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(54) **MULTISTAGE COMPRESSOR**

MEHRSTUFIGER KOMPRESSOR

COMPRESSEUR MULTI-ÉTAGES

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Description

Technical Field

[0001] The present invention relates to a multistage compressor provided with a low stage-side compression mechanism and a high stage-side compression mechanism, which are driven by an electric motor, in a sealed housing.

Background Art

[0002] As one example of a multistage compressor provided with a low stage-side compression mechanism and a high stage-side compression mechanism, which are driven by an electric motor, in a sealed housing, a multistage compressor has been disclosed in Patent Document 1, which multistage compressor is configured so that an electric motor is provided in a substantially central portion in a sealed housing, and a low stage-side rotary compression mechanism and a high stage-side scroll compression mechanism are provided under and over the electric motor, respectively, with the electric motor being held therebetween, so that the low stage-side rotary compression mechanism and the high stage-side scroll compression mechanism are driven by the electric motor via a rotating shaft.

[0003] In the multistage compressor described in Patent Document 1, after a low-pressure refrigerant gas has been sucked from the refrigerating cycle side into the low stage-side rotary compression mechanism via a suction pipe and has been compressed to an intermediate pressure, this intermediate-pressure refrigerant gas is once discharged into the sealed housing. This multistage compressor is configured so that the intermediate-pressure refrigerant gas is sucked by the high stage-side scroll compression mechanism, being two-stage compressed to a high-temperature and pressure condition, and is discharged to the outside through a discharge pipe. Thus, the interior of the sealed housing has an intermediate-pressure refrigerant gas atmosphere.

[0004] For this multistage compressor, in the intermediate-pressure refrigerant gas discharged into the sealed housing, lubricating oil that is discharged into the sealed housing together with the refrigerant gas after being used for lubrication of the low stage-side rotary compression mechanism and lubricating oil that drops along the inside of the sealed housing from the high stage-side scroll compression mechanism after being used for lubrication of the high stage-side scroll compression mechanism have dissolved in large amounts. That is, this intermediate-pressure refrigerant gas is in an oil rich state. This intermediate-pressure refrigerant gas passes through internal passages of the electric motor and flows into a space above the electric motor, and thereafter is introduced to a suction port of the high stage-side scroll compression mechanism. During this time, a considerable amount of lubricating oil is separated by the collision with parts.

[0005] However, since a large amount of lubricating oil has dissolved in the intermediate-pressure refrigerant gas in the sealed housing, the lubricating oil is sucked into the high stage-side scroll compression mechanism together with the intermediate-pressure refrigerant gas in a state of not being separated sufficiently. This lubricating oil is discharged from the high stage-side scroll compression mechanism by accompanying the compressed refrigerant gas, and is circulated to the refrigerating cycle side. As a result, the oil circulation ratio (OCR) [the ratio of the mass flow rate of lubricating oil to the total mass flow rate (refrigerant flow rate + lubricating oil flow rate)] of the lubricating oil circulated to the refrigerating cycle side increases, and the heat exchange on the refrigerating cycle is hindered. Thereby, the system efficiency is lowered, and the compressor may fall short of lubricating oil.

[0006] Accordingly, the present inventor has proposed, in Patent Document 2, a multistage compressor capable of decreasing the oil circulation ratio by reducing the amount of lubricating oil sucked into the high stage-side compression mechanism by accompanying the intermediate-pressure refrigerant gas, and capable of improving the system efficiency and solving the shortage of lubricating oil. As shown in FIG. 15, this multistage compressor is configured so that a low stage-side compression mechanism (not shown) and a high stage-side compression mechanism 201 are provided under and over an electric motor 200, respectively, with the electric motor 200 being held therebetween, the intermediate-pressure refrigerant gas compressed by the low stage-side compression mechanism is discharged into a sealed housing 203, and this intermediate-pressure refrigerant gas is sucked by the high stage-side compression mechanism 201 and is two-stage compressed. This multistage compressor is provided with an oil separation plate 202 for centrifugally separating the lubricating oil, which is contained in the intermediate-pressure refrigerant gas sucked into the high stage-side compression mechanism 201, in such a manner that a rotating shaft 205 penetrates the oil separation plate 202. This oil separation plate 202 is a disc-shaped member fixedly provided on a balance weight 206 provided at the upper end of a rotor 204.

Citation List

Patent Document

[0007]

Patent Document 1: JPH0587074 A.

Patent Document 2: Japanese Patent Laid-Open Publication No. 2009-47039

Summary of Invention

Technical Problem

[0008] The action of lubricating oil separation according to Patent Document 2 is as described below. When the intermediate-pressure refrigerant gas in which the lubricating oil has dissolved passes through gas passages 204A in the rotor 204 and flows into a space above the electric motor 200, the intermediate-pressure refrigerant gas collides with the oil separation plate 202 rotating together with the rotor 204, and lubricating oil having a large specific gravity is separated from the intermediate-pressure refrigerant gas by the centrifugally separating action of the oil separation plate 202. After colliding with a stator coil end 207 of the electric motor 200 or directly, the centrifugally separated lubricating oil is introduced to the outer periphery side thereof after passing through the gap thereof, and flows to the bottom portion along the inner peripheral surface of the sealed housing 203. Thus, the lubricating oil separated from the intermediate-pressure refrigerant gas interferes with the stator coil end 207, whereby the separation from the intermediate-pressure refrigerant gas is completed. If the stator coil end 207 does not exist, the lubricating oil having been once separated flows out to the high stage-side compression mechanism 201 together with the intermediate-pressure refrigerant gas. In this description, the passing of the lubricating oil through the gap of the stator coil end 207 is sometimes referred to as "interference".

[0009] The balance weight 206, which is a fixing member by which the oil separation plate 202 is provided and fixed, is provided to assure the rotational balance of shafting including the low stage-side compression mechanism, the high stage-side compression mechanism 201, and the rotating shaft 205 connecting these mechanisms to each other. Therefore, the height of the balance weight 206 exceeds the height of the stator coil end 207 in some cases to assure the balance of the shafting. In this case, the height position of the oil separation plate 202 is higher than the upper end of the stator coil end 207. Therefore, the lubricating oil having been once separated does not interfere with the stator coil end 207, or even if interfering with the stator coil end 207, the interference is little, so that the once separated lubricating oil flows out to the high stage-side compression mechanism 201 together with the intermediate-pressure refrigerant gas. This makes the provision of the oil separation plate 202 meaningless.

[0010] Also, the oil separation plate 202 is attached to the upper end of the balance weight 206 merely with a rivet 208 or the like. Therefore, the fastening of the oil separation plate 202 to the balance weight 206 is loosened by the long-term use, and the position of the oil separation plate 202 may be shifted by the rotation of the rotor 204 or the collision of the intermediate-pressure refrigerant gas with the oil separation plate 202.

[0011] The present invention has been made to solve the above technical problems, and accordingly an object thereof is to provide a multistage compressor not only capable of causing the lubricating oil, which has been separated from intermediate-pressure refrigerant gas by the collision with an oil separation plate, to interfere with a stator coil end more effectively regardless of the height of a balance weight on which the oil separation plate is provided but also capable of improving the strength of fixing the oil separation plate.

Solution to Problem

[0012] The multistage compressor in accordance with the present invention includes, as a premise, a sealed housing, an electric motor, a low stage-side compression mechanism and a high stage-side compression mechanism, and an oil separation plate.

[0013] The electric motor is provided in the sealed housing and has a rotor and a stator having a stator coil end. The low stage-side compression mechanism and the high stage-side compression mechanism are driven via a rotating shaft rotated together with the rotor of the electric motor and are provided under and over the electric motor, respectively, with the electric motor being held therebetween. The oil separation plate which the rotating shaft penetrates is used to centrifugally separate the lubricating oil contained in a refrigerant gas sucked into the high stage-side compression mechanism after passing through gas passages in the rotor of the electric motor. This oil separation plate is fixed to the rotor by a fixing member comprising a plurality of segments divided in the height direction. For the multistage compressor in accordance with the present invention, the oil separation plate has the features described below.

[0014] The oil separation plate in accordance with the present invention is characterized in that, on one end side of the rotor, the oil separation plate is fixed by being held between the adjacent segments of the fixing member.

[0015] The oil separation plate in accordance with the present invention is fixed by being held between the segments adjacent in the up-and-down direction of the fixing member (for example, a balance weight) divided in the height direction. Therefore, the oil separation plate is located at a position lower than the upper end of the balance weight. For example, in the case where the balance weight is divided into two equal parts in the height direction, the oil separation plate is fixed by being held between a lower segment and an upper segment, so that the oil separation plate can be located at a position of one half the height of the balance weight. In this case, even if a flat oil separation plate is used, the oil separation plate can be located easily at a position lower than the upper end of the stator coil end. Therefore, the lubricating oil separated from an intermediate-pressure refrigerant gas by the collision with the oil separation plate flows downward, so that the lubricating oil can be caused to interfere with the stator coil end more reliably. Also, since the oil separation plate is fixed by being held between the upper segment and the lower segment, having a rigidity higher than that of a fastener such as a rivet, the strength of fixing the oil separation plate is improved. Therefore, the position of the oil separation plate is less liable to be shifted by the rotation of the rotor or the collision of the intermediate-pressure refrigerant gas.

[0016] The oil separation plate in accordance with the present invention preferably has a shape having a notch part on the other end side of the rotor. If the notch part is provided on the other end side of the oil separation plate, the center of gravity of the oil separation plate shifts to the one end side (the balance weight side), so that the portion itself on the one end side of the oil separation plate complements some of the functions of the balance weight. Thereby, the size of the balance weight itself can be reduced while the rotation balance of a rotation shafting is assured, and also the size of the multistage compressor itself can be reduced.

[0017] The oil separation plate in accordance with the present invention can also have a shape having a notch part at a position corresponding to the fastener for assembling the rotor on the other end side of the rotor. By providing the notch part at the position corresponding to the upper surface of the fastener such as the rivet, the rotor can be assembled by fastening the fastener to the rotor through the notch part from the upper portion of the oil separation plate after the oil separation plate has been held in the balance weight, so that the workability is improved.

[0018] The oil separation plate in accordance with the present invention is preferably located at a position lower than the upper end of the stator coil end on the other end side of the rotor, or is preferably located at a position lower than the one end side of the rotor on the other end side of the rotor. By doing this, the lubricating oil separated from the intermediate-pressure refrigerant gas by the collision with the oil separation plate is caused to flow downward, so that the lubricating oil can be caused to interfere with the stator coil end more reliably.

[0019] To locate the oil separation plate at a position lower than the other end side of the rotor on the other end side of the rotor, a bent part can be provided on the oil separation plate between the one end side of the rotor and the other end side of the rotor. As this bent part, a step-form bent part is preferable. Since the number of times the intermediate-pressure refrigerant gas containing the lubricating oil collides with the oil separation plate can be increased, the efficiency in separating the lubricating oil from the intermediate-pressure refrigerant gas is enhanced.

[0020] The oil separation plate in accordance with the present invention is preferably formed with the bent part so as to avoid a region in which the bent part intersects with the rotating shaft. Thereby, since the oil separation plate intersects at right angles with the rotating shaft in a portion in which the rotating shaft penetrates the oil separation plate, the area of the gap between the oil separation plate and the rotating shaft is made at a minimum, and the amount of the intermediate-pressure refrigerant gas (containing lubricating oil) leaking from this gap can be reduced.

[0021] To reduce the amount of the intermediate-pressure refrigerant gas leaking from this gap, the rotating shaft is provided with an oil separation assisting protrusion, which projects in the radial direction of the rotating shaft, above a position at which the rotating shaft penetrates the oil separation plate.

[0022] In the multistage compressor in accordance with the present invention, the opening areas of the gas passages formed in the rotor are preferably larger on the side on which the fixing member is provided. In the case where the bent part is provided on the oil separation plate, the number of times more of the intermediate-pressure refrigerant gas collides with the oil separation plate can be increased, so that the efficiency in separating the lubricating oil from the intermediate-pressure refrigerant gas is enhanced. "The side on which the fixing member is provided" means the side on which the fixing member is provided when the surface on which the gas passages are formed is divided into two parts in the radial direction.

[0023] In the multistage compressor in accordance with the present invention, the balance weight is preferably used as the fixing member. The reason for this is that the balance weight is provided on the rotor of the electric motor to assure the rotational balance of a rotation shafting including the rotating shaft, and if the balance weight is provided, the fixing member need not be provided separately.

[0024] In the multistage compressor in accordance with the present invention, taking the sum of the opening areas of the gas passages formed in the rotor as A1, and taking the total area of a gap between the oil separation plate and the stator coil end as A2, the expression $(A2-A1)/A1 = \pm 0.1$ is preferably satisfied.

Advantageous Effects of Invention

[0025] According to the present invention, regardless of the height of the balance weight, the lubricating oil separated from the intermediate-pressure refrigerant gas by the oil separation plate can be caused to interfere with the stator coil end, and also the strength of fixing the oil separation plate can be improved.

Brief Description of Drawings

[0026]

[FIG. 1] FIG. 1 is a longitudinal sectional view of a multistage compressor in accordance with a first embodiment of the present invention.
[FIG. 2] FIG. 2 is an enlarged longitudinal sectional view of an essential portion of the multistage compressor shown in FIG. 1.
[FIG. 3] FIG. 3A is a plan view of an oil separation plate in accordance with a first embodiment, and FIG. 3B is a plan view showing a rotor part in accordance with the first embodiment.
[FIG. 4] FIG. 4 is an enlarged longitudinal sectional view of an essential portion of a multistage compressor in accordance with a second embodiment.
[FIG. 5] FIG. 5 is an enlarged longitudinal sectional view of an essential portion of a multistage compressor in accordance with a third embodiment.
[FIG. 6] FIG. 6 is an enlarged longitudinal sectional view of an essential portion of a multistage compressor in accordance with a fourth embodiment.
[FIG. 7] FIG. 7 is an enlarged longitudinal sectional view of an essential portion of a multistage compressor in accordance with a fifth embodiment.
[FIG. 8] FIG. 8A is a plan view of a balance weight and an oil separation plate in accordance with a sixth embodiment, FIG. 8B is a plan view of a balance weight and an oil separation plate in accordance with a seventh embodiment, and FIG. 8C is a plan view of a balance weight and an oil separation plate in accordance with an eighth embodiment.
[FIG. 9] FIG. 9 is an enlarged longitudinal sectional view of an essential portion of a multistage compressor in accordance with a ninth embodiment.
[FIG. 10] FIG. 10 is an enlarged longitudinal sectional view of an essential portion of a multistage compressor using an oil separation plate having a bent part in fifth to eighth embodiments.
[FIG. 11] FIG. 11 is an enlarged longitudinal sectional view of an essential portion of a multistage compressor using a balance weight having a shape such that an upper segment projects toward a rotating shaft from a lower segment in fifth to ninth embodiments.
[FIG. 12] FIG. 12 is an enlarged longitudinal sectional view of an essential portion of a multistage compressor using a balance weight having a shape such that an upper segment projects toward a stator coil end from a lower segment in fifth to ninth embodiments.
[FIG. 13] FIG. 13 is a plan view of an essential portion of a multistage compressor showing another example of gas passages in accordance with the embodiments.
[FIG. 14] FIG. 14 is an enlarged longitudinal sectional view of an essential portion of a multistage compressor in accordance with the embodiments.
[FIG. 15] FIG. 15 is an enlarged longitudinal sectional view of an essential portion of a conventional multistage compressor disclosed in Patent Document 2.

Description of Embodiments

First embodiment

[0027] A multistage compressor 1 in accordance with a first embodiment of the present invention will now be described with reference to FIGS. 1 to 3.
[0028] The multistage compressor 1 includes a sealed housing 10. In a substantially central portion in the sealed housing 10, an electric motor 4 configured by a stator 5 and a rotor 6 is fixedly provided. To the rotor 6, a rotating shaft (crankshaft) 7 is connected integrally. The rotor 6 is usually constructed by assembling a plurality of laminated magnetic steel sheets with fasteners such as rivets or bolts. Under the electric motor 4, a low stage-side rotary compression mechanism 2 is provided. The low stage-side rotary compression mechanism 2 is configured by a publicly-known rotary compression mechanism including a cylinder body 21 that has a cylinder chamber 20 and is provided so as to be fixed to the sealed housing 10; an upper bearing 22 and a lower bearing 23 that are fixedly provided above and below the cylinder body to seal the upper portion and the lower portion of the cylinder chamber 20, respectively; a rotor 24 that is fitted to a crank part 7A of the rotating shaft 7 and revolves on the inner peripheral surface of the cylinder chamber 20; and a blade for partitioning the interior of the cylinder chamber 20 into the suction side and the discharge side, a blade pressing spring, and the like (these not shown).
[0029] The low stage-side rotary compression mechanism 2 is configured so as to suck a low-pressure refrigerant

gas (working gas) into the cylinder chamber 20 via a suction pipe 25, compress the refrigerant gas to an intermediate pressure by means of the revolution of the rotor 24, and thereafter discharge the refrigerant gas into the sealed housing 10 via a discharge chamber 26. The intermediate-pressure refrigerant gas passes through gas passages 6A and the like provided in the rotor 6 of the electric motor 4, flows in a space above the electric motor 4, and is further sucked into a high stage-side scroll compression mechanism 3 to be subjected to two-stage compression.

[0030] The high stage-side scroll compression mechanism 3 includes a support member 31, and a fixed scroll member 32 and an orbiting scroll member 33. The support member 31 has a bearing 30 for supporting the rotating shaft 7, and is provided so as to be fixed to the sealed housing 10. The fixed scroll member 32 and the orbiting scroll member 33 each have a spiral wrap 32B and a spiral wrap 33B erected on an end plate 32A and an end plate 33A, respectively, and form a pair of compression chambers 34 by assembling the spiral wraps 32B and 33B on the support member 31 so as to be meshed with each other. Also, the high stage-side scroll compression mechanism 3 is configured by a publicly known scroll compression mechanism including an orbiting boss part 35 that connects the orbiting scroll member 33 to an eccentric pin 7B provided at the shaft end of the rotating shaft 7 and revolvingly drives the orbiting scroll member 33; a rotation inhibiting mechanism 36 such as an Oldham’s ring or the like that is provided between the orbiting scroll member 33 and the support member 31 to revolve the orbiting scroll member 33 while inhibiting the rotation thereof; a discharge valve 40 that is provided on the back surface of the fixed scroll member 32; and a discharge cover 42 that is fixedly provided on the back surface of the fixed scroll member 32 and forms a discharge chamber 41 between the discharge cover 42 and the fixed scroll member 32.

[0031] The high stage-side scroll compression mechanism 3 is configured so as to suck the intermediate-pressure refrigerant gas, which has been discharged into the sealed housing 10 by being compressed by the low stage-side rotary compression mechanism 2, into the compression chamber 34, compress the intermediate-pressure refrigerant gas to a high-temperature and pressure state by the revolving drive of the orbiting scroll member 33, and thereafter discharge the intermediate-pressure refrigerant gas into the discharge chamber 41 through the discharge valve 40. This high-temperature and pressure refrigerant gas is introduced from the discharge chamber 41 to the outside of the compressor, that is, the refrigerating cycle side through a discharge pipe 43. Also, the support member 31 constituting the high stage-side scroll compression mechanism 3 is provided so as to be fixed to a bracket 44, which is provided in the sealed housing 10, with a screw.

[0032] Between the lowest end portion of the rotating shaft (crankshaft) 7 and the lower bearing 23 of the low stage-side rotary compression mechanism 2, a publicly known positive-displacement lubrication pump 11 is assembled. This lubrication pump 11 is configured so as to be capable of pumping up lubricating oil 12 filled in the bottom portion of the sealed housing 10, and forcedly feeding the lubricating oil 12 to locations requiring lubrication such as bearing portions of the low stage-side rotary compression mechanism 2 and the high stage-side scroll compression mechanism 3 via an oil feeding hole 13 provided in the rotating shaft 7.

[0033] The multistage compressor 1 is provided with a balance weight 46 on one side of the upper surface of the rotor 6 constituting the electric motor 4. The balance weight 46 is taller than a stator coil end 5A of the electric motor 4, and the upper end thereof lies above the upper end of the stator coil end 5A. At the upper end of the balance weight 46, an oil separation plate 45 that is rotated integrally with the rotor 6 is provided.

[0034] As shown in FIGS. 2, 3A and 3B, the oil separation plate 45 is a member provided with a step-form bent part 48 in a location of about one-third the diameter of a disc-shaped raw material. This bent part 48 is formed so as to extend downward from the balance weight 46 side. On the other end side of the rotor 6, the oil separation plate 45 configured as described above is located at a position lower than the one end side fixed to the balance weight 46. Especially in this embodiment, on the other end side of the rotor 6, the oil separation plate 45 is located at a position lower than the upper end of the stator coil end 5A. Also, on the other end side of the rotor 6, the oil separation plate 45 is located at a position lower than the upper end of the balance weight 46.

[0035] The outside diameter of the oil separation plate 45 is set to have a dimension of a degree such that a narrow gap is provided between the oil separation plate 45 and the inner periphery of the stator coil end 5A of the electric motor 4. Also, the oil separation plate 45 is provided with a through hole 47, which the rotating shaft 7 penetrates, in the central portion thereof. This through hole 47 is provided so as to has a dimension such that the inner peripheral end thereof is located on the center side from the gas passages 6A provided in the rotor 6 and so that a gap formed between the inner peripheral end of the through hole 47 and the outer peripheral surface of the rotating shaft 7 is as narrow as possible.

[0036] The multistage compressor 1 having the above-described configuration provides operational advantages described below.

[0037] The low-temperature and pressure refrigerant gas sucked into the cylinder chamber 20 of the low stage-side rotary compression mechanism 2 via the suction pipe 25 is compressed to an intermediate pressure by the revolution of the rotor 24, and thereafter is discharged into the discharge chamber 26. This intermediate-pressure refrigerant gas is discharged from the discharge chamber 26 into a space below the electric motor 4, and thereafter reaches the space above the electric motor 4 after passing through the gas passages 6A and the like provided in the rotor 6 of the electric motor 4.

[0038] The intermediate-pressure refrigerant gas having reached the space above the electric motor 4 passes through a gap between the support member 31 constituting the high stage-side scroll compression mechanism 3 and the sealed housing 10 and the like gap, being introduced to the suction port of the high stage-side scroll compression mechanism 3 provided in the fixed scroll member 32, and is sucked into the compression chamber 34. This intermediate-pressure refrigerant gas is two-stage compressed to a high-temperature and pressure state by the high stage-side scroll compression mechanism 3, thereafter is discharged into the discharge chamber 41 through the discharge valve 40, and is introduced to the refrigerating cycle side via the discharge pipe 43.

[0039] In the above-described two-stage compression process, some of the lubricating oil 12 used for the lubrication of the low stage-side rotary compression mechanism 2 dissolves in the refrigerant gas, and is discharged into the sealed housing 10 together with the intermediate-pressure refrigerant gas. Further, in this intermediate-pressure refrigerant gas, some of the lubricating oil 12 which is fed to the high stage-side scroll compression mechanism 3 via the oil feeding hole 13, and flows down to the bottom portion of the sealed housing 10 after lubricating the high stage-side scroll compression mechanism 3, dissolves entangledly. When the intermediate-pressure refrigerant gas in which the lubricating oil 12 has dissolved passes through the gas passages 6A in the rotor 6 and reaches the space above the electric motor 4, the intermediate-pressure refrigerant gas collides with the oil separation plate 45 rotating together with the rotor 6, and by the centrifugal separating action, the lubricating oil 12 is separated from the intermediate-pressure refrigerant gas.

[0040] The lubricating oil 12 centrifugally separated as described above is introduced to the outer periphery side of the stator coil end 5A of the electric motor 4 while interfering with the stator coil end 5A, and flows to the bottom portion of the sealed housing 10 along the inner peripheral surface of the sealed housing 10. On the other hand, the intermediate-pressure refrigerant gas from which the lubricating oil 12 has been separated flows from the outer peripheral gap of the oil separation plate 45 toward the space above the electric motor 4, being introduced to the suction port of the high stage-side scroll compression mechanism 3 therefrom, and is sucked into the compression chamber 34 to be subjected to two-stage compression.

[0041] Thus, the intermediate-pressure refrigerant gas from which the lubricating oil 12 has been separated can be sucked into the high stage-side scroll compression mechanism 3, so that the amount of the lubricating oil 12 that is sucked into the high stage-side scroll compression mechanism 3 by accompanying the intermediate-pressure refrigerant gas and is discharged to the outside together with a highpressure compressed gas can be reduced. Thereby, the oil circulation ratio (OCR) [the ratio of the mass flow rate of lubricating oil to the total mass flow rate (refrigerant flow rate + lubricating oil flow rate)] of the lubricating oil 12 circulated to the refrigerating cycle side is decreased. Therefore, the system efficiency can be improved, and the shortage of lubricating oil in the compressor can be solved.

[0042] Also, the oil separation plate 45 is provided with the through hole 47, and is penetrated by the rotating shaft 7. The inner peripheral end of the through hole 47 is located on the center side from the gas passages 6A provided in the rotor 6, and the gap formed between the inner peripheral end of the through hole 47 and the outer peripheral surface of the rotating shaft 7 is made as narrow as possible. Therefore, the intermediate-pressure refrigerant gas containing the lubricating oil 12, which has passed through the gas passages 6A in the rotor 6, always collides with the oil separation plate 45, and the lubricating oil 12 contained in the intermediate-pressure refrigerant gas can be separated by the centrifugally separating action of the oil separation plate 45. Therefore, the efficiency in separating the lubricating oil 12 from the intermediate-pressure refrigerant gas is enhanced, and the oil circulation ratio is decreased, whereby the system efficiency can be improved, and the shortage of lubricating oil can be solved.

[0043] In the multistage compressor 1 in accordance with the first embodiment, the upper end of the balance weight 46 lies above the upper end of the stator coil end 5A. However, by providing the step-form bent part 48 on the oil separation plate 45, on the other end side of the rotor 6, the oil separation plate 45 is located at a position lower than the one end side of the rotor 6. Therefore, the lubricating oil 12 separated from the intermediate-pressure refrigerant gas flows downward as shown in FIG. 2, so that the lubricating oil 12 easily interferes with the stator coil end 5A. Especially in this embodiment, on the other end side of the rotor 6, the oil separation plate 45 is located at a position lower than the upper end of the stator coil end 5A. Therefore, the lubricating oil 12 can be caused to interfere with the stator coil end 5A reliably.

[0044] Also, if the step-form bent part 48 is provided on the oil separation plate 45, the intermediate-pressure refrigerant gas (containing the lubricating oil 12) discharged from the gas passages 6A on the balance weight 46 side of the bent part 48 also collides with the bent part 48 in addition to a horizontal part 49, and the number of times the intermediate-pressure refrigerant gas collides with the oil separation plate 45 increases to two times. Therefore, in this embodiment in which the bent part 48 is provided on the oil separation plate 45, the lubricating oil 12 can be separated efficiently from the intermediate-pressure refrigerant gas.

[0045] In the multistage compressor 1, taking the sum of the opening areas of the gas passages 6A formed in the rotor 6 as A1, and taking the total area of the gap between the oil separation plate 45 and the stator coil end 5A as A2, it is preferable that the expression $(A2-A1)/A1 = \pm 0.1$ be satisfied. This condition does not produce a loss in pressure of the flowing intermediate-pressure refrigerant gas, or even if the loss is produced, this condition can control the loss so as to be small.

Second embodiment

[0046] In the first embodiment, the bent part 48 is provided in a region in which the oil separation plate 45 intersects with the rotating shaft 7. In contrast, an oil separation plate 50 in accordance with a second embodiment is configured so that a bent part 51 is provided between the rotating shaft 7 and the balance weight 46 as shown in FIG. 4. That is, the oil separation plate 50 is configured so that the bent part 51 is provided so as to avoid the region in which the bent part 51 intersects with the rotating shaft 7. By this configuration, since the oil separation plate 50 intersects at right angles with the rotating shaft 7 in a portion in which the rotating shaft 7 penetrates the oil separation plate 50, the area of the gap between the oil separation plate 50 and the rotating shaft 7 is made at a minimum, and the amount of the intermediate-pressure refrigerant gas (containing lubricating oil) leaking from this gap is reduced.

Third embodiment

[0047] As in the second embodiment, an oil separation plate 55 in accordance with a third embodiment is configured so that a bent part 56 is provided so as to avoid the region in which the bent part 56 intersects with the rotating shaft 7. However, as shown in FIG. 5, the bent part 56 is provided on the side opposite to the side on which the balance weight 46 is provided around the rotating shaft 7 (the counter balance weight side).

[0048] For the oil separation plate 55 in accordance with the third embodiment, in addition to the effect of reducing the amount of the intermediate-pressure refrigerant gas leaking from the gap, the amount of the intermediate-pressure refrigerant gas that collides with the oil separation plate 55 two times, that is, collides with a horizontal part 57 and the bent part 56 can be increased. Therefore, the lubricating oil 12 can be separated efficiently from the intermediate-pressure refrigerant gas.

[0049] In order to increase the amount of the intermediate-pressure refrigerant gas colliding with the oil separation plate 55 two times, it is effective to make, as shown in FIG. 13, the opening areas of the gas passages 6A formed in the rotor 6 on the side on which the balance weight 46 is provided (the left half in the figure) larger than those of the gas passages 6A on the counter balance weight 46 side (the right half in the figure). In FIG. 13, the opening areas of all (six) of the gas passages 6A on the side on which the balance weight 46 is provided are made larger. However, the present invention is not limited to this configuration. The total of the opening areas of all of the gas passages 6A on the side on which the balance weight 46 is provided has only to be made larger than the total of the opening areas of all of the gas passages 6A on the counter balance weight 46 side.

[0050] Also, in the third embodiment, in order to reduce the amount of the intermediate-pressure refrigerant gas leaking from the gap between the rotating shaft 7 and the oil separation plate 55, it is preferable that, as shown in FIG. 14, an oil separation assisting protrusion 7e projecting in the radial direction of the rotating shaft 7 be provided above the position at which the rotating shaft 7 penetrates the oil separation plate 55. The oil separation assisting protrusion 7e may be manufactured by fixing a ring-shaped member separate from the rotating shaft 7 to the rotating shaft 7, or may be formed integrally with the rotating shaft 7 when the rotating shaft 7 is manufactured.

[0051] Further, for the bent parts 51 and 56 shown in the second and third embodiments, the number of steps is one. However, the present invention is not limited to this configuration. The number of steps may be made plural, that is, two or more.

Fourth embodiment

[0052] In the first to third embodiments, the bent part 48, 51, 56 is of a step form. However, the bent part of the present invention is not limited to this form.

[0053] Like an oil separation plate 60 in accordance with a fourth embodiment shown in FIG. 6, a bent part 61 can be made such as to be bent so as to lower toward the stator coil end 5A on the counter balance weight 46 side.

[0054] Since the oil separation plate 60 in accordance with the fourth embodiment lowers toward the stator coil end 5A on the counter balance weight 46 side, the intermediate-pressure refrigerant gas can be caused to interfere with the stator coil end 5A more reliably. In the present invention, the position at which the bent part 61 is formed is not subject to any restriction, and the bent part 61 can be formed on the counter balance weight 46 side.

[0055] In the above-described first to fourth embodiments, an example has been shown in which on the other end side of the rotor 6, the oil separation plate 45 is located at a position lower than the upper end of the stator coil end 5A. However, the present invention is not limited to this configuration. If, on the other end side of the rotor 6, the oil separation plate 45 is located at a position lower than the one end side fixed to the balance weight 46 (fixed member), the lubricating oil 12 separated from the intermediate-pressure refrigerant gas flows downward toward the other end side. Therefore, even if the stator coil end 5A is short, the lubricating oil 12 easily interferes with the stator coil end 5A.

[0056] Also, in the above-described first to fourth embodiments, a mode has been shown in which the oil separation plate 45 is fixed to the upper end of the balance weight 46. However, the present invention is not limited to this configuration. To all of the modes of the first to fourth embodiments, a later-described fifth embodiment can be applied, in which embodiment the oil separation plate 45 is fixed to a balance weight 70 by being held between a lower segment 71 and an upper segment 72 constituting the balance weight 70. Thereby, the lubricating oil 12 can be separated efficiently from the intermediate-pressure refrigerant gas. Also, since the oil separation plate 45 is fixed by being held between the upper segment 72 and the lower segment 71, having a rigidity higher than that of a fastener such as a rivet, the strength of fixing the oil separation plate 45 is improved. Therefore, the position of the oil separation plate is not shifted by the rotation of the rotor or the collision of the intermediate-pressure refrigerant gas.

Fifth embodiment

[0057] Next, the fifth embodiment is explained with reference to FIG. 7.

[0058] In the fifth embodiment, the balance weight 70 is formed by two members of the lower segment 71 and the upper segment 72. The lower segment 71 and the upper segment 72 are formed by dividing the balance weight 70 into two equal parts, and therefore the two segments 71 and 72 have almost the same specifications. The position of the upper end of the balance weight 70 is higher than the position of the upper end of the stator coil end 5A.

[0059] In the fifth embodiment, a flat oil separation plate 73 is fixed to the balance weight 70 by being held between the adjacent lower segment 71 and upper segment 72. Therefore, the oil separation plate 73 is placed at a position of one half the height of the balance weight 70, and this position is lower than the upper end of the stator coil end 5A. In the fifth embodiment, therefore, the intermediate-pressure refrigerant gas can be caused to interfere with the stator coil end 5A without provision of a bent part on the oil separation plate. Also, since the oil separation plate 73 is held between the lower segment 71 and the upper segment 72, having a rigidity higher than that of a rivet, the strength of fixing the oil separation plate is increased. The large area of a portion in which the lower segment 71 and the upper segment 72 hold the oil separation plate therebetween also contributes to the improvement in the strength of fixing the oil separation plate.

[0060] In FIGS. 8A to 8C relating to sixth to eighth embodiments, signs that are the same as those in FIG. 7 are applied to portions that are the same as those of the balance weight 70 (the upper segment 72) of the fifth embodiment, and the explanation thereof is omitted. Also, one end side of an oil separation plate 65, 66 means the side on which the oil separation plate 65, 66 is fixed to the balance weight 70 by being held between the lower segment 71 and the upper segment 72 constituting the balance weight 70, and the other end side thereof means the side on which the oil separation plate 65, 66 is not fixed to the balance weight 70.

Sixth embodiment

[0061] In the first to fifth embodiments, the oil separation plate 45 is of a symmetrical disc shape. However, the oil separation plate 45 of the present invention is not limited to this shape.

[0062] Like the oil separation plate 65 in accordance with the sixth embodiment shown in FIG. 8A, the oil separation plate 65 can be made asymmetrical by being provided with a notch part 80 on the other end side of the oil separation plate 65.

[0063] For the oil separation plate 65 in accordance with the sixth embodiment, due to the notch part 80 provided on the other end side, the center of gravity of the oil separation plate 65 shifts to the balance weight 70 side. Therefore, a portion on the one end side of the oil separation plate 65, more specifically, a portion of the oil separation plate 65 held between the lower segment 71 and the upper segment 72 complements some of the functions of the balance weight 70. Thereby, the size of the balance weight 70 itself can be reduced while the rotation balance of a rotation shafting is assured, so that the size of the multistage compressor 1 can be reduced.

[0064] This notch part 80 is formed by cutting the oil separation plate 65 into a bow shape on the other end side of the oil separation plate 65. However, the method for forming the notch part 80 is not subject to any restriction. The disc-shaped oil separation plate 65 may be cut, or the oil separation plate 65 originally having the notch part 80 may be manufactured by using a press or the like.

Seventh embodiment

[0065] The notch part 80 of the sixth embodiment is formed by cutting the other end side of the oil separation plate 65 into a bow shape. In contrast, a notch part 81 in accordance with the seventh embodiment is formed, as shown in FIG. 8B, on the other end side of the oil separation plate 66, at a position corresponding to a rivet 68a that does not contribute to the fixing of the balance weight 70 among four rivets (fasteners) 68a to 68d. The notch part 81 having an approximately circular shape has an area of a degree such as not to hinder the work for fastening the rivet 68a to the rotor 6.

[0066] If the notch part 81 is not formed, the assembling of the rotor 6 is performed by the procedure described below. First, the rivet 68a is fastened in the state in which magnetic steel sheets constituting the rotor 6 are laminated. Next, the lower segment 71 is placed at a predetermined position. Then, the oil separation plate 66 is placed on the lower segment 71, and further the upper segment 72 is placed on the lower segment 71 via the oil separation plate 66 to hold the oil separation plate 66 between the lower segment 71 and the upper segment 72. Thereafter, the remaining three rivets 68b to 68d are fastened from above the upper segment 72. Thus, if the notch part 81 is not formed, the work for holding the oil separation plate 66 between the lower segment 71 and the upper segment 72 is interposed, so that the work for fastening the rivets 68a to 68d is interrupted.

[0067] However, if the notch part 81 is formed, the work for fastening the rivets 68a to 68d can be performed continuously. That is, since the rivet 68d can be fastened through the notch part 81, after the oil separation plate 66 has been held between the lower segment 71 and the upper segment 72, all of the rivets 68a to 68d can be fastened in succession. Therefore, the workability for fastening the rivets 68a to 68d is high. Needless to say, the effects of the sixth embodiment can be achieved at the same time.

Eighth embodiment

[0068] Also, as shown in FIG. 8C, on the other end side of an oil separation plate 67, a saw-toothed notch part 82 can be formed. By using the notch part 82 having such a shape, the effects of the sixth embodiment can be achieved, and at the same time, aerodynamic noise occurring when the intermediate-pressure refrigerant gas passes through the oil separation plate 67 is suppressed, whereby the quietness of the multistage compressor 1 can be improved.

Ninth embodiment

[0069] A ninth embodiment is explained with reference to FIG. 9.

[0070] In the ninth embodiment, a balance weight 75 is formed by two members of a lower segment 76 and an upper segment 77. As in the fifth embodiment, the lower segment 76 and the upper segment 77 are formed by dividing the balance weight 70 into two equal parts, and the position of the upper end of the balance weight 75 is higher than the position of the upper end of the stator coil end 5A.

[0071] In the ninth embodiment, an oil separation plate 78 is formed integrally with the lower surface of the upper segment 77. In this case as well, the oil separation plate 78 is fixed to the balance weight 75 by being held between the lower segment 76 and the upper segment 77.

[0072] In the ninth embodiment as well, the intermediate-pressure refrigerant gas can be caused to interfere with the stator coil end 5A without provision of a bent part on the oil separation plate. Also, since the oil separation plate 78 is held between the adjacent lower segment 76 and upper segment 77, the strength of fixing the oil separation plate is increased.

[0073] In the above-described fifth to ninth embodiments, the flat oil separation plate 73, 65, 66, 67, 78 is used. However, the present invention is not limited to this configuration. As shown in FIG. 10, even if an oil separation plate 69 provided with a step-form bent part is used, the intermediate-pressure refrigerant gas can be caused to interfere with the stator coil end 5A reliably while the strength of fixing the oil separation plate 69 to the balance weight 70 is maintained.

[0074] Also, in the above-described fifth to ninth embodiments, the balance weight 70 is formed by the lower segment 71 and the upper segment 72, which have the same shape and size. However, the present invention is not limited to this configuration. A balance weight 90 may be formed by a lower segment 91 and an upper segment 92, which have different shapes and sizes. For this balance weight 90, as shown in FIG. 11, the upper segment 92 projects toward the rotating shaft 7 from the lower segment 91. Also, as shown in FIG. 12, a balance weight 95 can be formed so that an upper segment 94 projects toward the stator coil end 5A from the lower segment 93.

[0075] By giving such a shape and size to the lower and upper segments, the weight of the whole of the balance weight 90, 95 is increased, so that the oil separation plate 45 is fixed to the rotor 6 more reliably via the balance weight 90, 95.

[0076] Since the balance weight 90 has a sufficient weight, the rotational balance of the rotation shafting can be assured. Also, since the center of gravity of the balance weight 95 shifts to the direction away from the center of the rotating shaft 7, the lubricating oil can more reliably be centrifugally separated from the intermediate-pressure refrigerant gas. The balance weight 90, 95 can be selected according to the shape of the stator coil end 5A.

[0077] Also, in the above-described fifth to ninth embodiments, explanation has been given by taking the multistage compressor 1, which is formed by using a rotary compression mechanism as the low stage-side compression mechanism 2 and using a scroll compression mechanism as the high stage-side compression mechanism 3, as an example. However, the low stage-side compression mechanism 2 and the high stage-side compression mechanism 3 are not limited to the above-described compression mechanisms.

[0078] Further, the present invention is preferably applied to the electric motor 4 in which a coil is concentrically wound.

This is because the stator coil end of this motor is small and short.

[0079] Besides, the configurations described in the above embodiments can be selected or can be changed as appropriate to other configurations without departing from the scope of the present invention.

Reference Signs List

[0080]

1 ...	multistage compressor
2 ...	low stage-side rotary compression mechanism
3 ...	high stage-side scroll compression mechanism
4 ...	electric motor
5A ...	stator coil end
6 ...	rotor
6A ...	gas passage
7 ...	rotating shaft
10 ...	sealed housing
46, 70, 75, 90, 95 ...	balance weight
71, 76, 91, 93 ...	lower segment
72, 77, 92, 94 ...	upper segment
45, 50, 55, 60, 65, 66, 67, 69, 73, 78 ...	oil separation plate
48, 51, 56, 61 ...	bent part
68a, 68b, 68c, 68d ...	rivet
80, 81, 82 ...	notch part

Claims

1. A multistage compressor comprising:

   a sealed housing (10);
   an electric motor (4) which is provided in the sealed housing (10) and has a rotor (6) and a stator (5) having a stator coil end (5A);
   a low stage-side compression mechanism (2) and a high stage-side compression mechanism (3), which are driven via a rotating shaft (7) rotated together with the rotor (6) of the electric motor (4) and are provided under and over the electric motor (4), respectively, with the electric motor (4) being held therebetween;
   an oil separation plate (45, 50, 55, 60, 65, 66, 67, 69, 73, 78) which the rotating shaft (7) penetrates and which is used to centrifugally separate lubricating oil contained in a refrigerant gas sucked into the high stage-side compression mechanism (3) after passing through gas passages (6A) in the rotor (6) of the electric motor (4);
   characterized in that it further comprises a fixing member which comprises a plurality of segments (71, 76, 91, 93; 72, 77, 92, 94) divided in the height direction and fixes the oil separation plate (45, 50, 55, 60, 65, 66, 67, 69, 73, 78) to the rotor (6), and
   in that on one end side of the rotor (6), the oil separation plate (45, 50, 55, 60, 65, 66, 67, 69, 73, 78) is fixed by being held between the adjacent segments (71, 76, 91, 93; 72, 77, 92, 94).

2. The multistage compressor according to claim 1, wherein
   on the other end side of the rotor (6), the oil separation plate (65, 66, 67) has a notch part (80, 81, 82).

3. The multistage compressor according to claim 1 or 2, wherein
   on the other end side of the rotor (6), the oil separation plate (66) has a notch part (81) at a position corresponding to a fastener for assembling the rotor (6).

4. The multistage compressor according to claim 1, wherein
   on the other end side of the rotor (6), the oil separation plate (45, 50, 55, 69) is located at a position lower than the upper end of the stator coil end (5A).

5. The multistage compressor according to claim 1 or 4, wherein
   on the other end side of the rotor (6), the oil separation plate (45, 50, 55, 69) is located at a position lower than the

one end side of the rotor (6).

6. The multistage compressor according to claim 4 or 5, wherein the oil separation plate (45, 50, 55, 69) has a step-form bent part(48, 51, 56) between the one end side and the other end side.

7. The multistage compressor according to claim 6, wherein the oil separation plate (50, 55) is formed with the bent part (51, 56) so as to avoid a region in which the bent part (51, 56) intersects with the rotating shaft (7).

8. The multistage compressor according to any one of claims 4 to 7, wherein the opening areas of the gas passages (6A) formed in the rotor (6) are larger on the side on which the fixing member is provided.

9. The multistage compressor according to any one of claims 4 to 8, wherein the rotating shaft (7) is provided with an oil separation assisting protrusion (7e), which projects in the radial direction of the rotating shaft (7), above a position at which the rotating shaft penetrates the oil separation plate (55).

10. The multistage compressor according to any one of claims 4 to 9, wherein taking the sum of the opening areas of the gas passages (6A) formed in the rotor as A1, and taking the total area of a gap between the oil separation plate (45, 50, 55, 60, 65, 66, 67, 69, 73, 78) and the stator coil end (5A) as A2, an expression $(A2-A1)/A1 = \pm 0.1$ is satisfied.

11. The multistage compressor according to any one of claims 4 to 10, wherein the fixing member is a balance weight (46, 70, 75, 90, 95) provided on the rotor (6) of the electric motor (4) to assure the rotational balance of a rotation shafting including the rotating shaft (7).

Patentansprüche

1. Mehrstufiger Verdichter, umfassend:

ein abgedichtetes Gehäuse (10),
einen Elektromotor (4), der in dem abgedichteten Gehäuse (10) vorgesehen ist und einen Rotor (6) und einen (5) Stator mit einem Statorspulenende (5A) aufweist,
einen niederstufenseitigen Verdichtungsmechanismus (2) und einen hochstufenseitigen Verdichtungsmechanismus (3), die über eine Drehwelle (7), welche gemeinsam mit dem Rotor (6) des Elektromotors (4) gedreht wird, angetrieben werden und unter bzw. über dem Elektromotor (4) vorgesehen sind, wobei der Elektromotor (4) dazwischen gehalten wird,
eine Ölabscheideplatte (45, 50, 55, 60, 65, 66, 67, 69, 73, 78), durch welche die Drehwelle (7) hindurchführt und welche verwendet wird, um Schmieröl, das in einem Kühlgas enthalten ist, welches in den hochstufenseitigen Verdichtungsmechanismus (3) gesaugt wird, nachdem es durch Gaskanäle (6A) in dem Rotor (6) des Elektromotors (4) hindurchtritt, zentrifugal abzuscheiden,
dadurch gekennzeichnet, dass er ferner ein Befestigungsglied umfasst, das mehrere Segmente (71, 76, 91, 93; 72, 77, 92, 94) umfasst, die in der Höhenrichtung geteilt sind, und die Ölabscheideplatte (45, 50, 55, 60, 65, 66, 67, 69, 73, 78) an dem Rotor (6) befestigt, und
dadurch, dass an einer Endseite des Rotors (6) die Ölabscheideplatte (45, 50, 55, 60, 65, 66, 67, 69, 73, 78) befestigt ist, indem sie zwischen den benachbarten Segmenten (71, 76, 91, 93; 72, 77, 92, 94) gehalten wird.

2. Mehrstufiger Verdichter nach Anspruch 1, wobei an der anderen Endseite des Rotors (6) die Ölabscheideplatte (65, 66, 67) einen Aussparungsteil (80, 81, 82) aufweist.

3. Mehrstufiger Verdichter nach Anspruch 1 oder 2, wobei an der anderen Endseite des Rotors (6) die Ölabscheideplatte (66) einen Aussparungsteil (81) an einer Position aufweist, die einem Befestigungselement zum Montieren des Rotors (6) entspricht.

4. Mehrstufiger Verdichter nach Anspruch 1, wobei an der anderen Endseite des Rotors (6) die Ölabscheideplatte (45, 50, 55, 69) an einer Position angeordnet ist, die tiefer als das obere Ende des Statorspulenendes (5A) liegt.

5. Mehrstufiger Verdichter nach Anspruch 1 oder 4, wobei an der anderen Endseite des Rotors (6) die Ölabscheideplatte (45, 50, 55, 69) an einer Position angeordnet ist, die tiefer als die eine Endseite des Rotors (6) liegt.

6. Mehrstufiger Verdichter nach Anspruch 4 oder 5, wobei die Ölabscheideplatte (45, 50, 55, 69) einen stufenförmig gebogenen Teil (48, 51, 56) zwischen der einen Endseite und der anderen Endseite aufweist.

7. Mehrstufiger Verdichter nach Anspruch 6, wobei die Ölabscheideplatte (50, 55) mit dem gebogenen Teil (51, 56) derart ausgebildet ist, dass sie einen Bereich umgeht, in dem der gebogene Teil (51, 56) die Drehwelle (7) kreuzt.

8. Mehrstufiger Verdichter nach einem beliebigen der Ansprüche 4 bis 7, wobei die Öffnungsflächen der Gaskanäle (6A), die in dem Rotor (6) ausgebildet sind, auf der Seite, auf der das Befestigungsglied vorgesehen ist, größer sind.

9. Mehrstufiger Verdichter nach einem beliebigen der Ansprüche 4 bis 8, wobei die Drehwelle (7) mit einem ölabscheidungsunterstützenden Vorsprung (7e) versehen ist, der in der radialen Richtung der Drehwelle (7) oberhalb einer Position vorsteht, an der die Drehwelle durch die Ölabscheideplatte (55) hindurchführt.

10. Mehrstufiger Verdichter nach einem beliebigen der Ansprüche 4 bis 9, wobei, wenn die Summe der Öffnungsflächen der Gaskanäle (6A), die in dem Rotor ausgebildet sind, als A1 angenommen wird und die Gesamtfläche eines Zwischenraums zwischen der Ölabscheideplatte (45, 50, 55, 60, 65, 66, 67, 69, 73, 78) und dem Statorspulenende (5A) als A2 angenommen wird, der folgende Ausdruck erfüllt ist: $(A2-A1)/A1 = \pm 0{,}1$.

11. Mehrstufiger Verdichter nach einem beliebigen der Ansprüche 4 bis 10, wobei das Befestigungsglied ein Ausgleichsgewicht (46, 70, 75, 90, 95) ist, das an dem Rotor (6) des Elektromotors (4) vorgesehen ist, um das Rotationsgleichgewicht eines Drehwellenstrangs, der die Drehwelle (7) umfasst, sicherzustellen.

Revendications

1. Compresseur multi-étages comportant :

   un logement étanche (10) ;
   un moteur électrique (4) qui est prévu dans le logement étanche (10) et a un rotor (6) et un stator (5) ayant une extrémité de bobine de stator (5A) ;
   un mécanisme de compression d'étage inférieur (2) et un mécanisme de compression d'étage supérieur (3), qui sont entraînés par l'intermédiaire d'un arbre de rotation (7) entraîné en rotation avec le rotor (6) du moteur électrique (4) et sont prévus en dessous et au-dessus du moteur électrique (4), respectivement, avec le moteur électrique (4) maintenu entre eux ;
   une plaque de séparation d'huile (45, 50, 55, 60, 65, 66, 67, 69, 73, 78) que l'arbre de rotation (7) pénètre et qui est utilisée pour séparer par centrifugation de l'huile de lubrification contenue dans un gaz réfrigérant aspiré dans le mécanisme de compression d'étage supérieur (3) après être passé à travers des passages de gaz (6A) dans le rotor (6) du moteur électrique (4) ;
   caractérisé en ce qu'il comporte en outre un élément de fixation qui comporte une pluralité de segments (71, 76, 91, 93 ; 72, 77, 92, 94) divisés dans la direction de hauteur et fixe la plaque de séparation d'huile (45, 50, 55, 60, 65, 66, 67, 69, 73, 78) sur le rotor (6),
   et
   en ce que, sur un côté d'extrémité du rotor (6), la plaque de séparation d'huile (45, 50, 55, 60, 65, 66, 67, 69, 73, 78) est fixée en étant maintenue entre les segments adjacents (71, 76, 91, 93 ; 72, 77, 92, 94).

2. Compresseur multi-étages selon la revendication 1, dans lequel

sur l'autre côté d'extrémité du rotor (6), la plaque de séparation d'huile (65, 66, 67) a une partie d'encoche (80, 81, 82).

3. Compresseur multi-étages selon la revendication 1 ou 2, dans lequel
sur l'autre côté d'extrémité du rotor (6), la plaque de séparation d'huile (66) a une partie d'encoche (81) dans une position correspondant à un élément de fixation pour l'assemblage du rotor (6).

4. Compresseur multi-étages selon la revendication 1, dans lequel
sur l'autre côté d'extrémité du rotor (6), la plaque de séparation d'huile (45, 50, 55, 69) se trouve dans une position plus basse que l'extrémité supérieure de l'extrémité de bobine de stator (5A).

5. Compresseur multi-étages selon la revendication 1 ou 4, dans lequel
sur l'autre côté d'extrémité du rotor (6), la plaque de séparation d'huile (45, 50, 55, 69) se trouve dans une position plus basse que l'un côté d'extrémité du rotor (6).

6. Compresseur multi-étages selon la revendication 4 ou 5, dans lequel
la plaque de séparation d'huile (45, 50, 55, 69) a une partie pliée en forme de marche (48, 51, 56) entre le premier côté d'extrémité et l'autre côté d'extrémité.

7. Compresseur multi-étages selon la revendication 6, dans lequel
la plaque de séparation d'huile (50, 55) est formée avec la partie pliée (51, 56) de façon à éviter une zone dans laquelle la partie pliée (51, 56) croise l'arbre de rotation (7).

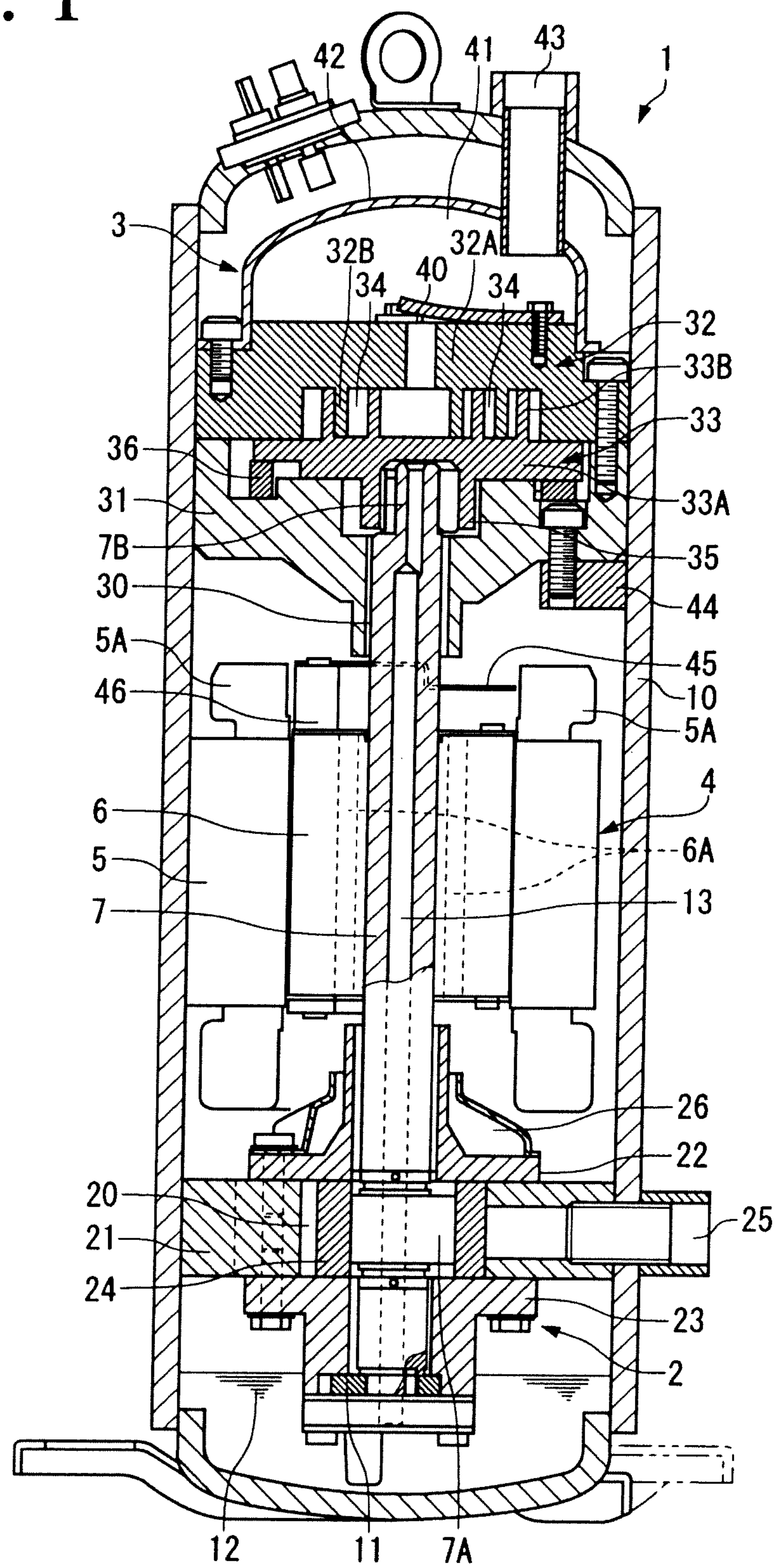
8. Compresseur multi-étages selon l'une quelconque des revendications 4 à 7, dans lequel
les sections d'ouverture des passages de gaz (6A) formés dans le rotor (6) sont plus grandes sur le côté sur lequel l'élément de fixation est prévu.

9. Compresseur multi-étages selon l'une quelconque des revendications 4 à 8, dans lequel
l'arbre de rotation (7) est pourvu d'une saillie d'assistance de séparation d'huile (7e), qui dépasse dans la direction radiale de l'arbre de rotation (7), au-dessus d'une position au niveau de laquelle l'arbre de rotation pénètre la plaque de séparation d'huile (55).

10. Compresseur multi-étages selon l'une quelconque des revendications 4 à 9, dans lequel
en prenant la somme des sections d'ouverture des passages de gaz (6A) formés dans le rotor comme A1, et en prenant la surface totale d'un espace entre la plaque de séparation d'huile (45, 50, 55, 60, 65, 66, 67, 69, 73, 78) et l'extrémité de bobine de stator (5A) comme A2, une expression $(A2-A1)/A1 = \pm 0{,}1$ est satisfaite.

11. Compresseur multi-étages selon l'une quelconque des revendications 4 à 10, dans lequel
l'élément de fixation est un contrepoids (46, 70, 75, 90, 95) prévu sur le rotor (6) du moteur électrique (4) pour assurer l'équilibre de rotation d'une ligne d'arbre de rotation comprenant l'arbre de rotation (7).

FIG. 1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44
5A
45
10
46
5A
6
4
6A
5
7
13
26
22
20
25
21
24
23
2
12
11
7A

FIG. 2

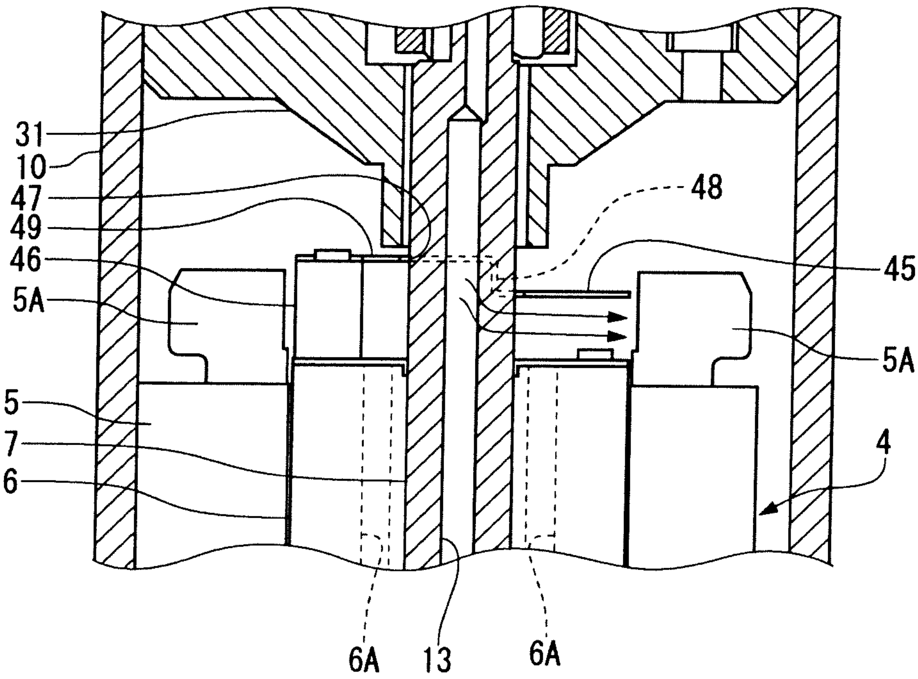


FIG. 3A

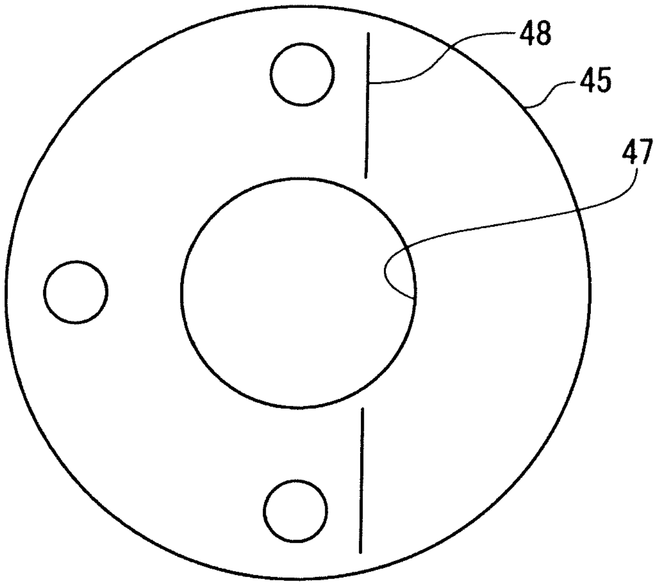


FIG. 3B

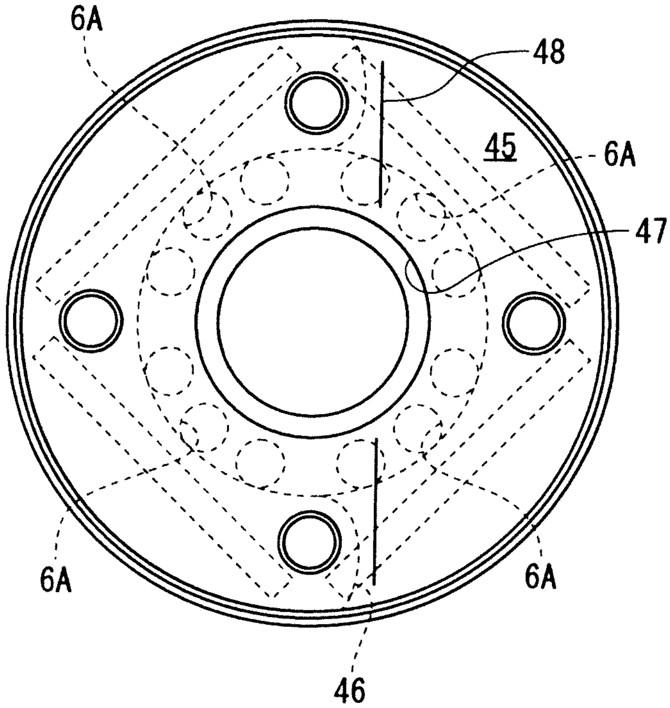


FIG. 4

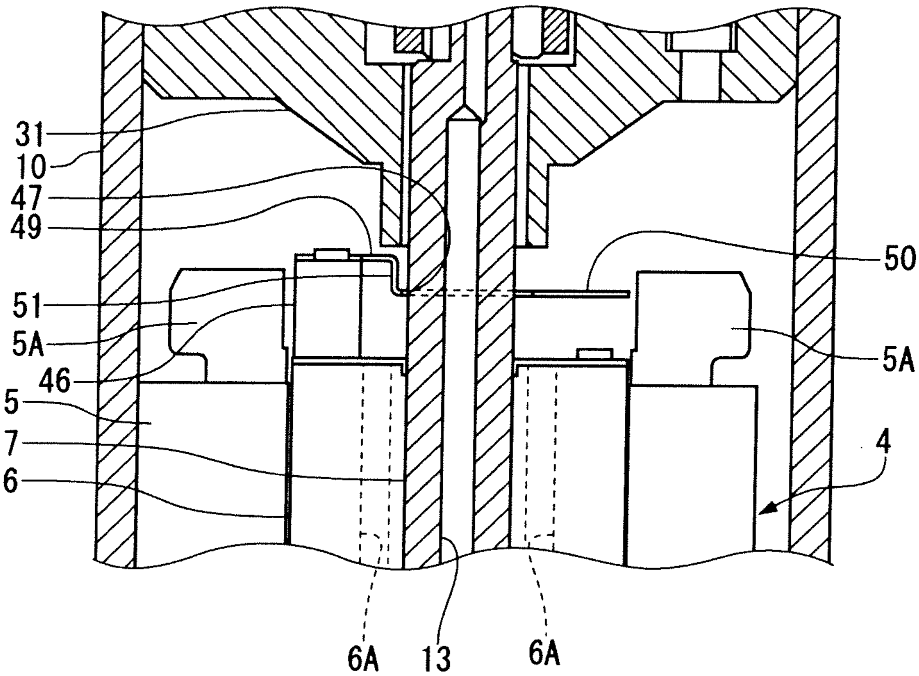


FIG. 5

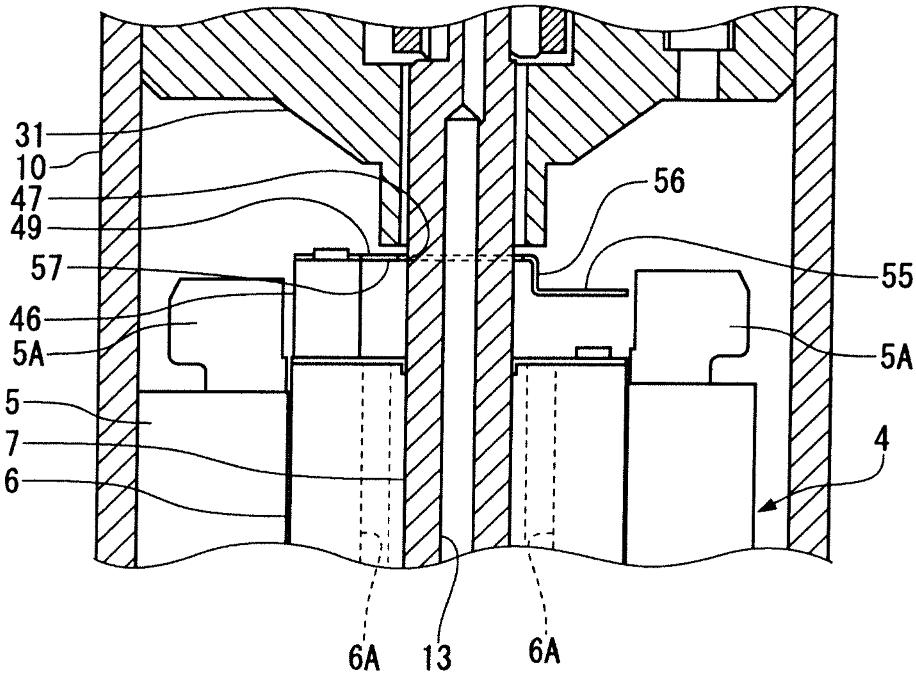


FIG. 6

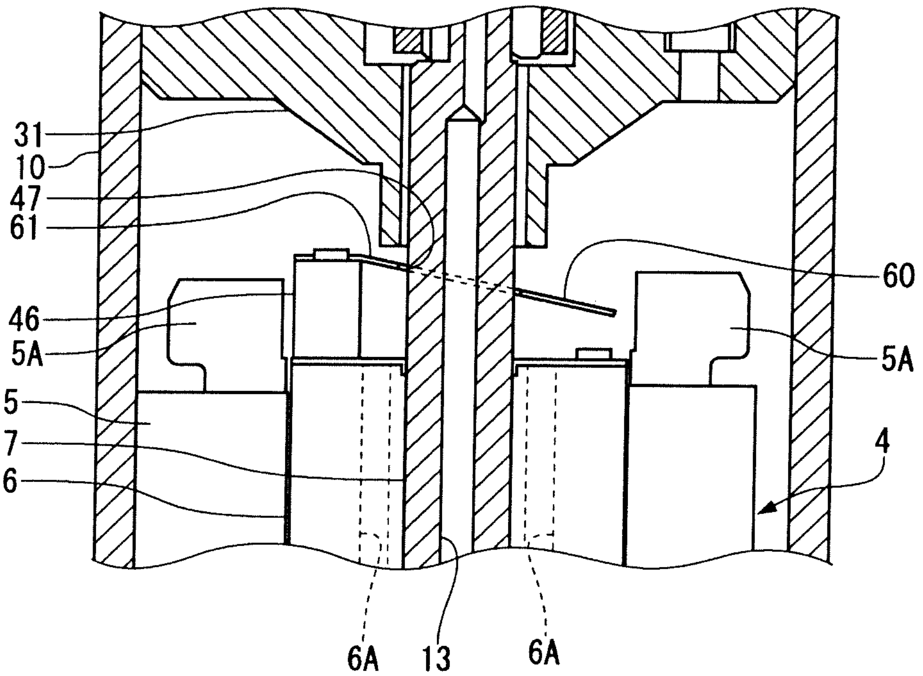


FIG. 7

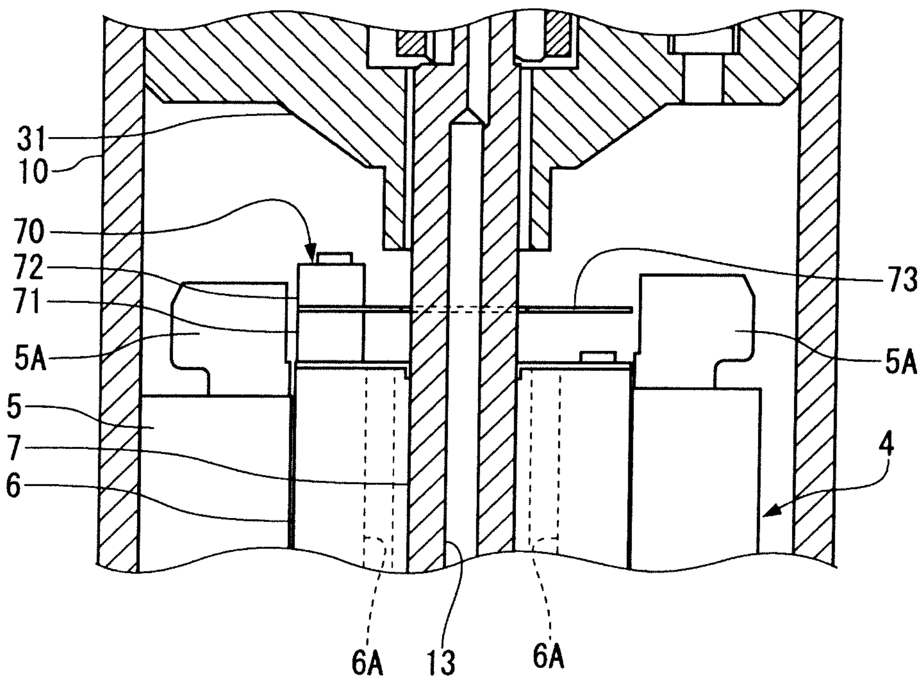


FIG. 8A

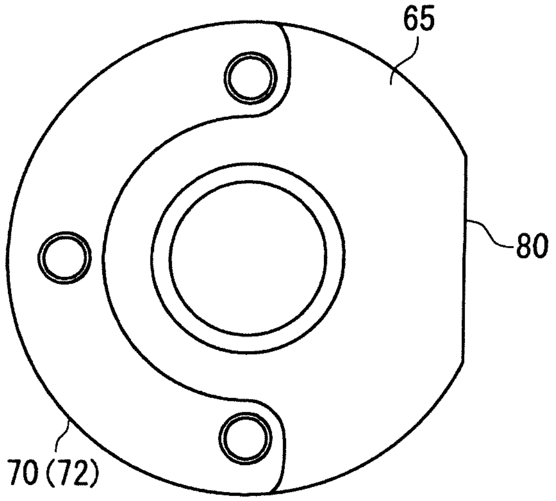


FIG. 8B

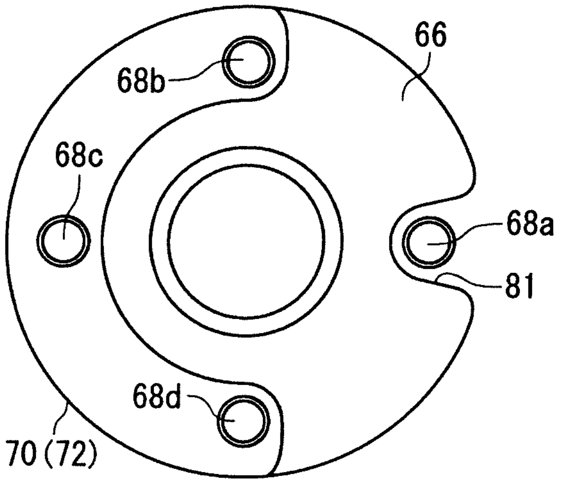


FIG. 8C

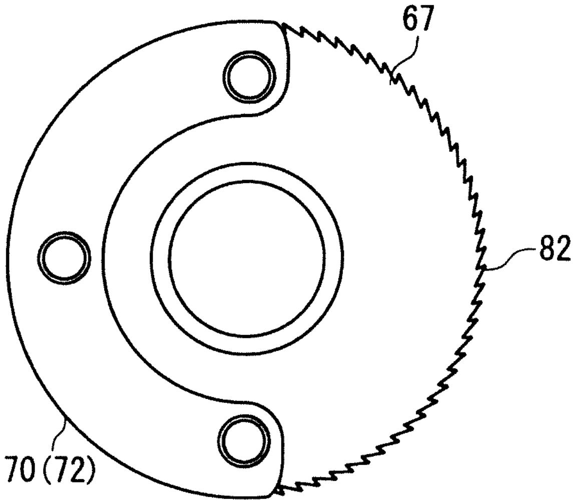


FIG. 9

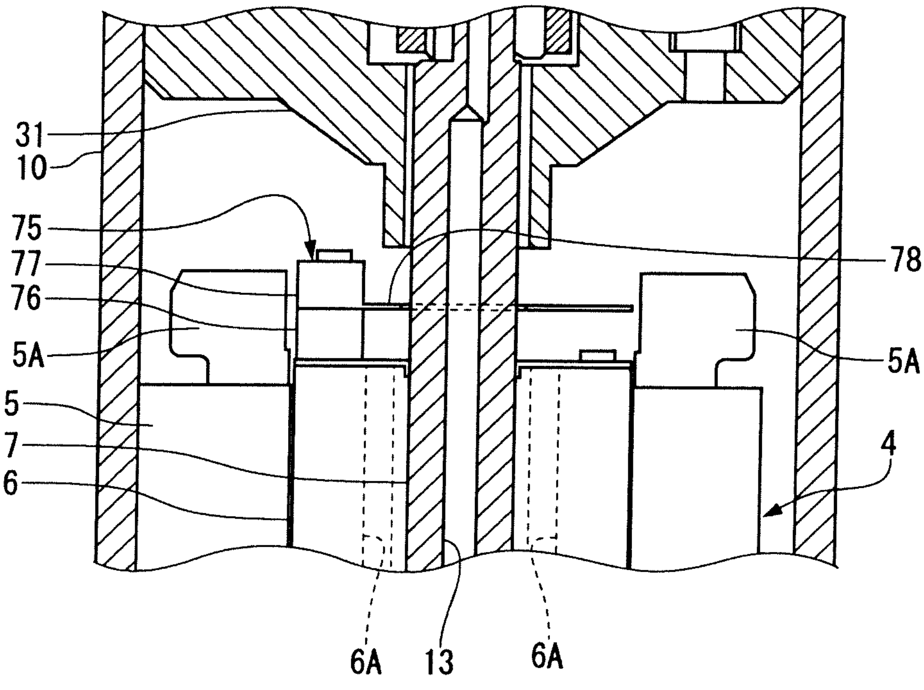


FIG. 10

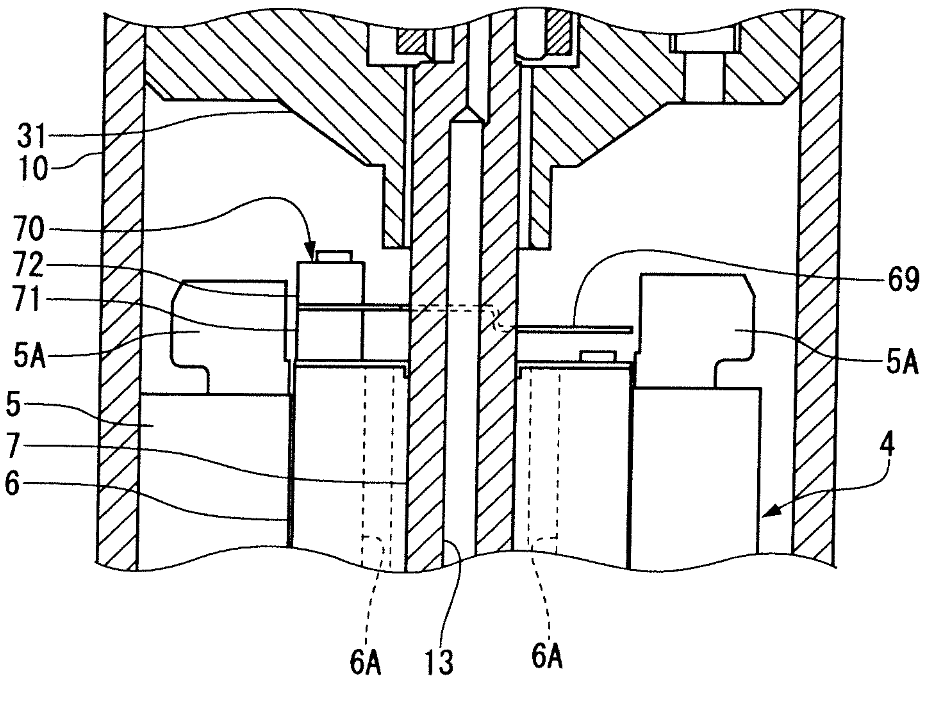


FIG. 11

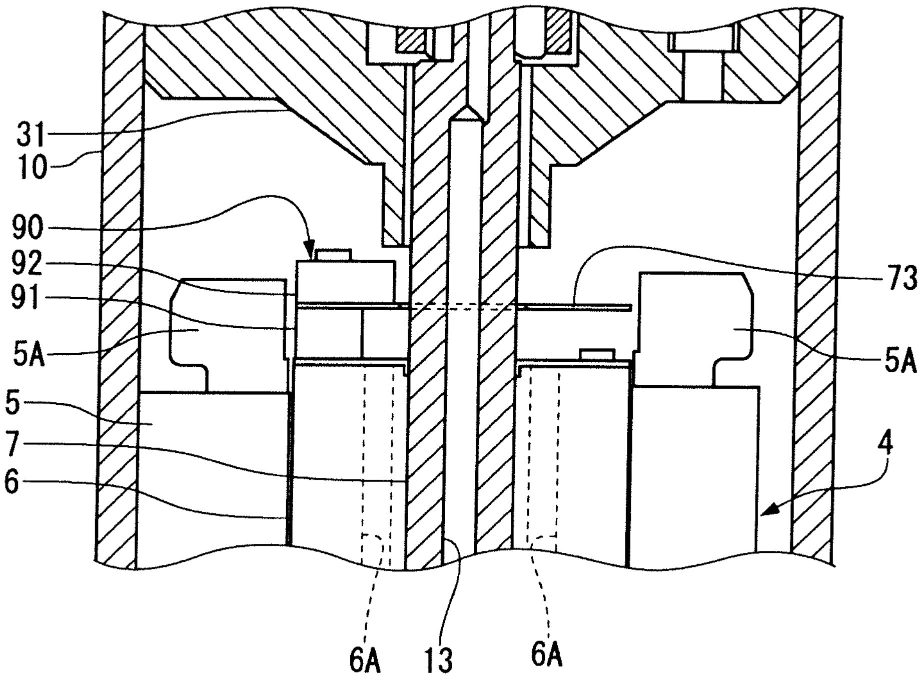


FIG. 12

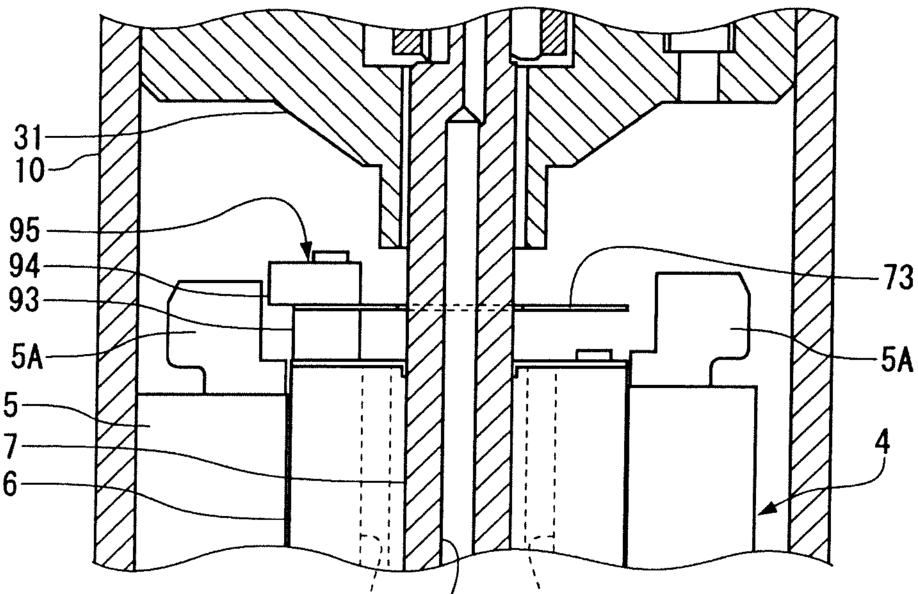


FIG. 13

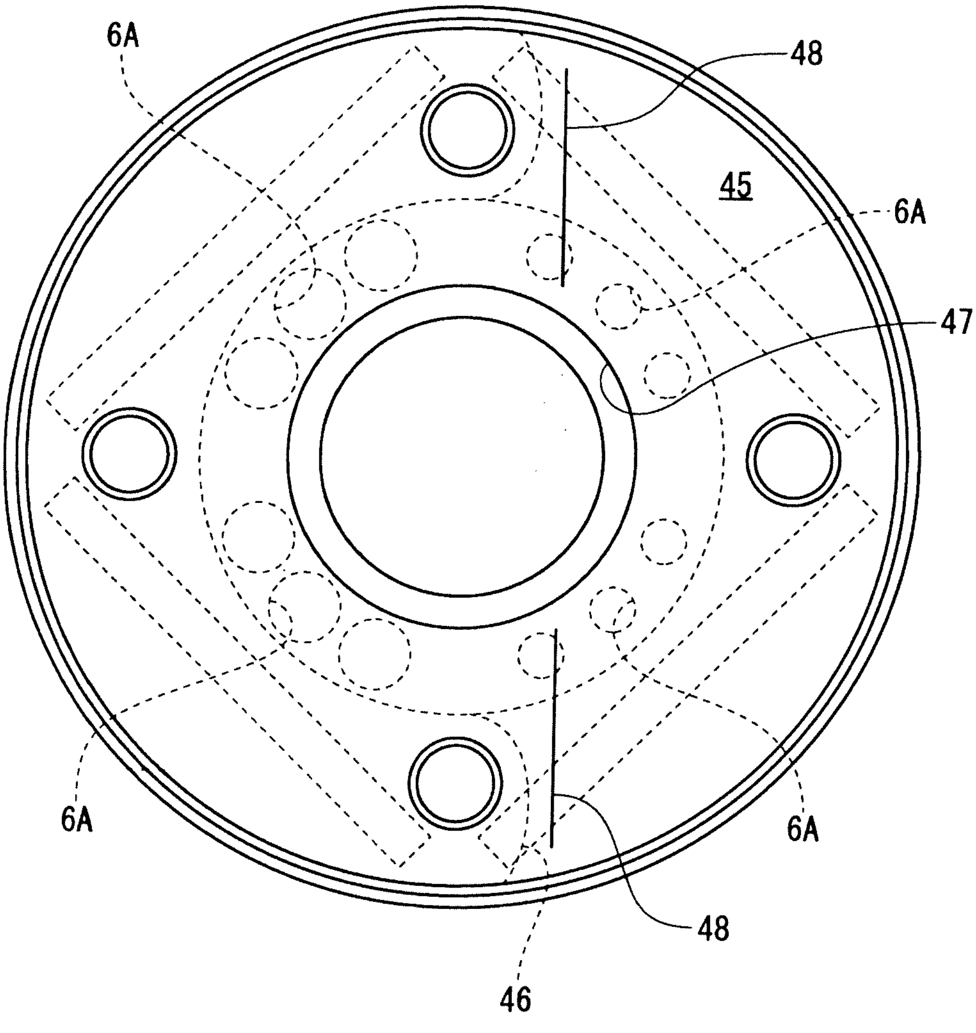


FIG. 14

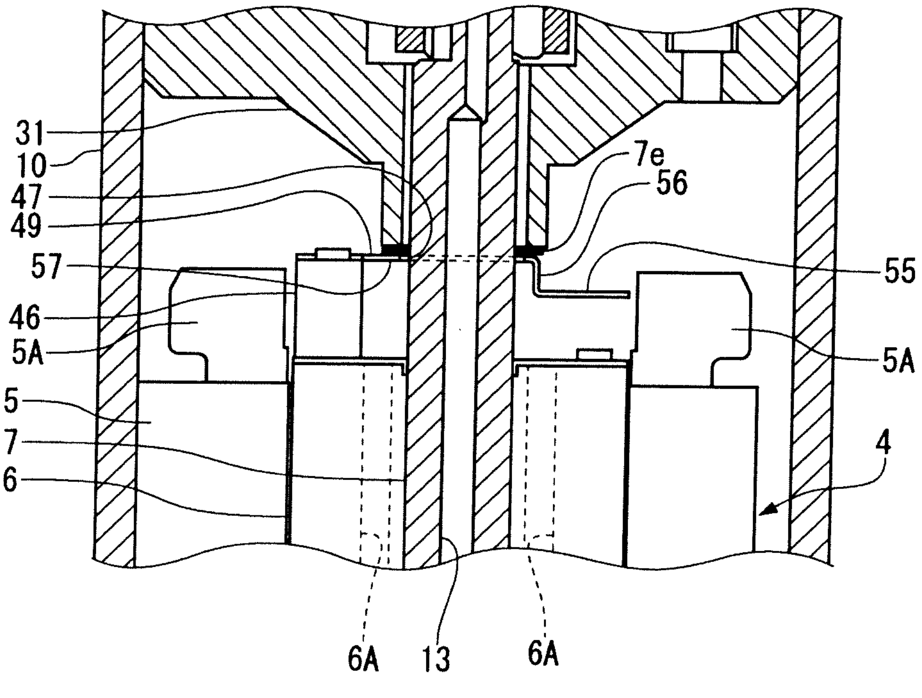
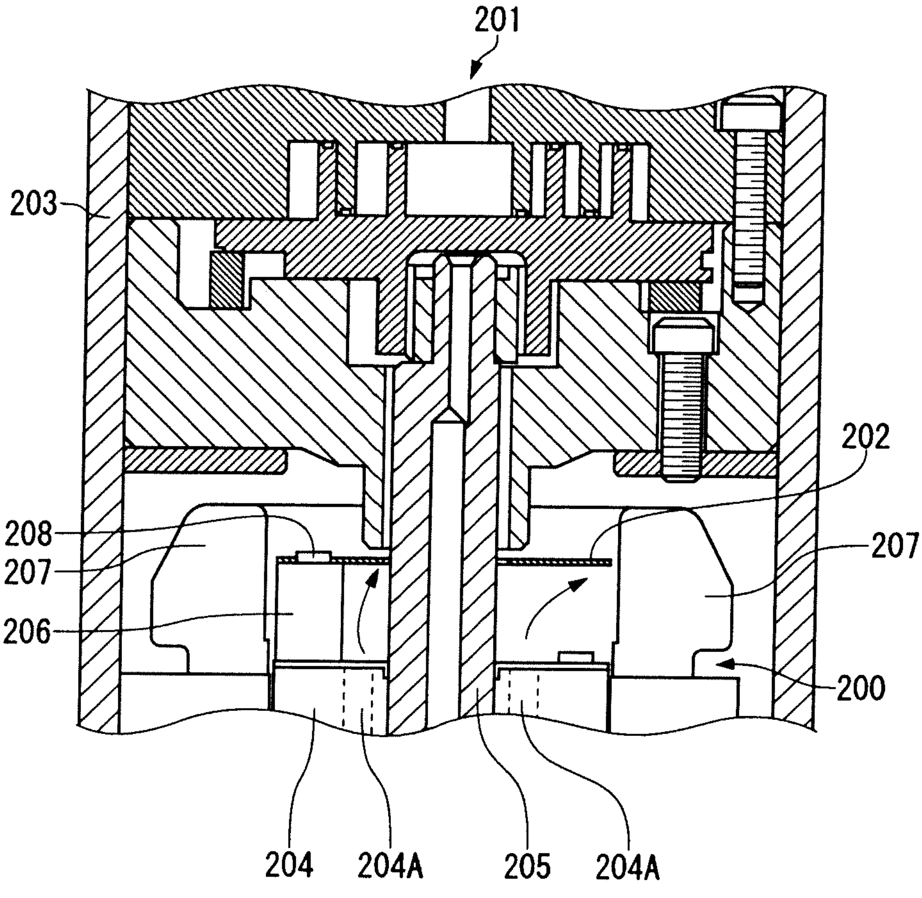


FIG. 15



REFERENCES CITED IN THE DESCRIPTION

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- JP 2009047039 A **[0007]**