US 20140301872A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2014/0301872 A1

(43) Pub. Date: Oct. 9, 2014

OKUNO et al.

(54) **COMPRESSOR**

(71) Applicant: **Kabushiki Kaisha Kobe Seiko Sho (Kobe Steel, Ltd.)**, Kobe-shi (JP)

(72) Inventors: **Takashi OKUNO**, Takasago-shi (JP); **Kenji Nagura**, Takasago-shi (JP)

(73) Assignee: **Kabushiki Kaisha Kobe Seiko Sho (Kobe Steel, Ltd.)**, Kobe-shi (JP)

(21) Appl. No.: **14/230,113**

(22) Filed: **Mar. 31, 2014**

(30) **Foreign Application Priority Data**

Apr. 8, 2013 (JP) 2013-080539

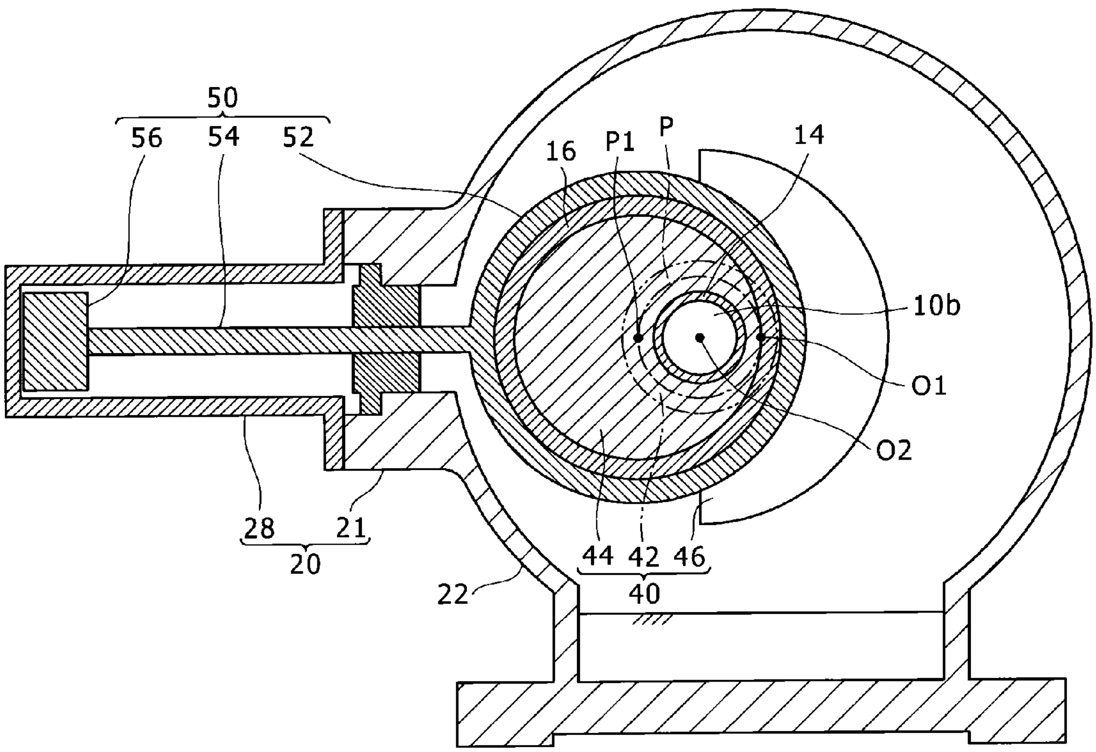
Publication Classification

(51) **Int. Cl.**
F04B 35/00 (2006.01)

(52) **U.S. Cl.**
CPC ***F04B 35/002*** (2013.01)
USPC **417/364**

(57) **ABSTRACT**

A compressor of the present invention includes a crank shaft, a bearing, a casing, an outer-race gear that is disposed so as to surround the crank shaft, a planetary gear that has a radius of a pitch circle set to a half of a radius of a pitch circle of the outer-race gear and causes the crank shaft to be inserted therethrough so that the planetary gear rotates relative to the crank shaft, a piston that is connected to the planetary gear so as to rotate relative to the planetary gear and moves in a reciprocating manner in the direction parallel to the radial direction of the outer-race gear inside the casing in a manner such that the planetary gear rotates inside the outer-race gear while engaging with the outer-race gear, and a pump that supplies lubricant to the bearing. Here, the pump is accommodated inside the casing.



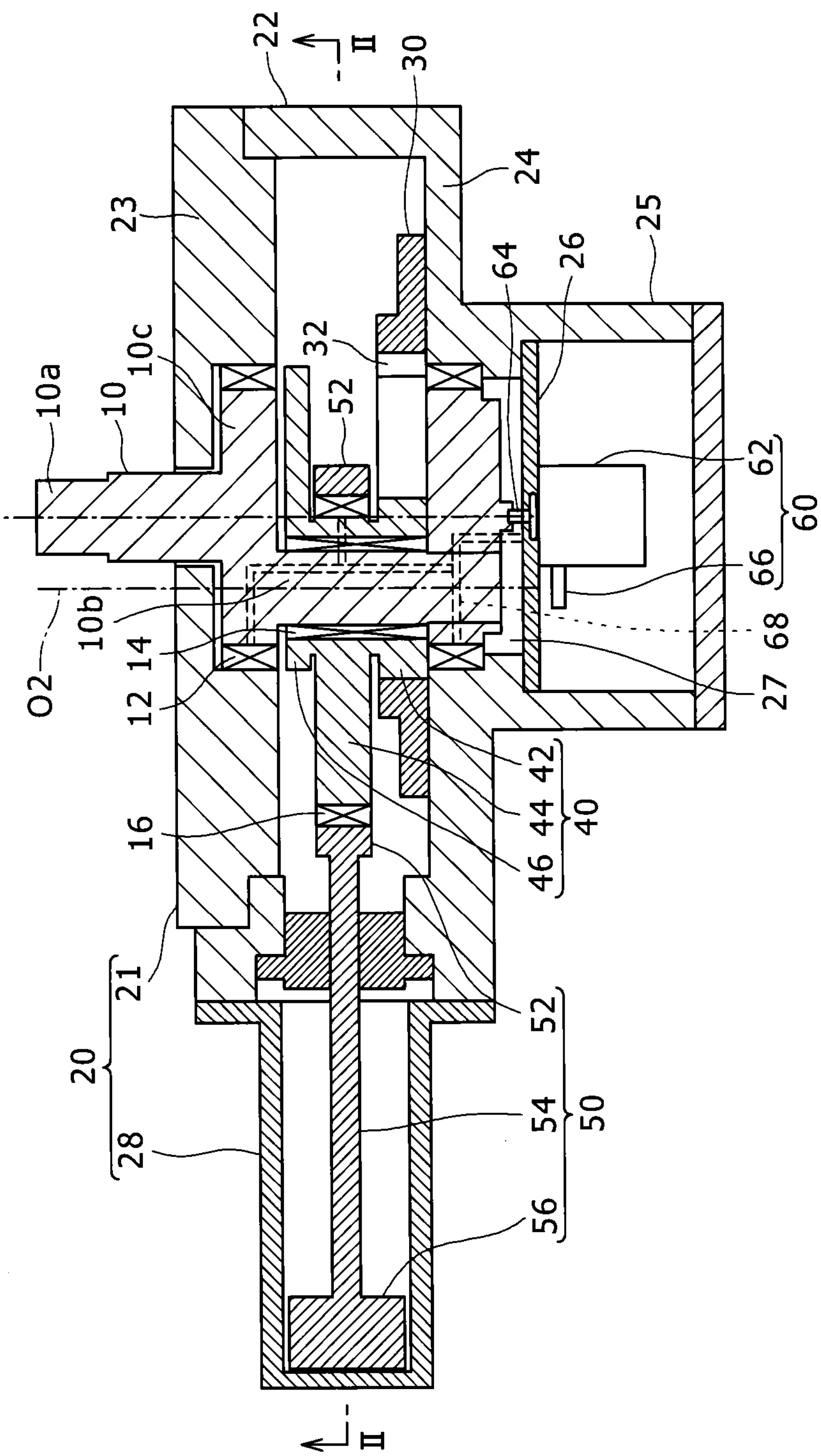

II
22
30
23
24
25
26
64
32
10c
10a
10
O1
52
62
60
66
68
27
10b
14
12
O2
42
44
40
16
46
21
52
20
28
54
50
56
II

FIG. 1

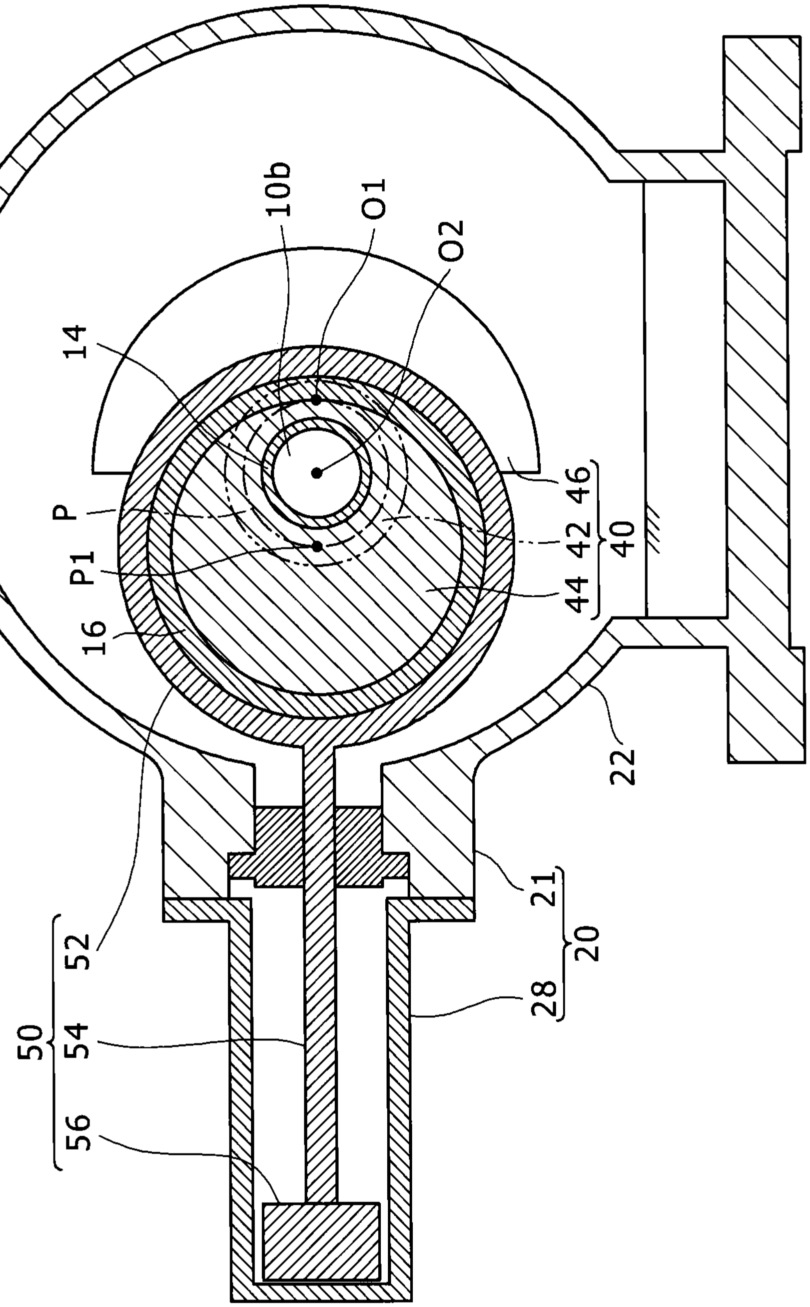
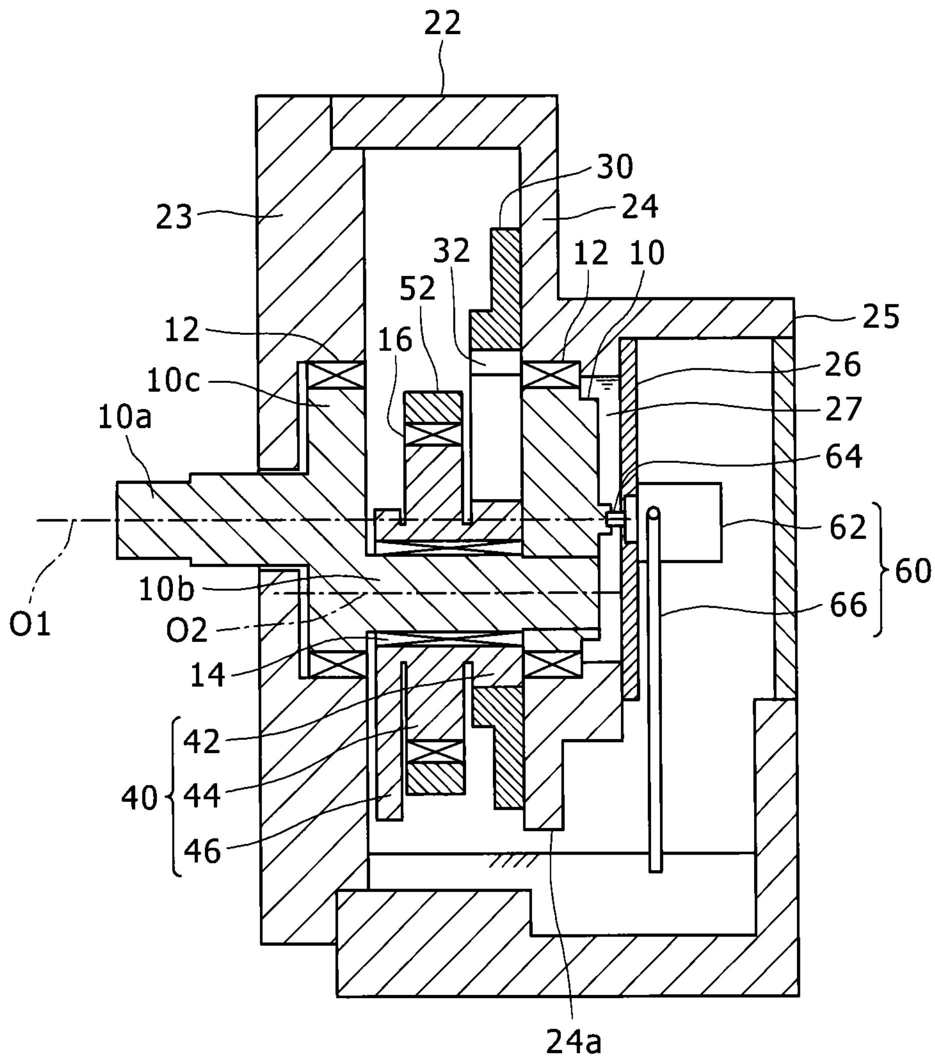


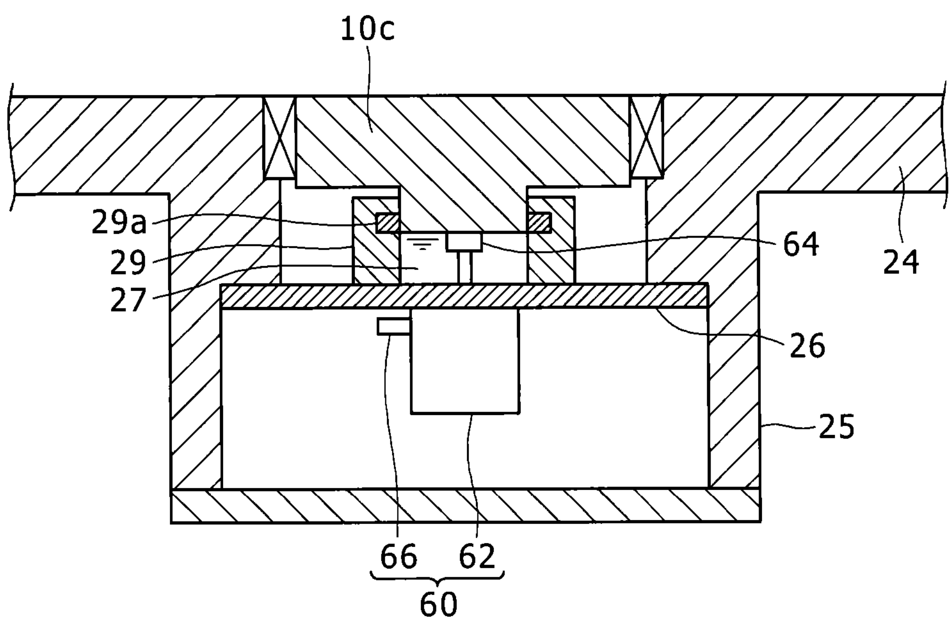
FIG. 2

FIG. 3



22
30
23
24
32
12
10
52
25
12
16
10c
26
27
10a
64
62
60
10b
O1
O2
66
14
42
40
44
46
24a

FIG. 4



COMPRESSOR

BACKGROUND OF THE INVENTION

[0001] 1. (Field of the Invention)

[0002] The present invention relates to a compressor.

[0003] 2. (Description of the Related Art)

[0004] Hitherto, there is known a compressor that includes a so-called hypocycloid mechanism with an outer-race gear and a planetary gear. For example, JP 60-144594 A discloses a compressor including a crank shaft that is rotationally driven by a motor, a casing that accommodates the crank shaft, an outer-race gear that is disposed so as to surround the crank shaft, a planetary gear that rotates inside the outer-race gear while engaging with an inner gear of the outer-race gear, and a piston that is connected to the planetary gear so as to rotate relative to the planetary gear. The planetary gear causes the crank shaft to be inserted therethrough so that the planetary gear rotates relative to the crank shaft. Further, a radius of a pitch circle of the planetary gear is set to a half of a radius of a pitch circle of the outer-race gear. The casing includes a cylinder that has a shape extending linearly along the direction parallel to the radial direction of the outer-race gear, and the piston is accommodated inside the cylinder. Further, an engagement point between the outer-race gear and the planetary gear while the piston is located at the top dead center inside the cylinder is set so as to match a point close to the piston in the intersection point between the pitch circle of the outer-race gear and the longitudinal direction of the cylinder. For this reason, when the planetary gear rotates inside the outer-race gear (revolves about the center of the outer-race gear) while engaging with the outer-race gear with the rotation of the crank shaft, the piston linearly moves in a reciprocating manner along the longitudinal direction of the cylinder inside the cylinder. Here, the cylinder has a shape in which the piston is guided in the longitudinal direction thereof while taking the posture of the piston at the top dead center, that is, a shape in which the piston is guided so as to move in a reciprocating manner along the longitudinal direction thereof without causing the piston to be inclined with respect to the longitudinal direction of the cylinder. Accordingly, when the planetary gear revolves inside the outer-race gear in a spinning state, the piston moves in a reciprocating manner while taking the same posture inside the cylinder. That is, in the compressor, the rotational movement of the planetary gear that is driven so as to revolve inside the outer-race gear by the crank shaft is converted into the linear reciprocating movement of the piston.

SUMMARY OF THE INVENTION

[0005] In general, the compressor of the related art includes a bearing that receives the crank shaft, and lubricant is supplied into the bearing by a pump. Then, there is a case in which the lubricant leaks from the pump when the lubricant is supplied from the pump to the bearing. In this case, since there is a need to provide an oil receiving portion that receives the lubricant leaking from the pump, cost increases and the number of components increases. In order to remove the oil receiving portion, there is a need to use a high-performance pump having excellent lubricant sealing performance. Even in this case, there is an increase in cost.

[0006] An object of the present invention is to provide a compressor that includes a hypocycloid mechanism and may decrease the number of components at low cost.

[0007] In order to solve the above-described problems, a compressor according to the present invention includes: a crank shaft that is rotationally driven by a prime mover; a bearing that receives the crank shaft; a casing that accommodates the crank shaft and the bearing; an outer-race gear that is disposed inside the casing so as to surround the crank shaft; a planetary gear that has a radius of a pitch circle set to a half of a radius of a pitch circle of the outer-race gear and causes the crank shaft to be inserted therethrough so that the planetary gear rotates relative to the crank shaft; a piston that is connected to the planetary gear so as to rotate relative to the planetary gear and moves in a reciprocating manner along the direction parallel to the radial direction of the outer-race gear inside the casing when the planetary gear rotates inside the outer-race gear while engaging with the outer-race gear; and a pump that is accommodated inside the casing and supplies lubricant to the bearing.

[0008] According to the present invention, the pump is accommodated inside the casing. For this reason, even when the lubricant leaks from the pump when the lubricant is supplied to the bearing, the lubricant stays inside the casing, and does not leak to the outside of the casing. Accordingly, there is no need to additionally provide a component such as an oil receiving portion that receives the lubricant leaking from the pump, and the leakage of the lubricant from the pump is permitted. Thus, there is no need to use a high-performance pump having excellent lubricant sealing performance. Further, since the compressor of this embodiment includes a so-called hypocycloid mechanism with the outer-race gear and the planetary gear, there is no need to require a strict lubricating condition like a compressor using a piston crank mechanism with a cross head. In addition, since the rotational movement of the crank shaft is directly converted into the reciprocating movement of the piston, the power transmission efficiency is excellent compared to the compressor using the piston crank mechanism.

[0009] Even in this case, the crank shaft may be connected to the pump so that the pump is driven by the rotation of the crank shaft.

[0010] With such a configuration, since the prime mover as the power source for rotating the crank shaft is used as the power source of the pump, there is no need to provide a dedicated power source for driving the pump, and hence the structure becomes simplified.

[0011] Further, in the present invention, an oil buffer may be formed between the crank shaft and an attachment wall for the pump.

[0012] With such a configuration, the lubricant may be sufficiently supplied to the bearing and the like.

[0013] As described above, according to the present invention, it is possible to provide a compressor that includes a hypocycloid mechanism and may decrease the number of components at low cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** is a cross-sectional view schematically illustrating the structure of a compressor of a first embodiment of the present invention.

[0015] FIG. **2** is a cross-sectional view taken along the line II-II of FIG. **1**.

[0016] FIG. **3** is a cross-sectional view illustrating the compressor of FIG. **1** when viewed from a different angle.

[0017] FIG. **4** is a cross-sectional view illustrating the vicinity of an attachment wall for a compressor of a second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

[0018] A compressor of a first embodiment of the present invention will be described by referring to FIGS. **1** to **3**.

[0019] As illustrated in FIGS. **1** to **3**, a compressor of this embodiment includes a crank shaft **10** that is rotationally driven by a prime mover, a bearing **12** that receives the crank shaft **10**, a casing **20**, an outer-race gear **30** that is disposed inside the casing **20**, a planetary member (planetary carrier) **40** that includes a planetary gear **42** engaging with an inner gear **32** of the outer-race gear **30**, a piston **50** that moves in a reciprocating manner along a specific reciprocating direction inside the casing **20** while rotating relative to the planetary member **40**, and a pump **60** that supplies lubricant to the bearing **12** or each gear. Furthermore, FIG. **2** is a cross-sectional view taken along the line II-II of FIG. **1**, but FIG. **2** illustrates an imaginary planetary gear **42**. Further, FIG. **2** illustrates a pitch circle P of the planetary gear **42** by the one-dotted chain line.

[0020] As illustrated in FIGS. **1** and **3**, the crank shaft **10** includes a main shaft **10***a* that is connected to the prime mover, a crank pin **10***b* that includes a center axis O2 disposed at a position biased from the center axis O1 of the main shaft **10***a* so as to extend in a direction parallel to the center axis O1, and a crank arm **10***c* that connects the main shaft **10***a* to the crank pin **10***b*.

[0021] As illustrated in FIGS. **1** and **2**, the casing **20** mainly includes a crank casing **21** that accommodates the crank shaft **10** and a cylinder **28** that accommodates the piston **50**. Furthermore, a suction line that suctions a gas such as a hydrogen gas into the cylinder **28** and a discharge line that discharges a gas compressed inside the cylinder **28** to the outside of the cylinder **28** are not illustrated in the drawings.

[0022] The crank casing **21** accommodates the crank shaft **10**, the bearing **12**, the outer-race gear **30**, the planetary member **40**, a part of the piston **50**, and the pump **60**. More specifically, the crank casing **21** includes a main body **22** that accommodates the crank shaft **10**, the bearing **12**, the outer-race gear **30**, the planetary member **40**, and a part of the piston **50** and a pump accommodation portion **25** that accommodates the pump **60**. As illustrated in FIGS. **1** and **3**, the pump accommodation portion **25** is adjacent to the main body **22** in the direction of the center axis O1 of the main shaft **10***a*. An attachment wall **26** for the pump **60** is provided in the boundary between the main body **22** and the pump accommodation portion **25** inside the crank casing **21**. An oil buffer **27** that retains lubricant drawn from the pump **60** is formed in a space surrounded by the attachment wall **26**, the main body **22**, and the crank shaft **10**. In this embodiment, the crank casing **21** has airtightness and pressure resistance. More specifically, the pressure resistance corresponds to the pressure resistance capable of withstanding the pressure substantially equal to the pressure of the gas suctioned from the suction line.

[0023] As illustrated in FIGS. **1** and **3**, the main body **22** includes a first wall **23** that holds the crank arm **10***c* close to the main shaft **10***a* and a second wall **24** that holds the crank arm **10***c* distant from the main shaft **10***a*. The first wall **23** includes a first opening that is formed in the direction of the center axis O1, and the first opening retains the main shaft **10***a* and retains the crank arm **10***c* and the bearing **12** on the close side from the main shaft **10***a*. The second wall **24** includes a second opening that is formed in the direction of the center axis O1, and the second opening retains the bearing **12** and the crank arm **10***c* on the far side from the main shaft **10***a*. The first wall **23** and the second wall **24** are disposed so as to face each other in a posture in which both walls are perpendicular to the center axis O1. The attachment wall **26** is attached to the outer surface of the second wall **24** so as to block the second opening of the second wall **24**. As illustrated in FIG. **3**, a lower end **24***a* of the second wall **24** is separated from the bottom wall of the crank casing **21**, and hence the inside of the main body **22** is connected to the inside of the pump accommodation portion **25**. For this reason, the lubricant that is supplied to each bearing or each gear and falls to the lower portion of the main body **22** is led to the pump accommodation portion **25**. That is, the lower portion of the main body **22** and the lower portion of the pump accommodation portion **25** serve as an oil reservoir. The pump accommodation portion **25** has a shape that surrounds the pump **60** along with the attachment wall **26**. Furthermore, the inner surface of the bottom wall of the pump accommodation portion **25** is set to a position lower than the inner surface of the bottom wall of the main body **22**.

[0024] As illustrated in FIG. **1**, the cylinder **28** extends in a linear shape along the direction parallel to the radial direction of the circle formed about the center axis O1 of the outer-race gear **30** within a horizontal plane. The cylinder **28** guides the reciprocating movement of the piston **50** along the parallel direction (the reciprocating direction).

[0025] As illustrated in FIGS. **1** and **3**, the bearing **12** is provided between the crank shaft **10** and the crank casing **21**, and more specifically, between the crank arm **10***c* and the main body **22**. Further, a first bearing **14** that permits the rotation of the planetary member **40** relative to the crank pin **10***b* is provided between the crank shaft **10** and the planetary member **40**, and a second bearing **16** that permits the rotation of the piston **50** relative to the planetary member **40** is provided between the planetary member **40** and the piston **50**.

[0026] The outer-race gear **30** is an internally-toothed gear that includes the inner gear **32**. As illustrated in FIG. **3**, the outer-race gear **30** has a radius larger than the rotation radius of the crank pin **10***b*, and is disposed inside the main body **22** of the crank casing **21** so as to surround the crank shaft **10**. More specifically, the outer-race gear **30** is attached to the inner surface of the second wall **24** of the main body **22** in a posture in which the center thereof matches the center axis O1 of the main shaft **10***a* of the crank shaft **10**.

[0027] The planetary member **40** includes the planetary gear **42** that engages with the outer-race gear **30**, an eccentric shaft **44** that is connected to the planetary gear **42**, and a counter weight **46** that is connected to the eccentric shaft **44**. As illustrated in FIGS. **1** and **3**, the planetary gear **42**, the eccentric shaft **44**, and the counter weight **46** are connected in this order in the direction of the center axis O1 of the main shaft **10***a* so as to rotate together. The crank pin **10***b* of the crank shaft **10** is inserted through the planetary member **40** so that the planetary member **40** rotates relative to the crank shaft **10**.

[0028] The planetary gear **42** rotates inside the outer-race gear **30** (revolves about the center axis O1) while engaging with the outer-race gear **30** as the crank pin **10***b* of the crank shaft **10** rotates about the center axis O1. The radius of the pitch circle P (see FIG. **2**) of the planetary gear **42** is set to a half of the radius of the pitch circle of the outer-race gear **30**. Here, an engagement point (hereinafter, referred to as a "top dead center engagement point P1") between the outer-race gear **30** and the planetary gear **42** while the piston **50** is located at the top dead center inside the cylinder **28** is set so as to match the point close to the piston **50** in the intersection point between the pitch circle of the outer-race gear **30** and the longitudinal direction of the cylinder **28**. Then, since the radius of the pitch circle P of the planetary gear **42** is a half of the radius of the outer-race gear **30**, the top dead center engagement point P1 linearly moves in a reciprocating manner along the longitudinal direction of the cylinder **28**, that is, the reciprocating direction with the rotation of the planetary gear **42**.

[0029] As illustrated in FIGS. **1** and **3**, the eccentric shaft **44** is adjacently connected to the planetary gear **42** in the direction of the center axis O1 so that the center thereof is located at a position biased from the center axis of the planetary gear **42** (the center axis O2 of the crank pin **10***b*). Specifically, the center axis of the eccentric shaft **44** is set so as to pass the top dead center engagement point P1. For this reason, the eccentric shaft **44** rotates (spins) about the center axis of the eccentric shaft **44** while rotating relative to the crank pin **10***b* with the revolution of the planetary gear **42**, and linearly moves in a reciprocating manner along the reciprocating direction. In this embodiment, the eccentric shaft **44** is formed in a disk shape.

[0030] As illustrated in FIGS. **1** and **2**, the counter weight **46** is adjacently connected to the eccentric shaft **44** in the direction of the center axis O1 so that the center of gravity thereof is located at the opposite to the center of gravity of the eccentric shaft **44** with respect to the center axis of the planetary gear **42**.

[0031] As illustrated in FIGS. **1** and **2**, the piston **50** includes an annular portion **52** that surrounds the eccentric shaft **44** through the second bearing **16**, a piston rod **54** that extends in the longitudinal direction of the cylinder **28** from the annular portion **52**, and a piston body **56** that is connected to the front end of the piston rod **54**.

[0032] The annular portion **52** is rotatable relative to the eccentric shaft **44**. For this reason, the annular portion **52** linearly moves in the reciprocating direction so as to follow the linear movement of the eccentric shaft **44** along the reciprocating direction. That is, since the second bearing **16** is interposed between the eccentric shaft **44** and the annular portion **52**, the rotational movement of the eccentric shaft **44** is not transmitted to the annular portion **52**, and only the linear movement of the eccentric shaft **44** is transmitted to the annular portion **52**.

[0033] The piston rod **54** has a shape that extends along the extension line of the track of the center of the eccentric shaft **44** during the reciprocating movement of the eccentric shaft **44** (the track of the top dead center engagement point P1 during the revolution of the planetary gear **42** about the center axis O1) along the reciprocating direction. The piston rod **54** linearly moves inside the cylinder **28** along with the linear movement of the annular portion **52** in the reciprocating direction.

[0034] Here, the cylinder **28** has a shape in which the piston **50** is guided in the longitudinal direction while the posture of the piston **50** at the top dead center is maintained. More specifically, the cylinder **28** has a shape in which the piston body **56** is guided in a reciprocating manner along the longitudinal direction thereof without being inclined with respect to the longitudinal direction of the cylinder **28**. For this reason, when the planetary gear **42** revolves about the center axis O1 in a spinning state, the piston body **56** linearly moves in a reciprocating manner inside the cylinder **28** while taking the same posture as that of the top dead center. Thus, the piston body **56** compresses a gas suctioned from the suction line.

[0035] As illustrated in FIGS. **1** and **3**, the pump **60** includes a pump body **62** that supplies lubricant to each of the bearings (the bearing **12**, the first bearing **14**, and the second bearing **16**) and the gears, and a suction portion **66** that suctions the lubricant from the oil reservoir inside the crank casing **21** to the pump body **62**. The pump body **62** is attached to the attachment wall **26** provided inside the crank casing **21**. The pump body **62** is connected to the crank shaft **10** through a coupling **64** disposed in a hole formed in the attachment wall **26**. Specifically, the coupling **64** connects a portion passing the center axis O1 in the crank arm **10***c* distant from the main shaft **10***a* to a rotor (not illustrated) built in the pump body **62**. For this reason, the drive power of the crank shaft **10** is transmitted to the pump body **62** through the coupling **64**. The pump body **62** supplies the lubricant suctioned from the oil reservoir inside the crank casing **21** by the suction portion **66** to each bearing or each gear at a predetermined supply pressure through a supply line **68** (see FIG. **1**).

[0036] Here, the pressure inside the crank casing **21** becomes a pressure substantially equal to the pressure of the gas suctioned from the suction line, and the supply pressure at which the pump **60** supplies the lubricant becomes a pressure (hereinafter, referred to as a "pure supply pressure") purely necessary for supplying the lubricant to each bearing or each gear. For this reason, the sealing pressure that seals the leakage of the lubricant from the inside of the pump body **62** to the outside of the pump body **62** may be set to the pure supply pressure or so. On the contrary, in a case where the crank casing **21** has airtightness and pressure resistance and the pump **60** is disposed at the outside of the casing **20**, the supply pressure at which the pump **60** supplies the lubricant becomes the sum of the inner pressure of the crank casing **21** and the pressure at which the lubricant is supplied to each bearing or each gear. For this reason, the sealing pressure that seals the leakage of the lubricant from the inside of the pump body **62** to the outside of the pump body **62** becomes higher than the pure supply pressure. That is, in this embodiment, since the crank casing **21** has airtightness and pressure resistance and the pump **60** is accommodated inside the casing **20**, the sealing pressure of the pump **60** may be decreased. Thus, it is possible to ensure the sealing performance of the pump without using a high-performance pump having excellent sealing performance.

[0037] Next, the running operation of the compressor of this embodiment will be described.

[0038] When the prime mover is driven, the crank shaft **10** is rotationally driven. In accordance with this rotational driving operation, the planetary gear **42** spins about the center axis O2 of the crank pin **10***b* while rotating relative to the crank pin **10***b* of the crank shaft **10** and revolves about the center axis **01** of the main shaft **10***a* inside the outer-race gear **30** while engaging with the outer-race gear **30**. Here, the top dead center engagement point P1 is set so as to match the point near the piston **50** in the intersection point between the pitch circle of the outer-race gear **30** and the longitudinal direction of the cylinder **28**. Furthermore, since the radius of the pitch circle P of the planetary gear **42** is a half of the radius of the outer-race gear **30**, the eccentric shaft **44** linearly moves in a reciprocating manner along the reciprocating direction along with the planetary gear **42** while rotating (spinning) about the center axis thereof, when the planetary gear **42** revolves inside the outer-race gear **30** while the engagement point of both gears is maintained at the top dead center engagement point P**1**. The piston **50** linearly moves in a reciprocating manner in the reciprocating direction relative to the eccentric shaft **44** so as to follow the reciprocating movement of the eccentric shaft **44**. Thus, a gas suctioned from the suction line is compressed. Further, the pump **60** occasionally supplies the lubricant suctioned from the oil reservoir inside the crank casing **21** to each bearing or each gear.

[0039] As described above, in the compressor of this embodiment, the pump **60** is accommodated inside the casing **20**. For this reason, even when the lubricant leaks from the pump **60** when the lubricant is supplied to the bearing **12** or each gear, the lubricant stays inside the casing **20** and does not leak to the outside of the casing **20**. Accordingly, there is no need to additionally provide a component such as an oil receiving portion that receives the lubricant leaking from the pump **60**, and the leakage of the lubricant from the pump **60** is permitted. Thus, there is no need to use a high-performance pump having excellent lubricant sealing performance. Further, since the compressor of this embodiment includes a so-called hypocycloid mechanism with the outer-race gear **30** and the planetary gear **42**, there is no need to require a strict lubricating condition like a compressor using a piston crank mechanism with a cross head. In addition, the rotational movement of the crank shaft **10** is directly converted into the reciprocating movement of the piston **50**. Therefore, the power transmission efficiency is excellent compared to the compressor using the piston crank mechanism.

[0040] Further, in this embodiment, since the crank shaft **10** is connected to the pump **60** so that the pump **60** is driven by the rotation of the crank shaft **10**, the prime mover as the power source for rotating the crank shaft **10** is used as the power source of the pump **60**. Accordingly, since there is no need to provide a dedicated power source for driving the pump **60**, the structure becomes simplified.

[0041] Further, in this embodiment, since the oil buffer **27** is formed in a space surrounded by the attachment wall **26**, the main body **22**, and the crank shaft **10**, the lubricant may be sufficiently supplied to the bearing **12** and the like.

[0042] Further, in the compressor of this embodiment, the crank casing **21** has airtightness and pressure resistance in addition to the configuration in which the pump **60** is accommodated inside the crank casing **21**. Accordingly, the sealing pressure for sealing the leakage of the lubricant from the inside of the pump **60** to the outside of the pump **60** may be decreased so as to become the pure supply pressure or so. Thus, it is possible to ensure the sealing performance of the pump without using a high-performance pump having excellent sealing performance.

Second Embodiment

[0043] FIG. **4** is a cross-sectional view illustrating the vicinity of the attachment wall **26** of a compressor of a second embodiment of the present invention. Furthermore, in the second embodiment, only the difference from the first embodiment will be described, and the structure, the operation, and the effect which are the same as those of the first embodiment will not be described.

[0044] In this embodiment, a cylindrical member **29** is attached to the surface opposite to the attachment surface for the pump **60** in the attachment wall **26**. The end of the crank shaft **10** is inserted into the cylindrical member **29**. An oil seal **29***a* is attached between the cylindrical member **29** and the end of the crank shaft **10**. Thus, a space is formed which is surrounded by the cylindrical member **29**, the crank shaft **10**, and the attachment wall **26**. That is, in this embodiment, this space serves as the oil buffer **27**. For this reason, in this embodiment, the volume capacity of the oil buffer **27** may be flexibly adjusted through the adjustment of the inner diameter of the cylindrical member **29**. Furthermore, the cylindrical member **29** may be formed as a single member with the attachment wall **26**.

[0045] Furthermore, it is understood that the embodiments disclosed herein are merely examples and do not limit the present invention in all respects. The scope of the present invention is expressed by claims instead of the embodiments, and includes the meaning equivalent to claims and all modifications within the scope.

[0046] For example, in the above-described embodiment, an example has been described in which the crank shaft **10** and the pump body **62** are connected to each other through the coupling **64**. However, the pump **60** may be driven while being independent from the crank shaft **10**. That is, a power source that drives the pump **60** may be provided separately from the prime mover that rotates the crank shaft **10**. With such a configuration, it is possible to individually manage the driving of the crank shaft **10** and the driving of the pump **60**.

[0047] Further, a portion that holds the bearing **12** may be a member separated from the first wall **23** or the second wall **24**. The piston **50** may be driven in an arbitrary direction such as a gravity direction, so long as the piston moves in a reciprocating manner along the direction parallel to the radial direction of the outer-race gear **30**.

What is claimed is:

1. A compressor comprising:

a crank shaft that is rotationally driven by a prime mover;

a bearing that receives the crank shaft;

a casing that accommodates the crank shaft and the bearing;

an outer-race gear that is disposed inside the casing so as to surround the crank shaft;

a planetary gear that has a radius of a pitch circle set to a half of a radius of a pitch circle of the outer-race gear and causes the crank shaft to be inserted therethrough so that the planetary gear rotates relative to the crank shaft;

a piston that is connected to the planetary gear so as to rotate relative to the planetary gear, the piston moving in a reciprocating manner along the direction parallel to the radial direction of the outer-race gear inside the casing when the planetary gear rotates inside the outer-race gear while engaging with the outer-race gear; and

a pump that is accommodated inside the casing and supplies lubricant to the bearing.

2. The compressor according to claim **1**,

wherein the crank shaft is connected to the pump so that the pump is driven by the rotation of the crank shaft.

3. The compressor according to claim **1**,

wherein an oil buffer is formed between the crank shaft and an attachment wall for the pump.

* * * * *