US010947976B2

(12) United States Patent
Yano et al.

(10) Patent No.: US 10,947,976 B2
(45) Date of Patent: Mar. 16, 2021

(54) **SCREW COMPRESSOR**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 285 days.

(21) Appl. No.: **16/060,065**

(22) PCT Filed: **Nov. 15, 2016**

(86) PCT No.: **PCT/JP2016/083831**
§ 371 (c)(1),
(2) Date: **Jun. 7, 2018**

(87) PCT Pub. No.: **WO2017/104334**
PCT Pub. Date: **Jun. 22, 2017**

(65) **Prior Publication Data**
US 2018/0355867 A1 Dec. 13, 2018

(30) **Foreign Application Priority Data**
Dec. 17, 2015 (JP) JP2015-246281

(51) **Int. Cl.**
F04C 29/00 (2006.01)
F04C 18/16 (2006.01)
F04C 23/00 (2006.01)

(52) **U.S. Cl.**
CPC ***F04C 29/005*** (2013.01); ***F04C 18/16*** (2013.01); ***F04C 29/0085*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC F04C 18/16–18; F04C 23/001–003; F04C 23/02; F04C 29/005; F04C 29/0085;
(Continued)

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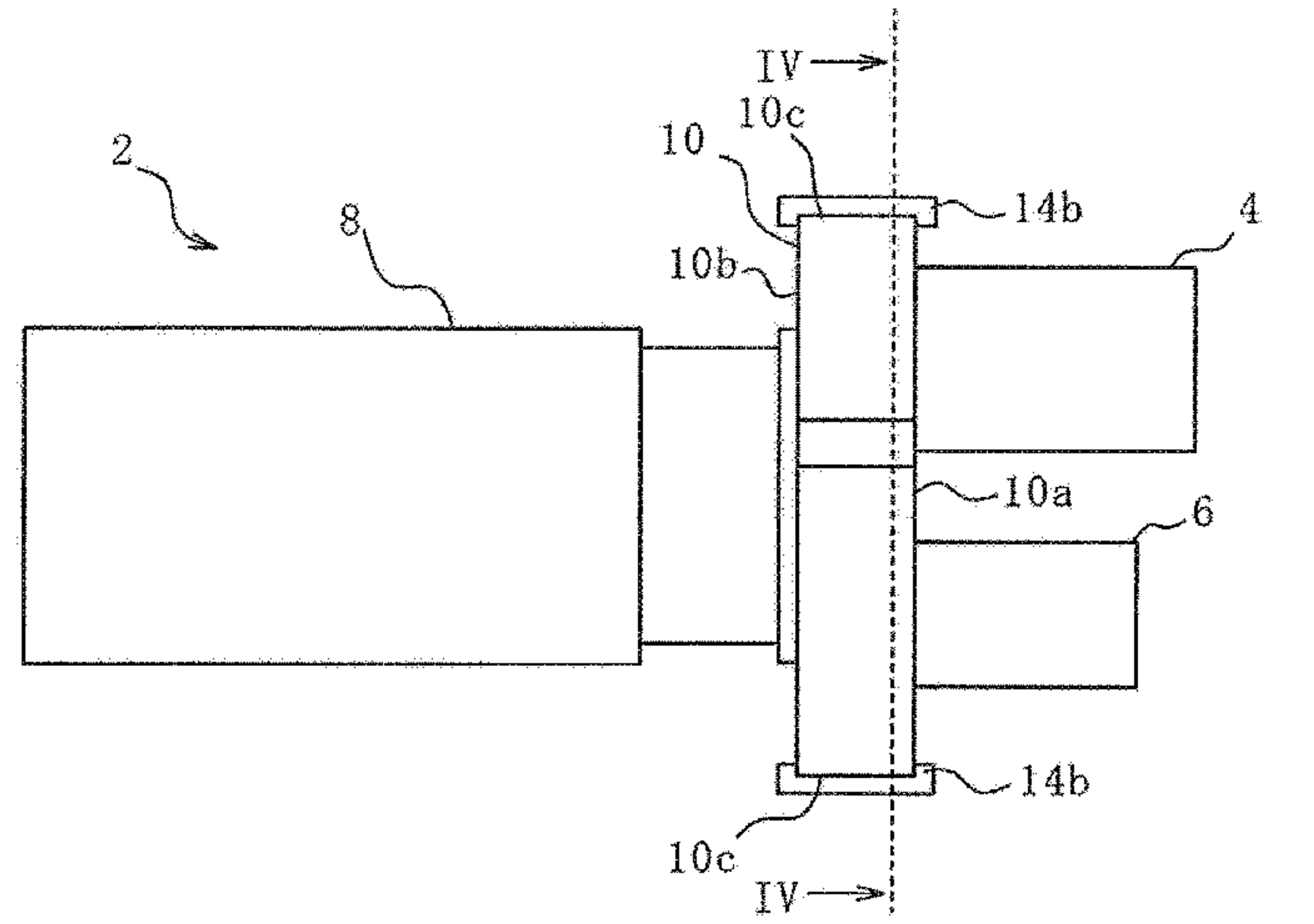
(57) **ABSTRACT**

The screw compressor includes a first-stage compressor main body and a second-stage compressor main body for compressing fluid with screw rotors, a motor for driving the first-stage compressor main body and the second-stage compressor main body, and a gear box. The gear box is connected to the first-stage compressor main body, the second-stage compressor main body, and the motor; transmits a driving force of the motor to the screw rotors, and includes a first attachment hole for attaching the first-stage compressor main body and a second attachment hole for attaching the second-stage compressor main body; and is provided with an annular rib surrounding both of the first attachment hole and the second attachment hole. In the screw compressor, the vibration of the natural vibration mode which is most burdensome and should be reduced can be efficiently reduced.

11 Claims, 4 Drawing Sheets



(52) **U.S. Cl.**
CPC *F04C 23/001* (2013.01); *F04C 2210/1005* (2013.01); *F04C 2270/12* (2013.01)

(58) **Field of Classification Search**
CPC F04C 2210/1005; F04C 2270/12; F04C 2270/125; F01C 21/007–008
USPC 418/9, 10, 197, 205
See application file for complete search history.

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Fig. 1

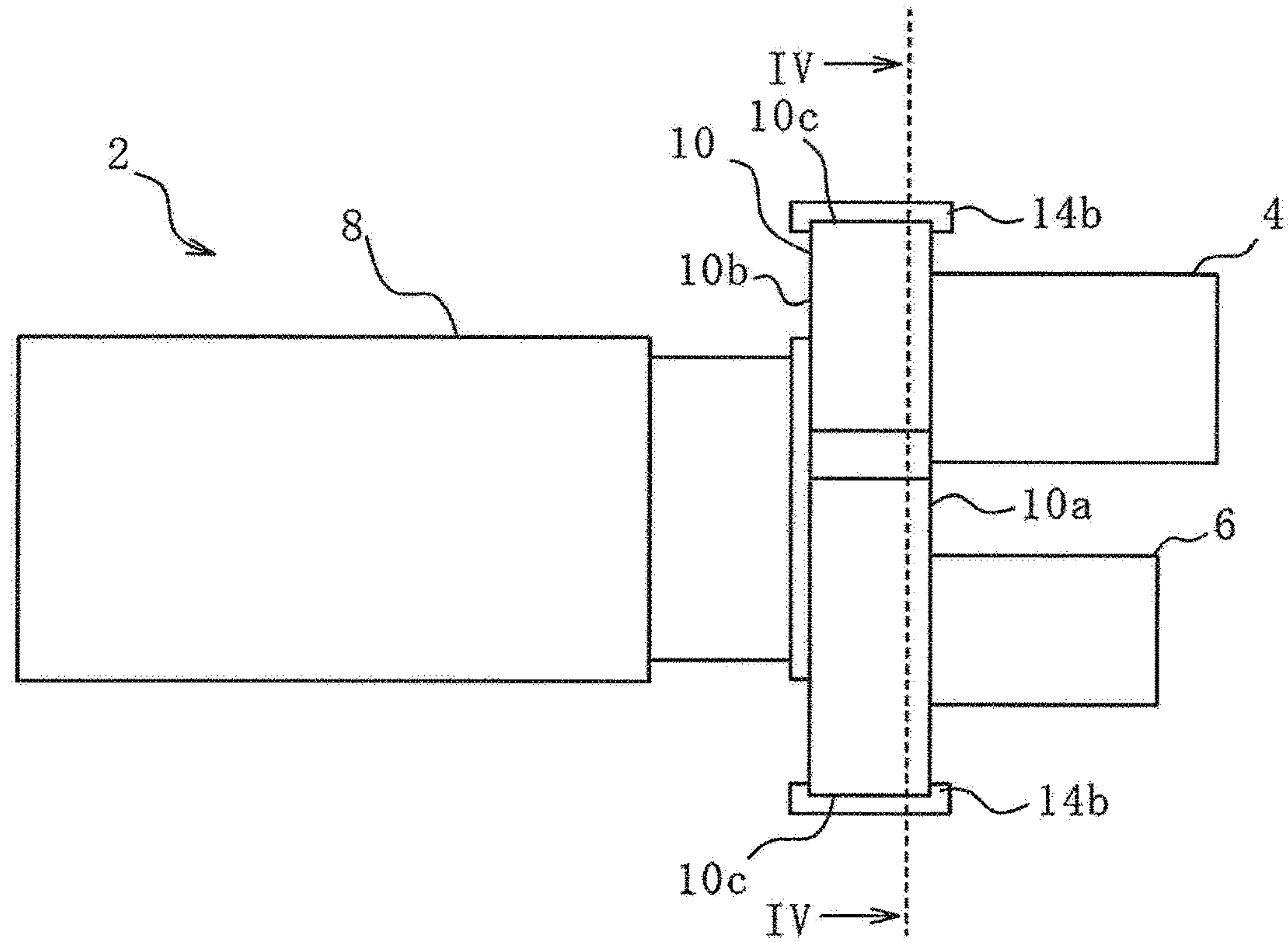

IV
10c
10
2
8
14b
4
10b
10a
6
14b
10c
IV

Fig. 2

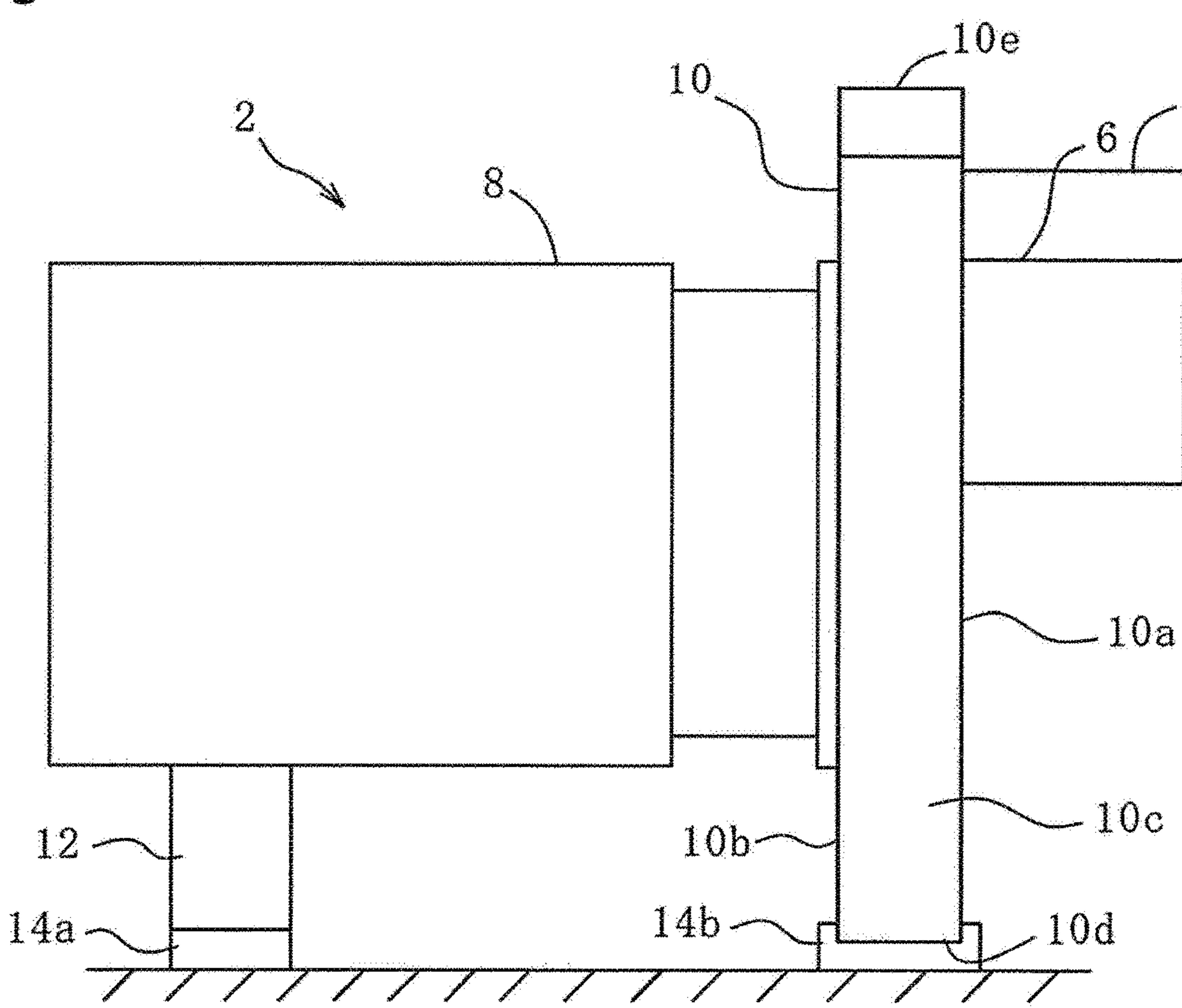
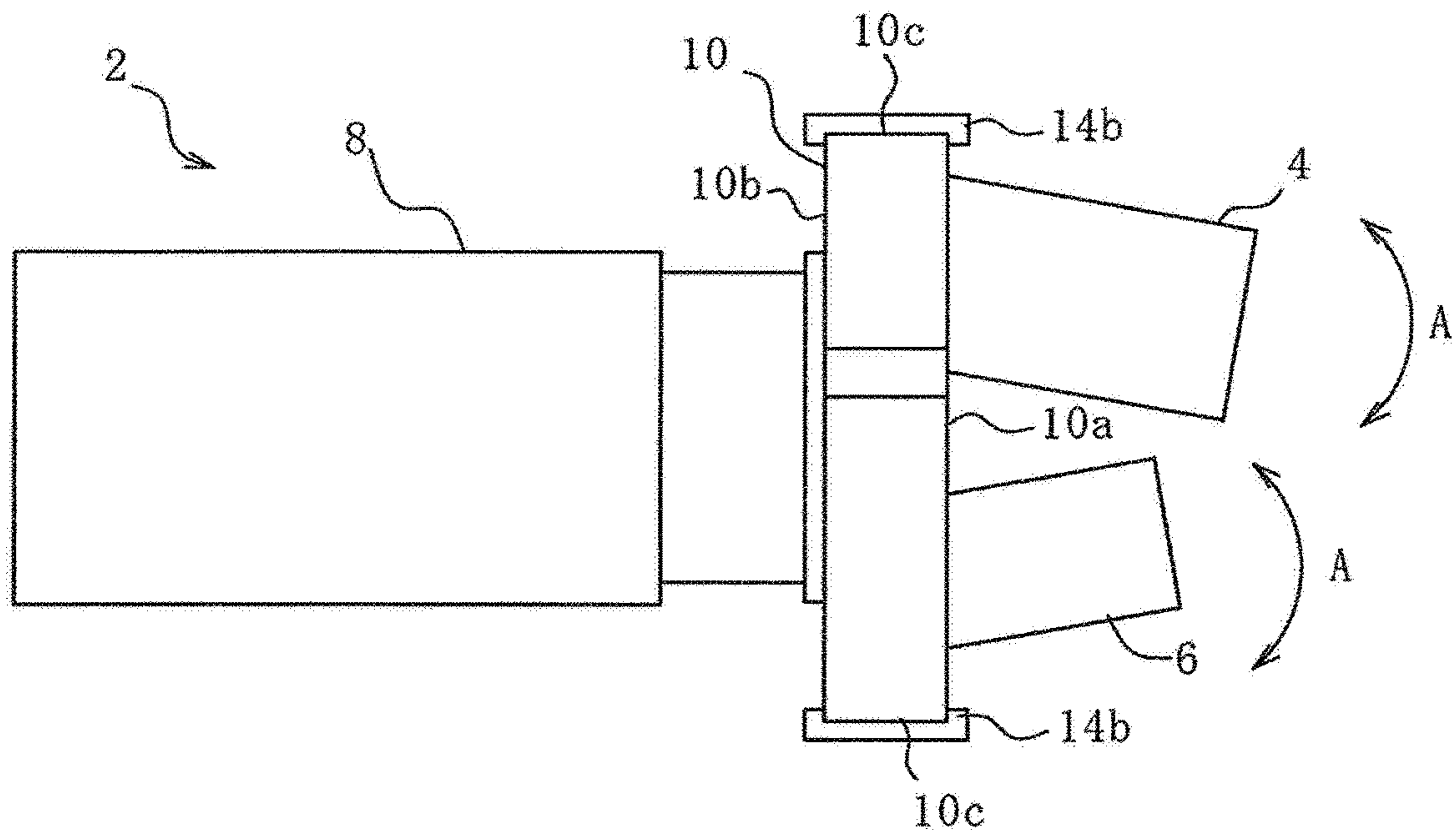
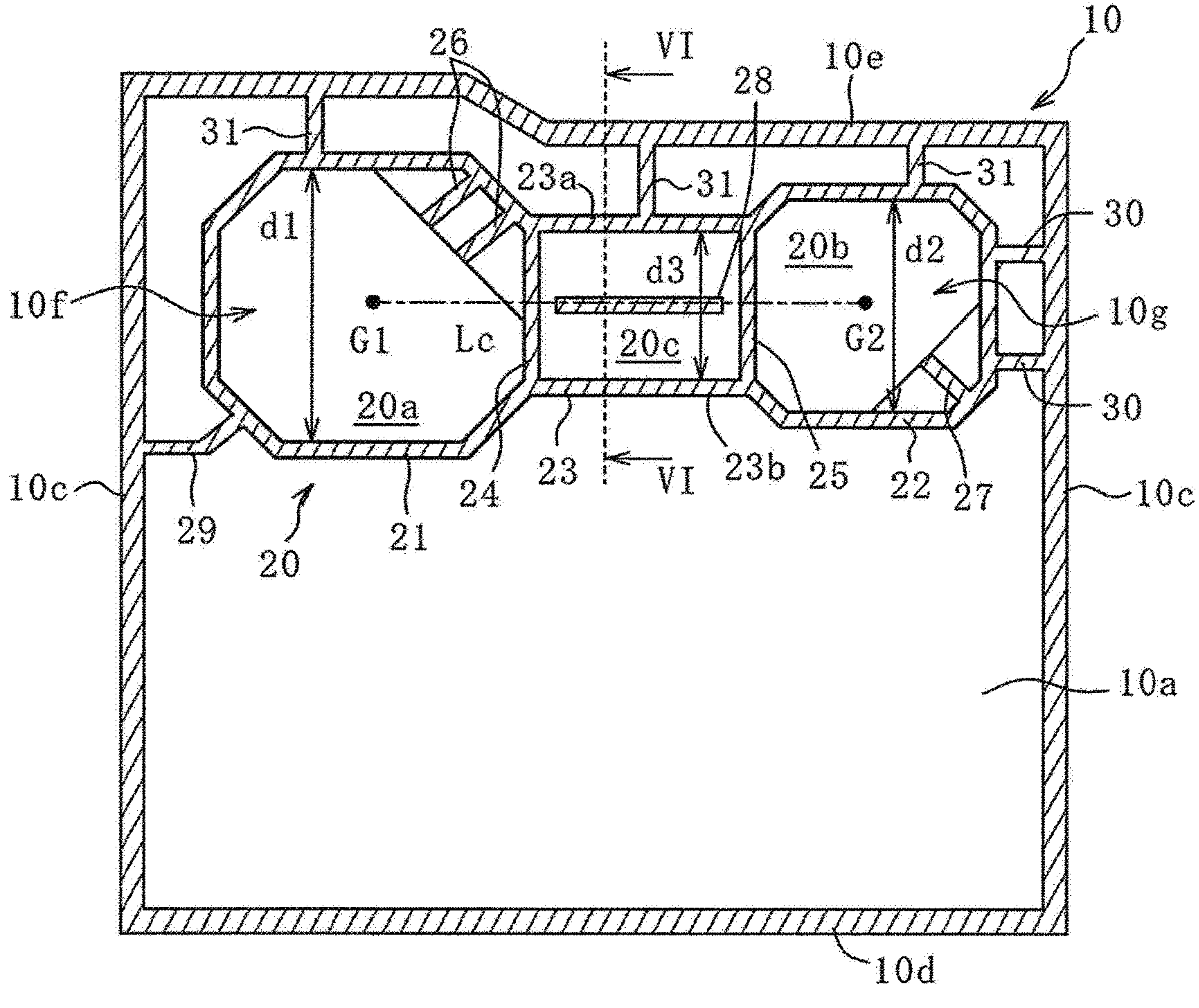

10e
10
4
6
2
8
10a
10c
12
10b
14a
14b
10d

Fig.3



2
8
10
10c
14b
10b
4
A
10a
A
6
14b
10c

Fig.4



26
VI
10e
10
28
31
23a
31
31
30
d1
d3
20b
d2
10f
10g
G1
Lc
20c
G2
20a
30
10c
23
VI
23b
25
22
27
10c
29
21
24
20
10a
10d

Fig.5

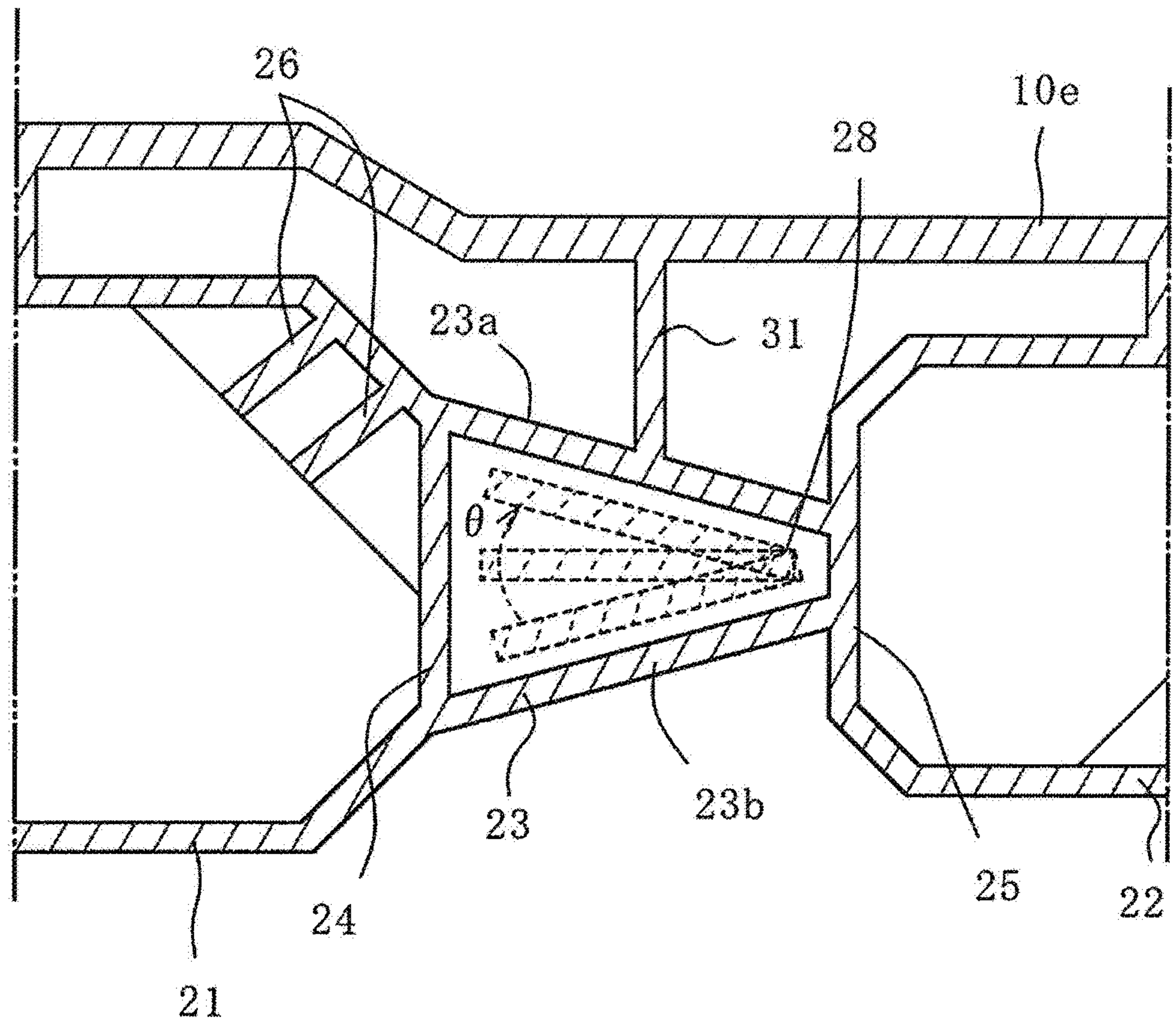

26
10e
28
23a
31
θ
23
23b
24
25
22
21

Fig.6

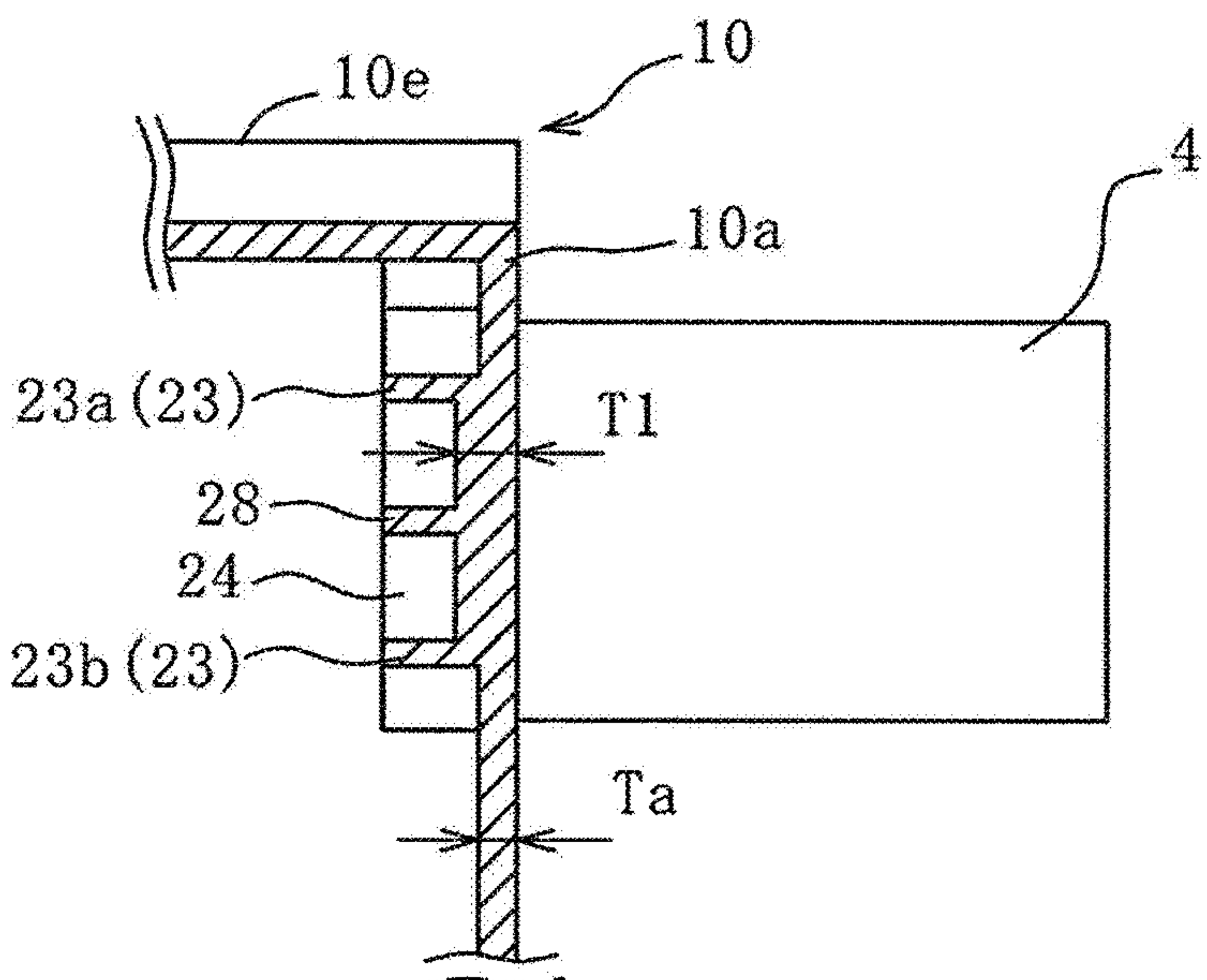
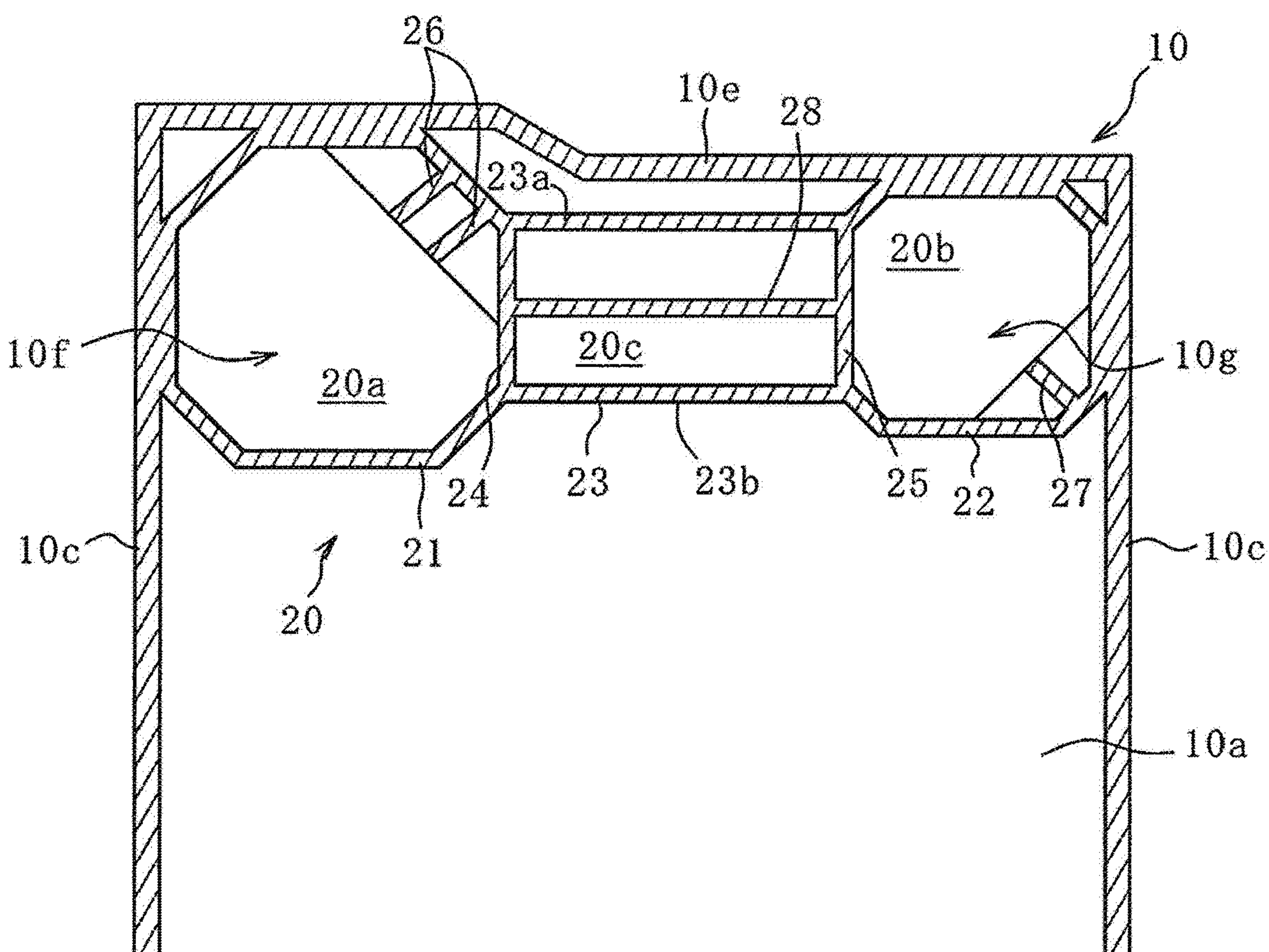

10e
10
4
10a
23a (23)
T1
28
24
23b (23)
Ta

Fig.7



26
10
10e
28
23a
20b
10f
20c
20a
10g
24
23
23b
25
22
27
21
10c
10c
20
10a
10d

SCREW COMPRESSOR

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a national phase application in the United States of International Patent Application No. PCT/JP2016/083831 with an international filing date of Nov. 15, 2016, which claims priority of Japanese Patent Application No. 2015-246281 filed on Dec. 17, 2015 the contents of which are incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to a screw compressor.

BACKGROUND ART

Screw compressors are widely used as supply sources of high pressure air in factories and the like. The screw compressor includes a motor, a gear box, and a compressor main body. Power from the motor is transmitted to the compressor main body via gears in the gear box. The transmitted power rotates screw rotors in the compressor main body to compress fluid such as air. At this time, the screw rotors rotate at high speed with both ends supported by bearings. Therefore, bearings are required to be designed to be resistant to breakage, and it is preferable that the vibration of the bearing portion is as small as possible.

In addition, the compressor main body and the gear box have a plurality of natural frequencies. When the natural frequency and the rotational speed of the compressor main body coincide, a resonance phenomenon occurs, and the vibration of the bearing portion of the compressor main body increases. In order to prevent the increase in vibration, it is preferable to set the natural frequency to be outside the rotational speed range of the compressor main body. However, it is practically impossible to avoid all of the plurality of natural frequencies from the rotational speed range of the compressor main body. Therefore, as for the natural frequency which cannot be avoided, it is preferable to perform design so that the vibration during resonance is made as small as possible.

For example, JP H10-318159 A discloses a compressor for reducing the vibration to be transmitted by a gear box with the structure of the gear box (coupling piece).

SUMMARY OT THE INVENTION

Problems to be Solved by the Invention

In the compressor described in JP H10-318159 A, the natural vibration mode is not studied in detail, and efficient vibration reduction is not achieved.

An object of the present invention is to efficiently reduce the vibration of a screw compressor.

Means for Solving the Problems

As a result of various experiments and analyses on the vibration of a screw compressor, the inventor of the present invention specified a natural vibration mode in which the vibration is conspicuous among a plurality of natural vibration modes (hereinafter referred to as a "specific natural vibration mode"). Specifically, the specific natural vibration mode is a vibration mode in the horizontal direction in which the first stage compressor main body and the second stage

compressor main body repeat approaching and separating. The present invention is based on this new knowledge.

The present invention provides a screw compressor comprising: a first-stage compressor main body and a second-stage compressor main body respectively configured to compress fluid with screw rotors; an electric motor configured to drive the first-stage compressor main body and the second-stage compressor main body; and a gear box connected to the first-stage compressor main body, the second-stage compressor main body, and the electric motor, configured to transmit a driving force of the electric motor to the screw rotors, including a first attachment hole for attaching the first-stage compressor main body and a second attachment hole for attaching the second-stage compressor main body, provided with an annular rib surrounding both of the first attachment hole and the second attachment hole.

According to the above configuration, the vibration in the specific natural vibration mode can be efficiently reduced. Specifically, providing an annular rib around a first attachment hole and a second attachment hole of the gear box to improve the rigidity against the specific natural vibration mode allows the screw compressor to be reduced in vibration and to be made resistant to breakage.

The annular rib includes: a first rib region being a portion provided around the first attachment hole, a second rib region being a portion provided around the second attachment hole, and a third rib region being a region between the first rib region and the second rib region, wherein a maximum space in a vertical direction between an upper portion and a lower portion of a first rib portion constituting the first rib region is a first space, wherein a maximum space in a vertical direction between an upper portion and a lower portion of a second rib portion constituting the second rib region is a second space, wherein a maximum space in a vertical direction between an upper portion and a lower portion of a third rib portion constituting the third rib region is a third space. Preferably, the third space is not more than the first space and not more than the second space, a central upper rib being a rib on an upper side of the third rib portion is arranged above an imaginary center line connecting a center of the first attachment hole and a center of the second attachment hole, and a central lower rib being a rib on a lower side of the third rib portion is arranged below the imaginary center line.

Since the third space is not more than the first space and not more than the second space, the rigidity against the specific natural vibration mode of the third rib portion can be improved and the vibration of the specific natural vibration mode can be suppressed. This is because a comparison of when the third space is wide and when the third space is narrow shows that the rigidity against the specific natural vibration mode improves when the third space is narrow. In addition, since the central upper rib is arranged above the imaginary center line and the central lower rib is arranged below the imaginary center line, the rib arrangement in the vertical direction can be balanced, and the torsion on the attachment surfaces of the first-stage compressor main body and the second-stage compressor main body of the gear box can be suppressed. It should be noted that the center of the attachment hole means the position of the center of gravity of a mass body when the mass body having a uniform density is filled in the attachment hole.

Preferably, a plate thickness of the gear box between the central upper rib and the central lower rib is larger than an average value of plate thicknesses of other portions of the gear box.

Since the portion of the gear box between the central upper rib and the central lower rib has an amount of deformation larger than other portions of the gear box in the vibration of the specific natural vibration mode, increasing the plate thickness of this portion allows the rigidity against the specific natural vibration mode to be improved and the vibration of the specific natural vibration mode to be suppressed.

Preferably, the screw compressor further comprises a fourth rib portion connecting a connection portion between the first rib portion and the central upper rib and a connection portion between the first rib portion and the central lower rib, and a fifth rib portion connecting a connection portion between the second rib portion and the central upper rib and a connection portion between the second rib portion and the central lower rib.

Providing the fourth rib portion and the fifth rib portion causes the rigidity around the first attachment hole and the second attachment hole to be improved and the rigidity against the specific natural vibration mode to be improved, and allows the rigidity against the torsion on the attachment surfaces of the first-stage compressor main body and the second-stage compressor main body to be also improved. Therefore, both vibration of the specific natural vibration mode and torsion can be suppressed.

Preferably the screw compressor further comprises a sixth rib portion connecting an outer periphery of the first attachment hole and the first rib portion or the fourth rib portion. Further, it is preferable that the screw compressor comprises a seventh rib portion connecting an outer periphery of the second attachment hole and the second rib portion or the fifth rib portion.

Providing the sixth rib portion and the seventh rib portion allows the rigidity around the first attachment hole and the second attachment hole and the rigidity against the torsion on the attachment surfaces of the first-stage compressor main body and the second-stage compressor main body to be improved. Therefore, both vibration of the specific natural vibration mode and torsion can be suppressed.

Preferably, the screw compressor further comprises, between the central upper rib and the central lower rib, an eighth rib portion extending along the central upper rib or the central lower rib, or extending along the central lower rib within a range of an angle formed between the central upper rib and the central lower rib.

Providing the eighth rib portion allows the rigidity against the specific natural vibration mode to be improved and the vibration of the specific natural vibration mode to be suppressed.

A part of the first rib portion may be integral with the side wall of the gear box. In addition, a part of the second rib portion may be integral with the side wall of the gear box. In addition, a part of the first rib portion, a part of the second rib portion, or a part of the central upper rib may be integral with the top plate of the gear box.

Since a part of the first rib portion and a part of the second rib portion are integral with the side wall of the gear box, the rigidity of the first rib portion and the second rib portion can be improved. In addition, integrating a part of the upper portion of the annular rib with the top plate of the gear box allows the rigidity of the upper portion of the annular rib to be improved, and the rigidity against the specific natural vibration mode to be improved. Therefore, both vibration of the specific natural vibration mode and torsion can be suppressed.

Preferably, the screw compressor further comprises a ninth rib portion connecting the first rib portion and a side wall of the gear box. Further, it is preferable that the screw compressor further comprise a tenth rib portion connecting the second rib portion and a side wall of the gear box.

Providing the ninth rib portion and the tenth rib portion allows the first rib portion and the second rib portion to be connected to the side wall of the gear box, and the rigidity of the first rib portion and the second rib portion to be improved. In addition, providing the eleventh rib portion allows at least one of the first rib portion, the second rib portion, and the third rib portion to be connected to the top plate of the gear box, and the rigidity of the annular rib to be improved. Therefore, both vibration of the specific natural vibration mode and torsion can be suppressed.

It is preferable that the height of the annular rib is larger than the average value of the plate thickness of the gear box.

Concretely specifying the height of the rib to not less than a certain value allows improvement in rigidity to be concretely achieved, and specifying the minimum value of the height of the rib allows the minimum rigidity to be secured.

According to the present invention, in a screw compressor, providing an annular rib around a first attachment hole and a second attachment hole of the gear box to improve the rigidity against the specific natural vibration mode allows the vibration to be efficiently reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a plan view of a screw compressor according to a first embodiment of the present invention;

FIG. **2** is a side view of the screw compressor of FIG. **1**;

FIG. **3** is a schematic view showing a specific natural vibration mode of the screw compressor of FIG. **2**;

FIG. **4** is a sectional view of the screw compressor of FIG. **1** taken along a line IV-IV;

FIG. **5** is a sectional view of a modified example of the eighth rib portion shown in FIG. **4**;

FIG. **6** is a sectional view of sectional view of the screw compressor of FIG. **4** taken along a line VI-VI; and

FIG. **7** is a sectional view of a screw compressor according to a second embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

In the following, embodiments of the present invention will be described with reference to the accompanying drawings.

First Embodiment

Referring to FIGS. **1** and **2**, a screw compressor **2** according to the present embodiment includes a first-stage compressor main body **4**, a second-stage compressor main body **6**, a motor (electric motor) **8**, and a gear box **10**.

The first-stage compressor main body **4** and the second-stage compressor main body **6** are attached to the gear box **10**, and each of them includes inside a pair of male and female screw rotors (not shown). The screw rotors receive a driving force from the motor **8** via gears (not shown) arranged inside the gear box **10** to be driven. The discharge port of the first-stage compressor main body **4** and the intake port of the second-stage compressor main body **6** are fluidly connected with piping (not shown). The air is sucked and compressed by the first-stage compressor main body **4**, supplied to the second-stage compressor main body **6**, further compressed by the second-stage compressor main body **6**, and then discharged.

The motor **8** is installed on the floor surface via a support member **12** and a rubber vibration insulator **14***a* in a state of being attached to the gear box **10**. The motor **8** drives the first-stage compressor main body **4** and the second-stage compressor main body **6** as described above.

The gear box **10** is a box closed with a front wall **10***a*, a rear wall **10***b*, two side walls **10***c* and **10***c*, a bottom plate **10***d*, and a top plate **10***e*. The rear wall **10***b* is provided with a motor attachment hole (not shown) for attaching the motor **8**. The front wall **10***a* is provided with a first attachment hole **10***f* for attaching the first-stage compressor main body **4** and a second attachment hole **10***g* for attaching the second-stage compressor main body **6** (see FIG. **4**). The gear box **10** is installed on the floor surface with two rubber vibration insulators **14***b* attached under the bottom plate **10***d*.

Usually, when a driving force is transmitted from the motor **8** to the first-stage compressor main body **4** and the second-stage compressor main body **6** attached to the gear box **10**, the first-stage compressor main body **4** and the second-stage compressor main body **6** vibrate with a plurality of natural vibration modes. Among the plurality of natural vibration modes, there is a mode particularly burdensome to the screw compressor **2**. It is preferable to reduce the vibration of this burdensome mode for improving the durability.

As a result of various experiments and analyses, the inventor of the present invention specified a natural vibration mode in which the vibration is conspicuous among a plurality of natural vibration modes (hereinafter referred to as a "specific natural vibration mode"). Specifically, as shown in FIG. **3**, the specific natural vibration mode is a vibration mode in the horizontal direction in which the first-stage compressor main body **4** and the second-stage compressor main body **6** repeat approaching and separating (see arrow A). The present invention is based on this new knowledge.

Referring to FIG. **4**, in the screw compressor **2** according to the present embodiment, ribs are provided in efficient arrangements on the inner surface of the front wall **10***a* of the gear box **10** in order to suppress the vibration of the specific natural vibration mode (see FIG. **3**). Hereinafter, the arrangement of the ribs will be described in detail.

On the inner surface of the front wall **10***a* of the gear box **10**, an annular rib **20** surrounding the first attachment hole **10***f* and the second attachment hole **10***g* is provided around the first attachment hole **10***f* and the second attachment hole **10***g*. The width of the annular rib **20** is about the average value of the plate thickness of the front wall **10***a* and the height is somewhat larger than the average value of the plate thickness of the front wall **10***a*. The shape of the annular rib **20** is not particularly limited and only has to surround the first attachment hole **10***f* and the second attachment hole **10***g*, but it is preferable to form the annular rib **20** in the vicinity of the first attachment hole **10***f* and the second attachment hole **10***g*.

According to the above configuration, the vibration in the specific natural vibration mode can be efficiently reduced. Specifically, since the annular rib **20** is provided around the first attachment hole **10***f* and the second attachment hole **10***g* of the gear box **10** to improve the rigidity against the specific natural vibration mode, the screw compressor **2** can be reduced in vibration and can be made resistant to breakage. In addition, concretely specifying the height of the annular rib **20** to not less than a certain value allows improvement in rigidity to be concretely achieved, and specifying the minimum value of the height of the annular rib **20** (average value of the plate thickness of the front wall **10***a*) allows the minimum rigidity to be secured.

The annular rib **20** is divided into a first rib region **20***a*, a second rib region **20***b*, and a third rib region **20***c*. The first rib region **20***a* is a portion provided around the first attachment hole **10***f* and includes a first rib portion **21**. The second rib region **20***b* is a portion provided around the second attachment hole **10***g* and includes a second rib portion **22**. The third rib region **20***c* is a region between the first rib region **20***a* and the second rib region **20***b* and includes a third rib portion **23**. Assume that the space in the portion widest in the vertical direction between the upper and lower portions of the first rib portion **21** is a first space d**1**, the space in the portion widest in the vertical direction between the upper and lower portions of the second rib portion **22** is a second space d**2**, and the space in the portion widest in the vertical direction between the upper and lower portions of the third rib portion **23** is a third space d**3**, then, in the present embodiment, the third space d**3** is not more than the first space d**1** and not more than the second space d**2**. That is, the third space d**3** is the narrowest, and the annular rib **20** has a shape in which the central portion is narrowed.

In addition, an imaginary center line Lc connecting a center G**1** of the first attachment hole **10***f* and a center G**2** of the second attachment hole **10***g* is set. In this case, a central upper rib **23***a* being the rib on the upper side of the third rib portion **23** is arranged above the imaginary center line Lc, and a central lower rib **23***b* being the rib on the lower side of the third rib portion **23** is arranged below the imaginary center line Lc. That is, the imaginary center line Lc is arranged between the central upper rib **23***a* and the central lower rib **23***b*. In the present embodiment, the central upper rib **23***a* and the central lower rib **23***b* are formed in parallel.

The third space d**3** is narrower than the other spaces d**1** and d**2**, so that the rigidity against the specific natural vibration mode of the third rib portion **23** can be improved, and vibration in the specific natural vibration mode can be suppressed. This is because a comparison of when the third space d**3** is wide and when the third space d**3** is narrow shows that the rigidity against the specific natural vibration mode improves when the third space d**3** is narrow. In addition, since the central upper rib **23***a* is arranged above the imaginary center line Lc and the central lower rib **23***b* is arranged below the imaginary center line Lc, the rib arrangement in the vertical direction can be balanced, and the torsion in the front wall **10***a* of the gear box **10** can be suppressed.

Referring to FIG. **6**, a plate thickness T**1** of the front wall **10***a* of the gear box **10** between the central upper rib **23***a* and the central lower rib **23***b* is formed to be thicker than an average value Ta of the plate thickness of the other portions of the gear box **10**. In order to increase the plate thickness T**1** of the portion of the front wall **10***a*, the portion may be patched with a different plate-shaped member. In the present embodiment, the plate thickness T**1** of the portion of the front wall **10***a* is formed about 1.2 to 2.0 times thicker than the average value Ta of the plate thickness of the other portions, but the numerical value is not limited.

Since the portion of the front wall **10***a* of the gear box **10** between the central upper rib **23***a* and the central lower rib **23***b* has an amount of deformation larger than the other portions of the front wall **10***a* of the gear box **10** in the vibration of the specific natural vibration mode, increasing the plate thickness of this portion allows the rigidity against the specific natural vibration mode to be improved and the vibration of the specific natural vibration mode to be suppressed.

As shown together in FIGS. **4** and **6**, the inner surface of the front wall **10***a* of the gear box **10** is provided with a fourth rib portion **24** connecting the connection portion of the first rib portion **21** and the central upper rib **23***a*, and the connection portion of the first rib portion **21** and the central lower rib **23***b*. In addition, the inner surface of the front wall **10***a* of the gear box **10** is provided with a fifth rib portion **25** connecting the connection portion of the second rib portion **22** and the central upper rib **23***a*, and the connection portion of the second rib portion **22** and the central lower rib **23***b*.

Providing the fourth rib portion **24** and the fifth rib portion **25** causes the rigidity around the first attachment hole **10***f* and the second attachment hole **10***g* to be improved and the rigidity against the specific natural vibration mode to be improved, and allows the rigidity against torsion in the front wall **10***a* to be also improved. Therefore, both vibration of the specific natural vibration mode and torsion can be suppressed.

In addition, the inner surface of the front wall **10***a* of the gear box **10** is provided with a sixth rib portion **26** connecting the outer periphery of the first attachment hole **10***f* and the first rib portion **21**. Furthermore, the inner surface of the front wall **10***a* of the gear box **10** is provided with a seventh rib portion **27** connecting the outer periphery of the second attachment hole **10***g* and the second rib portion **22**. In the present embodiment, two sixth rib portions **26** are provided and one seventh rib portion **27** is provided, but the number thereof is not particularly limited. In addition, the sixth rib portion **26** may connect the outer periphery of the first attachment hole **10***f* and the fourth rib portion **24**, and the seventh rib portion **27** may connect the outer periphery of the second attachment hole **10***g* and the fifth rib portion **25**.

Providing the sixth rib portion **26** and the seventh rib portion **27** allows the rigidity around the first attachment hole **10***f* and the second attachment hole **10***g* and the rigidity against torsion in the front wall **10***a* to be improved. Therefore, both vibration of the specific natural vibration mode and torsion can be suppressed.

In addition, the inner surface of the front wall **10***a* of the gear box **10** is provided with an eighth rib portion **28** extending along the central upper rib **23***a* and the central lower rib **23***b* between the central upper rib **23***a* and the central lower rib **23***b*. In the present embodiment, since the central upper rib **23***a* and the central lower rib **23***b* are formed in parallel, the eighth rib portion **28** extends along both of them. However, as shown in FIG. **5**, when the central upper rib **23***a* and the central lower rib **23***b* are not formed in parallel, the eighth rib portion **28** only has to extend along at least one of the central upper rib **23***a* and the central lower rib **23***b* as indicated by broken lines. Alternatively, the eighth rib portion **28** may extend at an angle within an angle θ formed between the central upper rib **23***a* and the central lower rib **23***b* with respect to the central lower rib **23***b*.

Providing the eighth rib portion **28** allows the rigidity against the specific natural vibration mode to be improved and the vibration of the specific natural vibration mode to be suppressed.

In addition, the inner surface of the front wall **10***a* of the gear box **10** is provided with a ninth rib portion **29** connecting the first rib portion **21** and the side wall **10***c* of the gear box **10**. Furthermore, the gear box **10** is provided with a tenth rib portion **30** connecting the second rib portion **22** and the side wall **10***c* of the gear box **10**. In the present embodiment, one ninth rib portion **29** is provided and two tenth rib portions **30** are provided, but the number thereof is not particularly limited. In addition, in order to shorten the length of the rib, it is preferable that the ninth rib portion **29** connects the left side portion of the first rib portion **21** and the side wall **10***c* of the gear box **10** in FIG. **4**. Similarly, it is preferable that the tenth rib portion **30** connects the right side portion of the second rib portion **22** and the side wall **10***c* of the gear box **10** in FIG. **4**.

In addition, the gear box **10** is provided with respective three eleventh rib portions **31** connecting the first rib portion **21**, the second rib portion **22**, and the central upper rib **23***a* with the top plate **10***e* of the gear box **10**. In the present embodiment, three eleventh rib portions **31** are provided, but the number thereof is not limited, and at least one of the first rib portion **21**, the second rib portion **22**, and the central upper rib **23***a* only has to be connected with the top plate **10***e* of the gear box **10**.

Providing the ninth rib portion **29** and the tenth rib portion **30** allows the first rib portion **21** and the second rib portion **22** to be connected to the side wall **10***c* of the gear box **10**, and the rigidity of the first rib portion **21** and the second rib portion **22** to be improved. In addition, providing the eleventh rib portion **31** allows at least one of the first rib portion **21**, the second rib portion **22**, and the third rib portion **23** to be connected to the top plate **10***e* of the gear box **10**, and the rigidity of the annular rib **20** to be improved. Therefore, both vibration of the specific natural vibration mode and torsion can be suppressed.

Second Embodiment

In the screw compressor **2** of the second embodiment shown in FIG. **7**, a part of the first rib portion **21** and a part of the second rib portion **22** are integral with the top plate **10***e* and the side wall **10***c* of the gear box **10**. The present embodiment is substantially the same as the first embodiment in FIG. **4** except for this point. Therefore, description of parts similar to the configuration shown in FIGS. **1** to **6** will be omitted.

In the present embodiment, the ninth to eleventh rib portions **29** to **31** (see FIG. **4**) of the first embodiment are omitted, and a part of the first rib portion **21** and a part of the second rib portion **22** are integral with the top plate **10***e* and the side wall **10***c* of the gear box **10**. As a modification of the present embodiment, a part of the third rib portion **23** may be integral with the top plate **10***e* of the gear box **10**.

Since a part of the first rib portion **21** and a part of the second rib portion **22** are integral with the side wall **10***c* of the gear box **10**, the rigidity of the first rib portion **21** and the second rib portion **22** can be improved. In addition, integrating a part of the upper portion of the annular rib **20** with the top plate **10***e* of the gear box **10** allows the rigidity of the upper portion of the annular rib **20** to be improved, and the rigidity against the specific natural vibration mode to be improved. Therefore, both vibration of the specific natural vibration mode and torsion can be suppressed.

The invention claimed is:

1. A screw compressor comprising:

a first-stage compressor main body and a second-stage compressor main body respectively configured to compress fluid with screw rotors;

an electric motor configured to drive the first-stage compressor main body and the second-stage compressor main body; and

a gear box connected to the first-stage compressor main body, the second-stage compressor main body, and the electric motor, and configured to transmit a driving force of the electric motor to the screw rotors of the first-stage and second-stage compressor bodies, the gear box including a first attachment hole for attaching the first-stage compressor main body and a second attachment hole for attaching the second-stage compressor main body, and being provided with an annular rib surrounding an entire contour of the first attachment hole and an entire contour of the second attachment hole,

wherein the annular rib includes:

a first rib region being a portion provided around the first attachment hole,

a second rib region being a portion provided around the second attachment hole, and

a third rib region being a region between the first rib region and the second rib region,

wherein a maximum space in a vertical direction between an upper portion and a lower portion of a first rib portion constituting the first rib region is a first space,

wherein a maximum space in a vertical direction between an upper portion and a lower portion of a second rib portion constituting the second rib region is a second space,

wherein a maximum space in a vertical direction between an upper portion and a lower portion of a third rib portion constituting the third rib region is a third space,

wherein the third space is not more than the first space and not more than the second space,

wherein a central upper rib being a rib on an upper side of the third rib portion is arranged above an imaginary center line connecting a center of the first attachment hole and a center of the second attachment hole, and

wherein a central lower rib being a rib on a lower side of the third rib portion is arranged below the imaginary center line, and

wherein the screw compressor further comprises, between the central upper rib and the central lower rib, an additional rib portion extending along the central upper rib or the central lower rib, or extending along the central lower rib within a range of an angle formed between the central upper rib and the central lower rib.

2. The screw compressor according to claim **1**, wherein a plate thickness of the gear box between the central upper rib and the central lower rib is larger than an average value of plate thicknesses of other portions of the gear box.

3. The screw compressor according to claim **1**, wherein a part of the first rib portion is integral with a side wall of the gear box.

4. The screw compressor according to claim **1**, further comprising an additional rib portion connecting the first rib portion and a side wall of the gear box.

5. The screw compressor according to claim **1**, wherein a part of the second rib portion is integral with a side wall of the gear box.

6. The screw compressor according to claim **1**, further comprising an additional rib portion connecting the second rib portion and a side wall of the gear box.

7. The screw compressor according to claim **1**, wherein a part of the first rib portion, a part of the second rib portion, or a part of the central upper rib is integral with a top plate of the gear box.

8. The screw compressor according to claim **1**, further comprising an additional rib portion connecting the first rib portion, the second rib portion, or the central upper rib and a top plate of the gear box.

9. The screw compressor according to claim **1**, wherein a height of the annular rib is larger than an average value of a plate thickness of the gear box.

10. A screw compressor comprising:

a first-stage compressor main body and a second-stage compressor main body respectively configured to compress fluid with screw rotors;

an electric motor configured to drive the first-stage compressor main body and the second-stage compressor main body; and

a gear box connected to the first-stage compressor main body, the second-stage compressor main body, and the electric motor, and configured to transmit a driving force of the electric motor to the screw rotors of the first-stage and second-stage compressor bodies, the gear box including a first attachment hole for attaching the first-stage compressor main body and a second attachment hole for attaching the second-stage compressor main body, and being provided with an annular rib surrounding an entire contour of the first attachment hole and an entire contour of the second attachment hole,

wherein the annular rib includes:

a first rib region being a portion provided around the first attachment hole,

a second rib region being a portion provided around the second attachment hole, and

a third rib region being a region between the first rib region and the second rib region,

wherein a maximum space in a vertical direction between an upper portion and a lower portion of a first rib portion constituting the first rib region is a first space,

wherein a maximum space in a vertical direction between an upper portion and a lower portion of a second rib portion constituting the second rib region is a second space,

wherein a maximum space in a vertical direction between an upper portion and a lower portion of a third rib portion constituting the third rib region is a third space,

wherein the third space is not more than the first space and not more than the second space,

wherein a central upper rib being a rib on an upper side of the third rib portion is arranged above an imaginary center line connecting a center of the first attachment hole and a center of the second attachment hole, and

wherein a central lower rib being a rib on a lower side of the third rib portion is arranged below the imaginary center line, and

wherein the screw compressor further comprises:

a fourth rib portion connecting a connection portion between the first rib portion and the central upper rib and a connection portion between the first rib portion and the central lower rib,

a fifth rib portion connecting a connection portion between the second rib portion and the central upper rib and a connection portion between the second rib portion and the central lower rib, and

a sixth rib portion connecting an outer periphery of the first attachment hole and the first rib portion or the fourth rib portion.

11. The screw compressor comprising:

a first-stage compressor main body and a second-stage compressor main body respectively configured to compress fluid with screw rotors;

an electric motor configured to drive the first-stage compressor main body and the second-stage compressor main body; and

a gear box connected to the first-stage compressor main body, the second-stage compressor main body, and the electric motor, and configured to transmit a driving force of the electric motor to the screw rotors of the first-stage and second-stage compressor bodies, the gear box including a first attachment hole for attaching the first-stage compressor main body and a second attachment hole for attaching the second-stage compressor main body, and being provided with an annular rib surrounding an entire contour of the first attachment hole and an entire contour of the second attachment hole,

wherein the annular rib includes:

a first rib region being a portion provided around the first attachment hole,

a second rib region being a portion provided around the second attachment hole, and

a third rib region being a region between the first rib region and the second rib region,

wherein a maximum space in a vertical direction between an upper portion and a lower portion of a first rib portion constituting the first rib region is a first space,

wherein a maximum space in a vertical direction between an upper portion and a lower portion of a second rib portion constituting the second rib region is a second space,

wherein a maximum space in a vertical direction between an upper portion and a lower portion of a third rib portion constituting the third rib region is a third space,

wherein the third space is not more than the first space and not more than the second space,

wherein a central upper rib being a rib on an upper side of the third rib portion is arranged above an imaginary center line connecting a center of the first attachment hole and a center of the second attachment hole, and

wherein a central lower rib being a rib on a lower side of the third rib portion is arranged below the imaginary center line, and

wherein the screw compressor further comprises:

a fourth rib portion connecting a connection portion between the first rib portion and the central upper rib and a connection portion between the first rib portion and the central lower rib,

a fifth rib portion connecting a connection portion between the second rib portion and the central upper rib and a connection portion between the second rib portion and the central lower rib, and

an additional rib portion connecting an outer periphery of the second attachment hole and the second rib portion or the fifth rib portion.

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