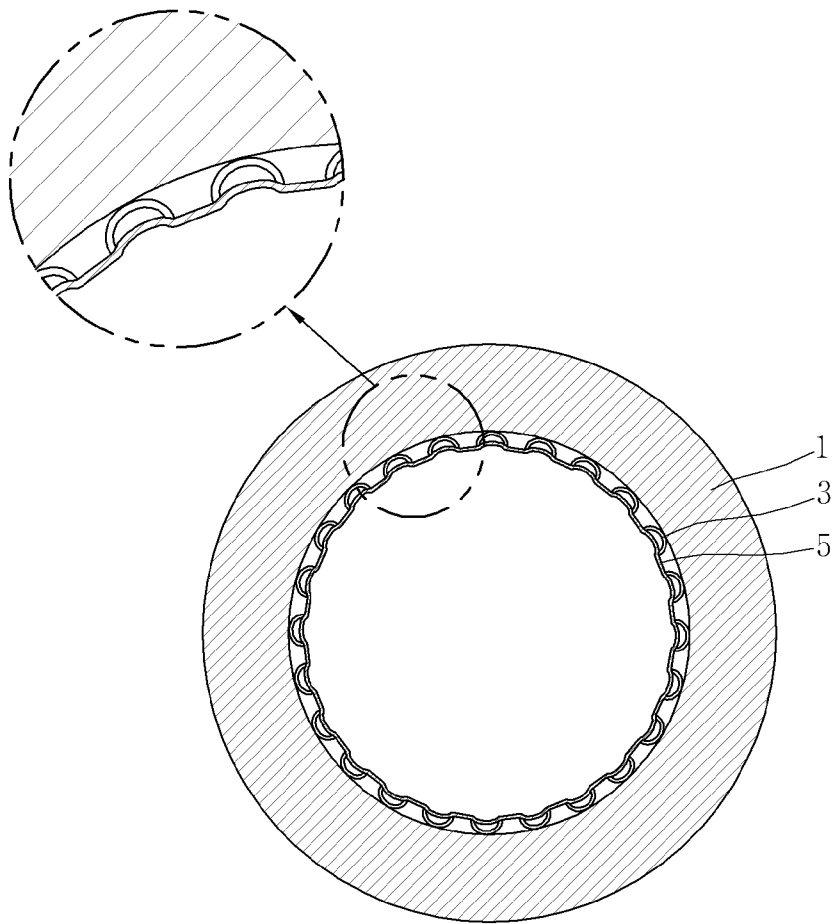
wherein the plurality of buffer members each have a fiber portion having a cylindrical shape and covering the exterior and thread provided within the fiber portion, and the plurality of buffer members are positioned on an inner circumferential surface of the bearing housing and spaced apart from one another at a predetermined interval in a length direction of the journal.

[Claim 7] The gas foil journal bearing of claim 6, wherein the plurality of buffer members are connected to each other through thread.

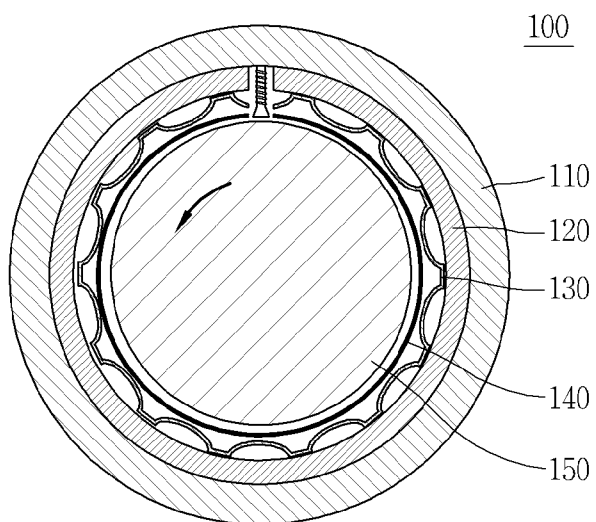
[Claim 8] A gas foil journal bearing comprising:
a bearing housing;
a journal rotated within the bearing housing according to driving of a motor;
a top foil provided between the bearing housing and the journal; and
a fiber member provided between the bearing housing and the top foil and configured to alleviate impact applied to the bearing housing through the journal,
wherein the fiber member includes a first fiber portion positioned to be tightly attached to an inner circumferential surface of the bearing housing and a plurality of second fiber portions protruding from the first fiber portion toward the journal and having spongy or cotton filling an interior thereof.

[Claim 9] The gas foil journal bearing of claim 8, wherein the plurality of second fiber portions are connected to each other through thread.

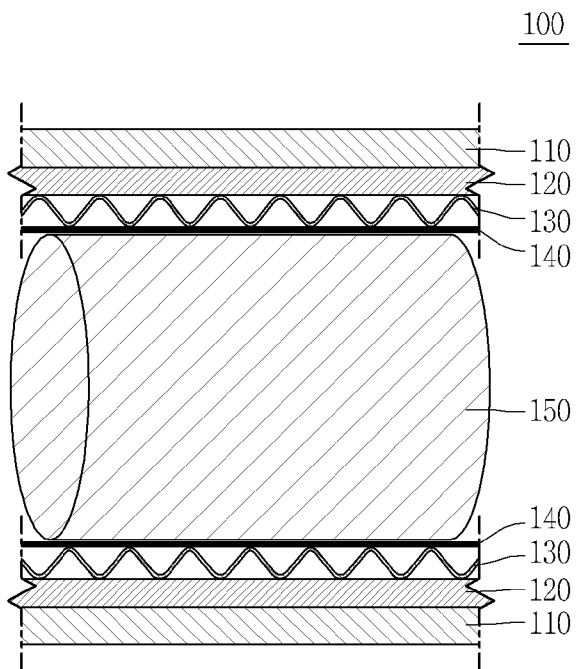
[Fig. 1]



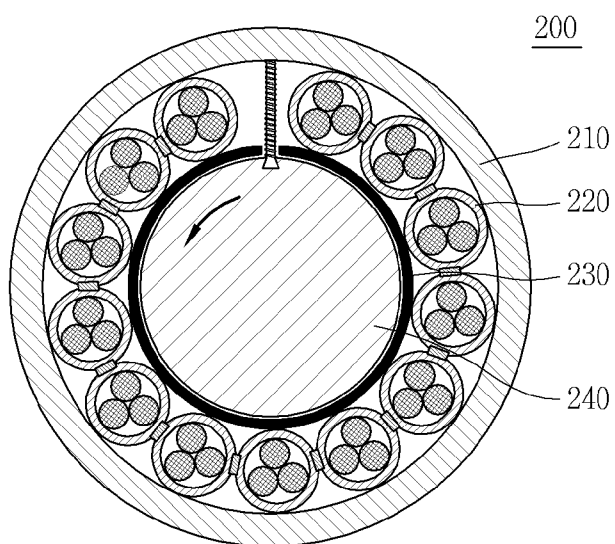
[Fig. 2]



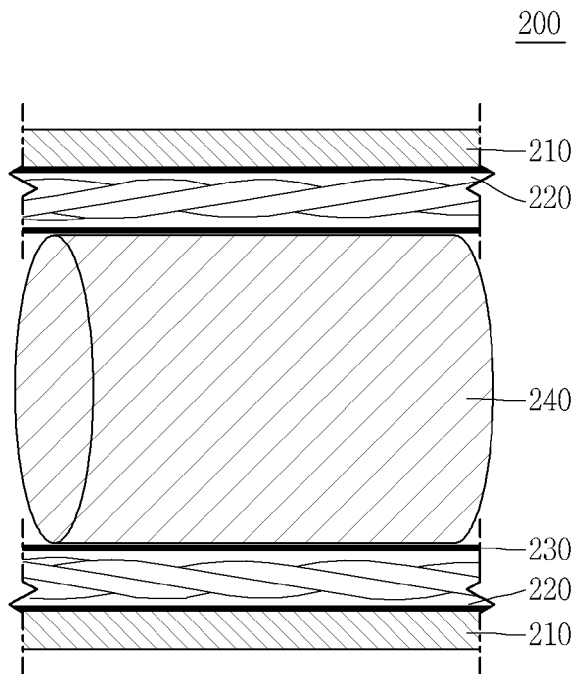
[Fig. 3]



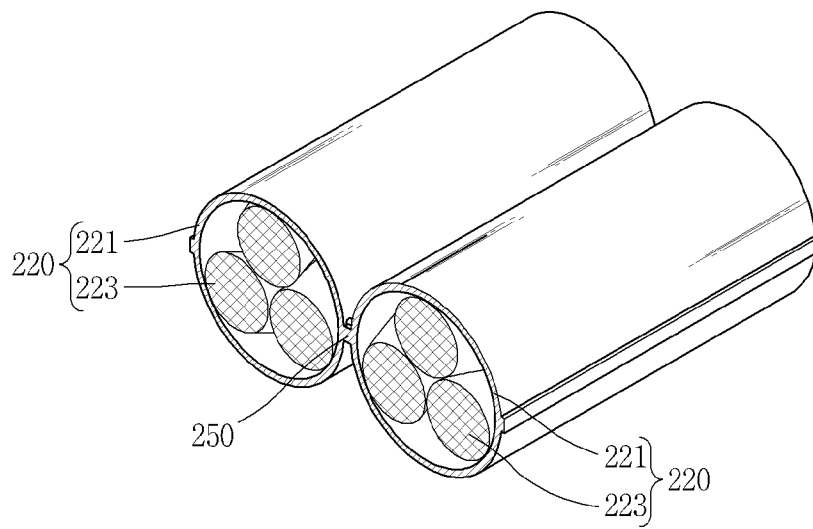
[Fig. 4]



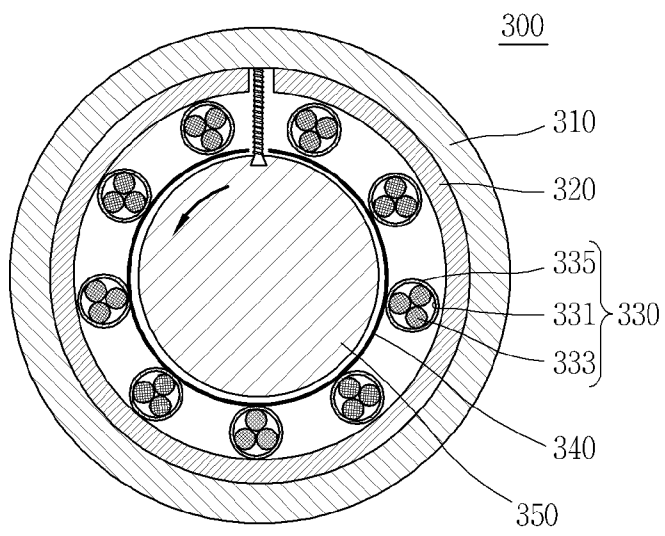
[Fig. 5]



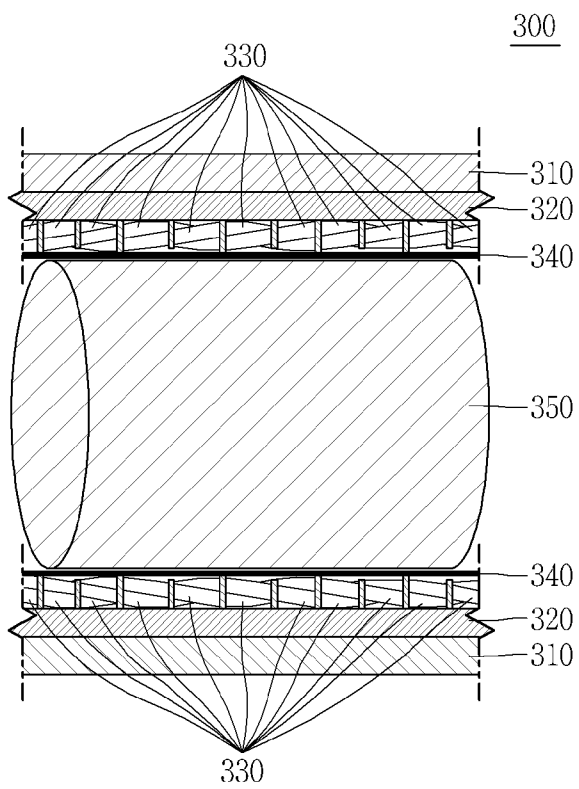
[Fig. 6]



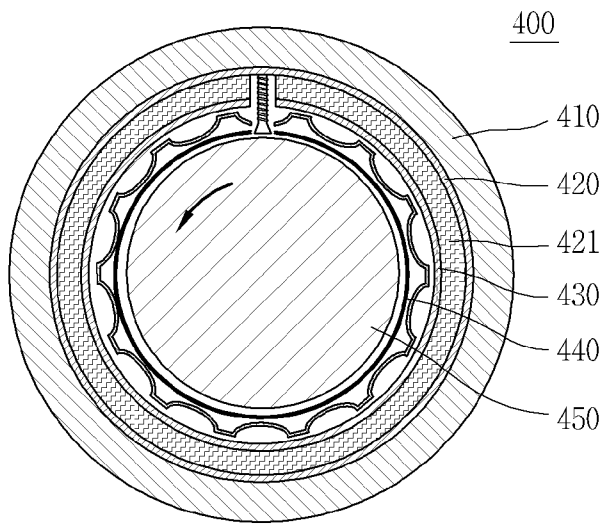
[Fig. 7]



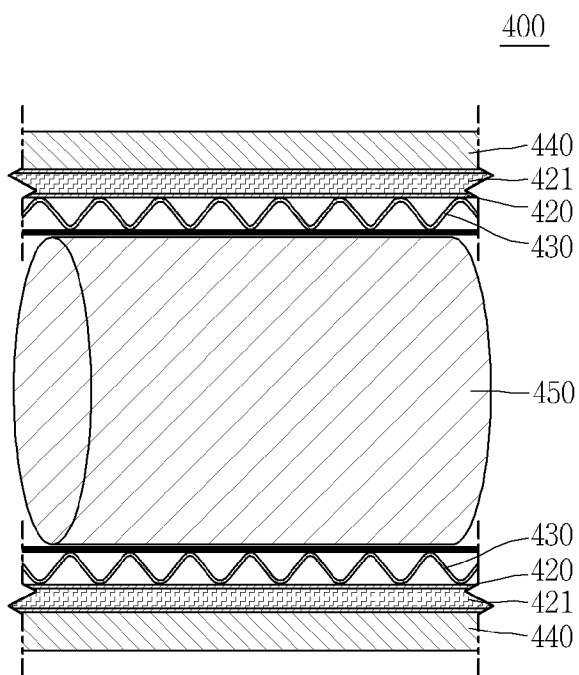
[Fig. 8]



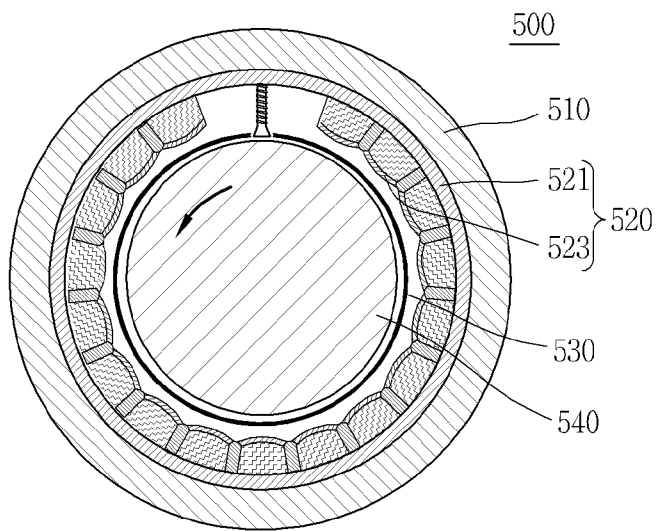
[Fig. 9]



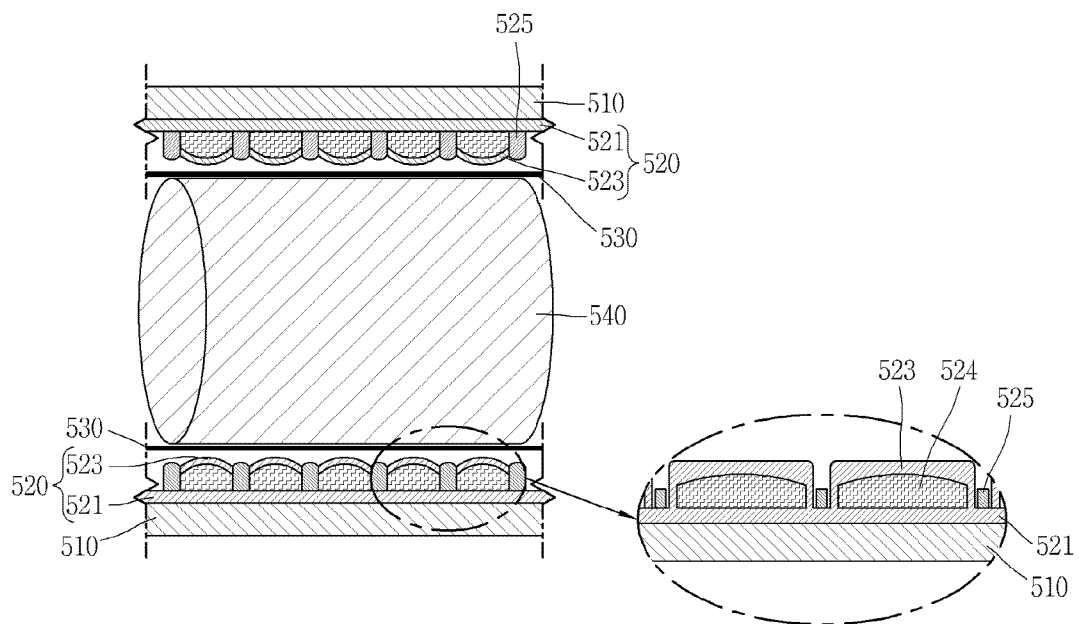
[Fig. 10]



[Fig. 11]



[Fig. 12]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2016/002932**A. CLASSIFICATION OF SUBJECT MATTER****F16C 17/02(2006.01)i, F16C 27/02(2006.01)i, F16C 33/02(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)

F16C 17/02; H02K 7/09; C23C 2/00; F01D 5/06; F16C 3/02; F16C 27/06; F16C 13/02; F16C 32/06; F16C 27/02; F16C 33/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: gas foil, journal, bearing, foil, fiber, housing, alleviate, impact, spongy, viscoelastic material, bearing cylinder, knot, cell and damp

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2006-0043605 A (DAIDO METAL CO., LTD.) 15 May 2006 See paragraphs [0061], [0072], [0080] and figures 5, 8.	1,3-4
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Y	JP 06-051264 U (NISSHIN STEEL CO., LTD.) 12 July 1994 See paragraph [0007] and figures 1-3.	1,3-4
Y	JP 09-014262 A (MITSUBISHI HEAVY IND LTD.) 14 January 1997 See paragraph [0021] and figures 1-3.	3-4
Y	JP 2001-132727 A (GENERAL ELECTRIC COMPANY) 18 May 2001 See paragraph [0009] and figures 1-4.	3-4
A	US 5519274 A (SCHARRER, JOSEPH K.) 21 May 1996 See column 3, line 6 - column 4, line 7 and figures 1-2.	1-9



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

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