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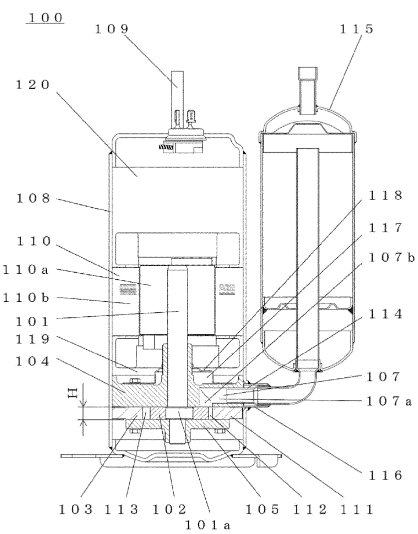
(54) ROTARY COMPRESSOR AND REFRIGERATION CYCLE DEVICE

(57) Each of a rotary compressor and a refrigeration cycle device of the present disclosure includes: a piston 102 driven by a drive shaft 101; a cylinder 103 accommodating the piston 102 which eccentrically rotates; an upper end plate 104 and a lower end plate 105 which close upper and lower opening surfaces of the cylinder 103; a vane 106 which partitions a space formed by the cylinder 103, the piston 102 and the upper and lower end plates 104, 105 into an intake chamber 112 and a compression chamber 113, and which is integrally operated with the piston 102; and an intake hole 107a which is provided at least in one of the upper and lower end plates 104, 105, and to which an intake pipe is connected, and intake gas being introduced from outside of the compressor 100 into the intake chamber 112 through the intake pipe. According to this, a cross-sectional area of leakage gap between the cylinder 103 and the vane 106 is reduced, leakage loss is reduced, a cross-sectional area of an intake passage is secured, increase in pressure loss is suppressed, and compressor efficiency can be enhanced.

[Fig. 1]



101 Drive shaft
102 Piston
103 Cylinder
104 Upper end plate (upper bearing)
105 Lower end plate (lower bearing)
107a Intake hole

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Description

[TECHNICAL FIELD]

[0001] The present disclosure relates to a rotary compressor and a refrigeration cycle device using the rotary compressor of an air conditioner, a freezing machine, a blower, a hot water supply system and the like.

[BACKGROUND TECHNIQUE]

[0002] Patent document 1 discloses a rotary compressor which reliably prevents a vane from jumping. This rotary compressor includes a cylinder whose both end openings are closed, a piston which rotates in the cylinder, a vane which forms a compression space together with the piston and the cylinder and which partitions the space into a high pressure side and a low pressure side, and connecting means for swingably connecting the piston and the vane to each other.

[PRIOR ART DOCUMENT]

[PATENT DOCUMENT]

[0003] [Patent Document 1] Japanese Patent Application Laid-open No.2000-120572

[SUMMARY OF THE INVENTION]

[PROBLEM TO BE SOLVED BY THE INVENTION]

[0004] The present disclosure provides a rotary compressor and a refrigeration cycle device in which a height of a cylinder is lowered to reduce leakage loss and a cross-sectional area of an intake passage is secured to suppress increase in pressure loss.

[MEANS FOR SOLVING THE PROBLEM]

[0005] Each of a rotary compressor and a refrigeration cycle device of the present disclosure includes: a drive shaft including an eccentric shaft; a piston fitted into the eccentric shaft; a cylinder accommodating the piston which eccentrically rotates; an upper end plate and a lower end plate which close upper and lower opening surfaces of the cylinder; a vane which partitions a space formed by the cylinder, the piston and the upper and lower end plates into an intake chamber and a compression chamber, and which is integrally operated with the piston; and an intake hole which is provided at least in one of the upper and lower end plates, and to which an intake pipe is connected, and intake gas being introduced from outside of the compressor into the intake chamber through the intake pipe.

[EFFECT OF THE INVENTION]

[0006] According to the rotary compressor and the refrigeration cycle device of the disclosure, a height of the cylinder can be lowered by increasing an inner diameter of the cylinder. Therefore, a cross-sectional area of a leakage gap between an inner periphery of the cylinder and an outer periphery of the piston is reduced to reduce leakage loss, and efficiency of the compressor can be enhanced. Further, since the intake passage is provided in any one of the upper and lower end plates, it is possible to secure an area of the intake passage, and to suppress the increase in pressure loss.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0007]

Fig. 1 is a vertical sectional view of a rotary compressor in a first embodiment of the present invention;
Fig. 2 is a lateral sectional view of a compression mechanism in the first embodiment of the invention;
Fig. 3 is an explanatory diagram of compressing action of the compression mechanism in the first embodiment of the invention;
Fig. 4 is a vertical sectional view of a rotary compressor in a second embodiment of the invention; and
Fig. 5 is a vertical sectional view of a rotary compressor in a third embodiment of the invention.

[MODE FOR CARRYING OUT THE INVENTION]

(Perception which becomes a basis of present disclosure)

[0008] When the present inventors achieved the present disclosure, a back surface of a vane of a rotary compressor was provided with a spring, the vane was pressed against a piston by a spring force and a pressure difference, and a compression chamber was formed by pressing action of the vane to carry out the compression. However, according to the conventional rolling type rotary compressor, the vane jumps by shortage of a pressing force under a load condition such as low compression ratio. Therefore, the rolling piston type has a problem that noise is deteriorated by collision between the vane and the piston, and performance is deteriorated by leakage from a gap between the vane and the piston.

[0009] Hence, there is conventionally proposed a technique in which a piston and a vane are swingably connected to each other and they are integrally operated to carry out the compression to prevent the vane from jumping. According to this, there are effects that it is possible not only to solve the above-described problem, but also eliminate the spring because it is unnecessary to press the vane by the spring, and reduce the number of parts and the number of assembling steps, and material costs are directly suppressed.

[0010] Further, according to a rotary compressor in which the piston and the vane integrally operate to carry out the compression, since a space for accommodating a spring is unnecessary, the vane can be placed on a more outer side as compared with the above-described rolling piston type rotary compressor. Hence, according to the rotary compressor, an inner diameter of the cylinder can be set larger and a height of the cylinder can be set lower. According to this, a cross-sectional area of a leakage gap of a seal portion between an outer periphery of the piston and an inner periphery of the cylinder can be made small, and leakage loss can be reduced.

[0011] However, if the height of the cylinder is set low, a diameter of the intake passage which is provided on the side of the outer periphery of the cylinder, and through which intake gas is introduced from outside of the compressor becomes small, and a sufficient cross-sectional area of the intake passage cannot be secured. Therefore, there are problems that pressure loss is increased in the intake procedure and efficiency of the compressor is deteriorated.

[0012] The present inventors found such a problem, and configured a subject matter of the present disclosure to solve the problem.

[0013] Hence, the disclosure provides a rotary compressor in which a height of the cylinder is lowered, leakage loss is reduced, a cross-sectional area of the intake passage is secured, and increase in pressure loss is suppressed.

[0014] Embodiments will be described below with reference to the drawings. However, description which is detail more than necessary will be omitted in some cases. For example, detailed description of already well known matters, or redundant description of substantially the same configuration will be omitted in some cases. This is for preventing the following description from becoming redundant more than necessary, and for making it easy for a person skilled in the art to understand the present disclosure.

[0015] The accompanying drawing and the following description are provided so that a person skilled in the art can sufficiently understand the present disclosure, and it is not intended that they limit the subject matter described in claims.

(First Embodiment)

[0016] A first embodiment will be described below using Figs. 1 to 3.

[1-1. Configuration]

[0017] In Figs. 1 and 2, a rotary compressor 100 includes a drive shaft 101, a piston 102, a cylinder 103, an upper end plate (upper bearing, hereinafter) 104 having a function as an upper bearing, a lower end plate (lower bearing, hereinafter) 105 having a function as a lower bearing, a vane 106 and an intake hole 107a.

[0018] An entire interior of a hermetic container 108 is discharge pressure atmosphere which is in communication with a discharge pipe 109. An electric motor 110 is accommodated in a central portion of the hermetic container 108, and a compression mechanism 111 is accommodated in a lower portion of the hermetic container 108. The compression mechanism 111 is driven by the drive shaft 101 which is fixed to a rotor 110a of the electric motor 110.

[0019] In the compression mechanism 111, the cylinder 103, the piston 102 and the vane 106 are sandwiched between the upper bearing 104 and the lower bearing 105, a space formed between the cylinder 103 and the piston 102 is partitioned by the vane 106, thereby forming an intake chamber 112 and a compression chamber 113, and compressing action is carried out.

[0020] An eccentric shaft 101a which is integrally formed with the drive shaft 101 is accommodated in the cylinder 103, and the piston 102 is rotatably attached to the eccentric shaft 101a. An engaging groove 102a is formed in an outer periphery of the piston 102. An engaging portion 106a is formed on a tip end of the vane 106, and the vane 106 is swingably connected to the piston 102. There is not a spring which is provided on a back surface of the vane 106 of a conventional rolling piston type compressor.

[0021] The upper bearing 104 is provided with an intake passage 107 which is composed of a radial intake hole 107a and an axial vertical hole 107b. The intake passage 107 is in communication with the intake chamber 112. An intake liner 114 is press-fitted into the intake hole 107a. The intake liner 114 separates high temperature and high pressure discharge gas in the hermetic container 108 and low temperature and low pressure intake gas in the intake hole 107a.

[0022] An accumulator 115 for preventing liquid of the compressor from being compressed is inserted into the intake liner 114. The accumulator 115 is connected together with an intake outer pipe 116 with wax or welding. The intake outer pipe 116 is fixed to the hermetic container 108. Working fluid is sucked into the rotary compressor 100. The accumulator 115 separates the working fluid into gas and liquid.

[0023] That is, the first embodiment is configured such that intake gas from outside of the compressor 100 is introduced into the intake chamber 112 through an intake pipe which is composed of the intake liner 114 and the intake outer pipe 116. The accumulator 115 is inserted into the intake liner 114. The intake pipe may be composed of only the accumulator 115 and the intake outer pipe 116, and the accumulator 115 may be connected directly to the intake hole 107a.

[0024] The rotary compressor 100 of the first embodiment uses carbon dioxide as the working fluid.

[1-2. Action]

[0025] Action of the rotary compressor 100 configured as described above will be described below based on Figs. 1 and 3.

[1-2-1. Compressing action]

[0026] Fig. 3 is a diagram for explaining volume variations of the intake chamber 112 and the compression chamber 113 whenever the crank angle is changed by 90°, and the volume is changed in directions of open arrows. The intake passage 107 of the upper bearing 104 which is not illustrated in Fig. 3 is located on the left side of the vane 106, and the intake passage 107 is in communication with the intake chamber 112.

[0027] If the electric motor 110 is biased and the drive shaft 101 rotates, the eccentric shaft 101a eccentrically rotates in the cylinder 103, and the connected piston 102 and the vane 106 integrally operate. According to this, suction action and compression action of the working fluid are repeated.

[0028] Low temperature and low pressure gas is sucked into the intake chamber 112 through the accumulator 115, the intake liner 114 and the intake passage 107. The low temperature and low pressure intake gas is compressed by the compression mechanism 111. The compressed high temperature and high pressure gas passes through a discharge hole (not shown) which is provided in the upper bearing 104 and which is in communication with the compression chamber 113, and the gas is discharged into a muffler chamber 117 (see Fig. 1) through a check valve. Thereafter, the discharge gas passes through each gap of a small hole provided in a muffler 118, an electric motor lower space 119 located between the compression mechanism 111 and the electric motor 110, and the electric motor 110. Then, the discharge gas is guided into an electric motor upper space 120, and discharged from the rotary compressor 100 through the discharge pipe 109.

[1-2-2. Refueling action]

[0029] Oil is stored in a lower portion of the hermetic container 108, and the compression mechanism 111 is normally immersed in oil. An oil passage (not shown) is provided in the drive shaft 101 in its axial direction. Oil pumped up from a lower end of the oil passage passes through a refueling hole (not shown) provided in the eccentric shaft 101a, lubricates a sliding portion of the eccentric shaft 101a, and reaches an inner periphery of the piston 102. Then, one portion of the oil lubricates journal bearing sliding portions of the upper bearing 104 and the lower bearing 105, and is discharged to outside of the compression mechanism 111. The other portion of the oil lubricates upper and lower end surfaces of the piston 102 and sliding portions of the upper bearing 104 and the lower bearing 105, and is supplied to the intake chamber 112 and the compression chamber 113.

[0030] Oil supplied from a back surface of the vane 106 lubricates a sliding portion of the vane 106 and thereafter, the oil is supplied to the intake chamber 112 and the compression chamber 113. The oil in the intake chamber 112 and the compression chamber 113 is discharged out from a discharge hole 121 together with gas and then, the oil moves into a current of the gas and reaches the discharge pipe 109. In the meantime, most of oil is separated from discharge gas and liquidized, and returns to a lower portion of the hermetic container 108 by gravity.

[1-3. Effect and the like]

[0031] As described above, in the embodiment, the rotary compressor 100 includes the drive shaft 101, the piston 102, the cylinder 103, the upper bearing 104, the lower bearing 105, the vane 106 and the intake hole 107a. The drive shaft 101 includes the eccentric shaft 101a. The piston 102 is fitted into the eccentric shaft 101a. The piston 102 which eccentrically rotates is accommodated in the cylinder 103. The upper bearing 104 and the lower bearing 105 close upper and lower opening surfaces of the cylinder 103. A space is formed by the cylinder 103, the piston 102, the upper bearing 104 and the lower bearing 105. The vane 106 partitions this space into the intake chamber 112 and the compression chamber 113, and the vane 106 integrally operates with the piston 102. The intake hole 107a is not provided in the cylinder 103 but is provided in the upper bearing 104, and the intake liner 114 and the accumulator 115 are connected to the intake hole 107a. The intake liner 114 and the accumulator 115 introduce intake gas from the rotary compressor 100 into the intake chamber 112.

[0032] According to this, in the case of the conventional rolling piston type compressor, a spring is required on the back surface of the vane 106, but in the case of the rotary compressor 100, a spring is not required. Correspondingly, the inner diameter D of the cylinder 103 can be made large, and the height H thereof can be lowered. Hence, a cross-sectional area of the leakage gap of a contact point seal portion between the outer periphery of the piston 102 and the inner periphery of the cylinder 103 is reduced, and leakage loss from the compression chamber 113 into the intake chamber 112 can be reduced. Simultaneously, the intake hole 107a has a sufficiently large diameter, and the cross-sectional area of the intake passage 107 can be secured. Therefore, when the intake hole 107a having a small diameter is provided in the cylinder 103 having low height H, pressure loss is generated in the intake passage 107, but the pressure loss is not increased, and efficiency of the compressor can be enhanced.

[0033] The rotary compressor 100 of the embodiment uses carbon dioxide as the working fluid.

[0034] According to this carbon dioxide refrigerant, a pressure difference between the intake chamber 112 and the compression chamber 113 is larger than that of other refrigerant such as HFC-based refrigerant, HC-based refrigerant and HFO-based refrigerant. Hence, influence in which leakage loss at the seal portion between the piston 102 and the cylinder 103 exerts on compressor efficiency is large. However, according to the configuration of the present disclosure, since the height H of the cylinder 103 can be set extremely low, the area of the seal portion between the piston 102 and the cylinder 103 can be reduced. Therefore, it is possible to more effectively reduce the leakage loss and to enhance the compressor efficiency.

[0035] According to the rotary compressor 100 of the embodiment, a ratio D/H of the inner diameter D and the height H of the cylinder 103 is in a range of 2 to 13.

[0036] According to this, it is possible to avoid a case in which the above-described effect is lowered because D/H is too small, and a case in which the surface areas of the intake chamber 112 and the compression chamber 113 are increased because D/H is too large and the heat receiving loss is increased. Hence, it is possible to enhance the compressor efficiency at a maximum.

[0037] It is more preferable that the D/H is in a range of 2 to 8.

[0038] According to this, it is possible to avoid a case in which a distance between an axis of the drive shaft 101 and an axis of the eccentric shaft 101a, i.e., an eccentric amount becomes extremely large and insertion performance of the piston 102 is deteriorated. Hence, it is possible to realize the efficient rotary compressor 100 which can easily be assembled.

[0039] According to the rotary compressor 100 of the embodiment, the engaging groove 102a is formed in the piston 102 and the engaging portion 106a is provided on a tip end of the vane 106. The engaging portion 106a is swingably connected by fitting the engaging portion 106a into the engaging groove 102a of the piston 102.

[0040] According to this, it is unnecessary to largely change a design of the piston 102, and the number of parts is not increased. Therefore, increase of costs can be suppressed to the minimum.

[0041] The rotary compressor 100 of the embodiment is used in a refrigeration cycle device. Since the piston 102 and the vane 106 are connected to each other using the above-described configuration, jumping of the vane which is the problem in the conventional rolling piton type is not generated, and it is possible to reduce noise and enhance efficiency. Hence, the rotary compressor and the refrigeration cycle device can be operated under an operation condition such as low pressure compression ratio. Since the operation range of the rotary compressor 100 is widened, a freedom degree of the operation of the refrigeration cycle device is enhanced, and system efficiency can be enhanced.

[0042] The rotary compressor 100 of the embodiment is used in a heat pump hot water supply system.

[0043] Temperature of discharge gas of the heat pump hot water supply system is higher than that of other refrigeration cycle device. Hence, temperature of the lower bearing 105 which is exposed to high temperature discharge gas becomes high, the lower bearing 105 receives heat of low temperature intake gas which passes through the intake passage 107, and volume efficiency is deteriorated. However, in the rotary compressor of the disclosure, since the inner diameter D of the cylinder 103 is large, i.e., since a distance between an inner wall of the hermetic container 108 and an inner wall of the cylinder 103 is short, a length of the intake passage 107 is also short. Hence, heat of intake gas is less prone to be received, and volume efficiency can more effectively be enhanced.

(Second Embodiment)

[0044] A second embodiment will be described below using Fig. 4.

[2-1. Configuration]

[0045] In a rotary compressor 200 of the second embodiment, two cylinders, i.e., an upper cylinder 2031 and a lower cylinder 2032 are constituted, and a partition plate 221 is provided between the upper cylinder 2031 and the lower cylinder 2032. This point is different from the rotary compressor 100 composed of the one cylinder 103 in the first embodiment.

[0046] The upper cylinder 2031, an upper piston 2021 and an upper vale (not shown) are sandwiched between an upper bearing 204 and a partition plate 221, the lower cylinder 2032, a lower piston 2022 and a lower vane (not shown) are sandwiched between the partition plate 221 and a lower bearing 205, and a space formed between the upper and lower cylinders 2031, 2032 and the upper and lower pistons 2021 and 2022 is partitioned by the upper and lower vanes. According to this, an upper intake chamber 2121, a lower intake chamber 2122 (not numbered), an upper compression chamber 2131 (not numbered) and a lower compression chamber 2132 are formed, and respective compression elements carry out compressing operations.

[0047] The upper bearing 204 is provided with an upper intake passage 2071. The upper intake passage 2071 is composed of a radial upper intake hole 2071a and an axial and an axial upper vertical hole 2071b, and the upper intake passage 2071 is in communication with the upper intake chamber 2121. The lower bearing 205 is provided with the lower intake passage 2072. The lower intake passage 2072 is composed of a radial lower intake hole 2072a and an axial lower vertical hole 2072b, and the lower intake passage 2072 is in communication with the lower intake chamber 2122.

[0048] A trapping volume of the rotary compressor 200 is the same as that of the rotary compressor 100 of the first embodiment, but since the two cylinders 2031 and 2032 share the volume, height Hu and Hl of the cylinders 2031 and 2032 are lower than the height H of the cylinder 103 of the rotary compressor 100 of the first embodiment.

[2-2. Action]

[0049] Action of the rotary compressor 200 configured as described above will be described below.

[2-2-1. Intake action]

[0050] Intake gas which is separated into gas and liquid by an accumulator 215 branches into two pipes, and is sucked from the upper and lower intake passages 2071 and 2072 into upper and lower intake chambers 2121 and 2122.

[2-2-2. Compressing action]

[0051] Compressing actions of the completion elements of the rotary compressor 200 are the same as those of the rotary compressor 100 of the first embodiment. However, upper lower compression chambers 2131 and 2132 carry out completion in opposite phase.

[0052] Lower discharge gas compressed by the lower cylinder 2032 flows into a muffler chamber 217 through a communication passage (not shown), and joins up with upper discharge gas which is compressed by the upper cylinder 2031. Flow of the discharge gas thereafter is the same as that of the rotary compressor 100 of the first embodiment.

[2-3. Effect and the like]

[0053] As described above, in this embodiment, the rotary compressor 200 includes a drive shaft 201, the upper piston 2021, the lower piston 2022, the upper cylinder 2031, the lower cylinder 2032, an upper bearing 204, a lower bearing 205, upper and lower vanes, the upper intake hole 2071a, the lower intake hole 2072a and a partition plate 221. Upper and lower compression elements are configured in the axial direction. The partition plate 221 is provided between the upper and lower compression elements. An upper bearing 204 and the lower bearing 205 support the drive shaft 201. The upper intake hole 2071a is provided in the upper bearing 204, and the lower intake hole 2072a is provided in the lower bearing 205.

[0054] According to this, by carrying out compression by the upper and lower pistons 2021 and 2022 in the opposite phase, it is possible to reduce torque variation as compared with the rotary compressor 100 of the first embodiment, and reduce vibration. Inner diameters D of the upper cylinder 2031 and the lower cylinder 203 are increased and heights Hu and Hl are reduced. Therefore, cross-sectional areas of leakage gases between outer peripheries of the pistons 2021 and 2022, inner diameters of the cylinders 2031 and 2032 and contact point seal portion are further reduced, and leakage loss from the compression chambers 2131 and 2132 into the intake chambers 2121 and 2122 can be reduced. In addition, the upper bearing 204 and the lower bearing 205 are provided with the upper intake hole 2071a and the lower intake hole 2072a. According to this, diameters of the intake holes 2071a and 2072a can sufficiently be increased, and cross-sectional areas of the intake passages 2071 and 2072 can sufficiently be secured. Therefore, when the cylinders 2031 and 2032 having low heights Hu and Hl are provided with the intake holes 2071a and 2072a having small diameters, pressure loss is generated in the intake passages 2071 and 2072, but the pressure loss is not increased, and efficiency of the compressor can further be enhanced.

(Third Embodiment)

[0055] A third embodiment will be described below using Fig. 5.

[3-1. Configuration]

[0056] A rotary compressor 300 of the third embodiment is different from the rotary compressor 200 of the second embodiment at least in that a partition plate 321 is provided with an intake hole 307a instead of an upper bearing 304 and a lower bearing 305.

[0057] The partition plate 321 is provided with an intake passage 307. The intake passage 307 is composed of a radial intake hole 307a, an upper vertical hole 307b which is in communication with an upper intake chamber 3121, and a lower vertical hole 307c which is in communication with a lower intake chamber 3122 (not numbered).

[3-2. Action]

[0058] Action of the rotary compressor 300 configured as described above will be described below.

[3-2-1. Suction action]

[0059] Intake gas which is separated into gas and liquid in an accumulator 315 is distributed into upper and lower portions in the intake passage 307, and is sucked into upper and lower intake chambers 3121 and 3122.

[3-2-2. Compressing action]

[0060] Gas sucked into the upper and lower intake chambers 3121 and 3122 is compressed in the same manner as that of the second embodiment.

[3-3. Effect and the like]

[0061] As described above, in the embodiment, the rotary compressor 300 includes a drive shaft 301, an upper piston 3021, a lower piston 3022, an upper cylinder 3031, a lower cylinder 3032, an upper bearing 304, a lower bearing 305, upper and lower vanes, the intake hole 307a and the partition plate 321. Upper and lower compression elements are configured in the axial direction. The partition plates 321 is provided between the upper and lower compression elements. The upper bearing 304 and the lower bearing 305 support the drive shaft 301. The partition plate 321 is provided with the intake hole 307a.

[0062] According to this, the accumulator 115 of the rotary compressor 100 in which one cylinder 103 of the first embodiment is configured can be used as it is. Hence, as compared with the rotary compressor 200 of the second embodiment, the number of parts and the number of assembling steps can be reduced, and it is possible to realize the inexpensive accumulator 315 and the inexpensive rotary compressor 300. Other effects are the same as those of the second embodiment.

(Other Embodiments)

[0063] As described above, the first to third embodiments are described as examples of techniques disclosed in the present application. However, the technique in this disclosure is not limited to this, and the technique can be applied to changed, replaced, added and omitted embodiments also. Further, constituent elements described in the above first to third embodiments can be combined as new embodiments.

[0064] Other embodiments will be described below.

[0065] In the first to third embodiments, the rotary compressor 100 of one cylinder and the rotary compressors 200 and 300 of two cylinders are described as one examples of the rotary compressor. It is only necessary that the rotary compressor compresses gas. Therefore, the rotary compressor is not limited to the rotary compressor 100 of one cylinder or the rotary compressors 200 and 300 of two cylinders. However, if the rotary compressor 100 of one cylinder or the rotary compressors 200 and 300 of two cylinders are used, there are merits that balance between costs, efficiency and reliability is kept and volume production can be made. As the rotary compressor, a two-stage compressor may be used. If the two-stage compressor is used as the rotary compressor, a pressure difference can be reduced even under an operating condition having a high pressure ratio and therefore, high efficiency can be realized by small leakage loss. Further as the rotary compressor, one cylinder may include a plurality of vanes and compression chambers. If this is used, torque variation can be reduced by carrying out the compression action which is substantially the same as that of the two-cylinder type in the configuration of the rotary compressor 100 of the one cylinder, and a pressure difference can be reduced if the two-stage compression configuration is employed. Therefore it is possible to realize a rotary compressor capable of carrying out low vibration and high pressure ratio operation with the small number of parts.

[0066] In the first embodiment, vane 106 having the engaging portion 106a which is swingably fitted into and connected to the engaging groove 102a formed in the piston 102 was described as one example of the vane. The vane partitions the intake chamber and the compression chamber from each other, the vane is always operated integrally with the piston, and a spring is unnecessary on the back surface of the vane. Therefore, the vane is not limited to the vane 106 including the engaging portion 106a which is swingably fitted into and connected to the engaging groove 102a formed in the piston 102. However, if this is used, it is unnecessary to largely change the design of the piston 102 as described above, and the number of parts is not increased and therefore, increase of costs can be suppressed to the minimum. As the vane, if a swing type vane which is completely integrally formed with the piston and in which the piston is swingably operated through a swinging bush provided in the cylinder is used, there is no contact point between the vane and the piston. Hence, leakage loss and sliding loss are eliminated completely in a very small gap, and efficiency of the rotary compressor 100 can be enhanced.

[0067] Further, in the first embodiment, carbon dioxide is described as one example of working fluid. Any working fluid may be used only if compressible fluid. Therefore, the working fluid is not limited to carbon dioxide. However, if carbon dioxide is used, a pressure difference between the intake chamber 112 and the compression chamber 113 is large as compared with other refrigerant such as HFC-based refrigerant, HC-based refrigerant and HFO-based refrigerant as described above, and influence in which leakage loss exerts on the efficiency of the compressor at the seal portion between the piston 102 and the cylinder 103 is large. However, if the height H of the cylinder 103 is set extremely low using the configuration of this disclosure, leakage loss can more effectively be reduced. Further, if mixture refrigerant of other HFO-based refrigerant and carbon dioxide is used to the HFC-based refrigerant and HC-based refrigerant as working fluid, it is possible to suppress temperature glide between an inlet and an outlet of a capacitor of the refrigeration cycle. Hence, it is possible to suppress the deterioration of heat exchanging efficiency of the capacitor.

[0068] The above-described embodiments are for exemplifying the techniques of the disclosure and therefore, the embodiments can variously be changed, replaced, added and omitted within patent claims and equable scope.

[INDUSTRIAL APPLICABILITY]

[0069] The present disclosure can be applied to a rotary compressor and a refrigeration cycle device in which leakage loss and pressure loss are generated. More specifically, the present disclosure can be applied to an air conditioner, a freezing machine, a blower, a hot water supply system and the like.

[DESCRIPTION OF SYMBOLS]

[0070]

100	rotary compressor
101, 201, 301	drive shaft
101a	eccentric shaft
102	piston
102a	engaging groove
103	cylinder
104, 204, 304	upper bearing (upper end plate)
105, 205, 305	lower bearing (lower end plate)
106	vane
106a	engaging portion
107	intake passage
107a	intake hole
107b	vertical hole
108	hermetic container
109	discharge pipe
110	electric motor
110a	rotor
110b	stator
111	compression mechanism
112	intake chamber
113	compression chamber
114	intake liner (intake pipe)
115	accumulator (intake pipe)
116	intake outer pipe (intake pipe)
117	muffler chamber
118	muffler
119	electric motor lower space
120	electric motor upper space
200	rotary compressor
2021	upper piston
2022	lower piston
2031	upper cylinder
2032	lower cylinder
2071	upper intake passage
2071a	upper intake hole
2071b	upper vertical hole
2072	lower intake passage
2072a	lower intake hole
2072b	lower vertical hole
2121	upper intake chamber
2122	lower intake chamber
2131	upper compression chamber
2132	lower compression chamber
215	accumulator
217	muffler chamber
221	partition plate
300	rotary compressor
3021	upper piston
3022	lower piston
3031	upper cylinder
3032	lower cylinder
307	intake passage
307a	intake hole
307b	upper vertical hole
307c	lower vertical hole
3121	upper intake chamber
3122	lower intake chamber
315	accumulator
321	partition plate

Claims

1. A rotary compressor comprising:

a drive shaft including an eccentric shaft;
a piston fitted into the eccentric shaft;
a cylinder accommodating the piston which eccentrically rotates;
an upper end plate and a lower end plate which close upper and lower opening surfaces of the cylinder;
a vane which partitions a space formed by the cylinder, the piston and the upper and lower end plates into an intake chamber and a compression chamber, and which is integrally operated with the piston; and
an intake hole which is provided at least in one of the upper and lower end plates, and to which an intake pipe is connected, and intake gas being introduced from outside of the compressor into the intake chamber through the intake pipe.

2. The rotary compressor according to claim 1, further comprising:

a plurality of compression elements in an axial direction of the rotary compressor, the compression elements being composed of the cylinder, the piston and the vane; and
a partition plate located between the plurality of compression elements; wherein
upper and lower bearings which support the drive shaft at upper and lower locations, and the partition plate are configured as the upper and lower end plates.

3. The rotary compressor according to claim 1 or 2, wherein
carbon dioxide is used as working fluid.

4. The rotary compressor according to any one of claims 1 to 3, wherein a ratio D/H of an inner diameter D and a height H of the cylinder is in a range of 2 to 13.

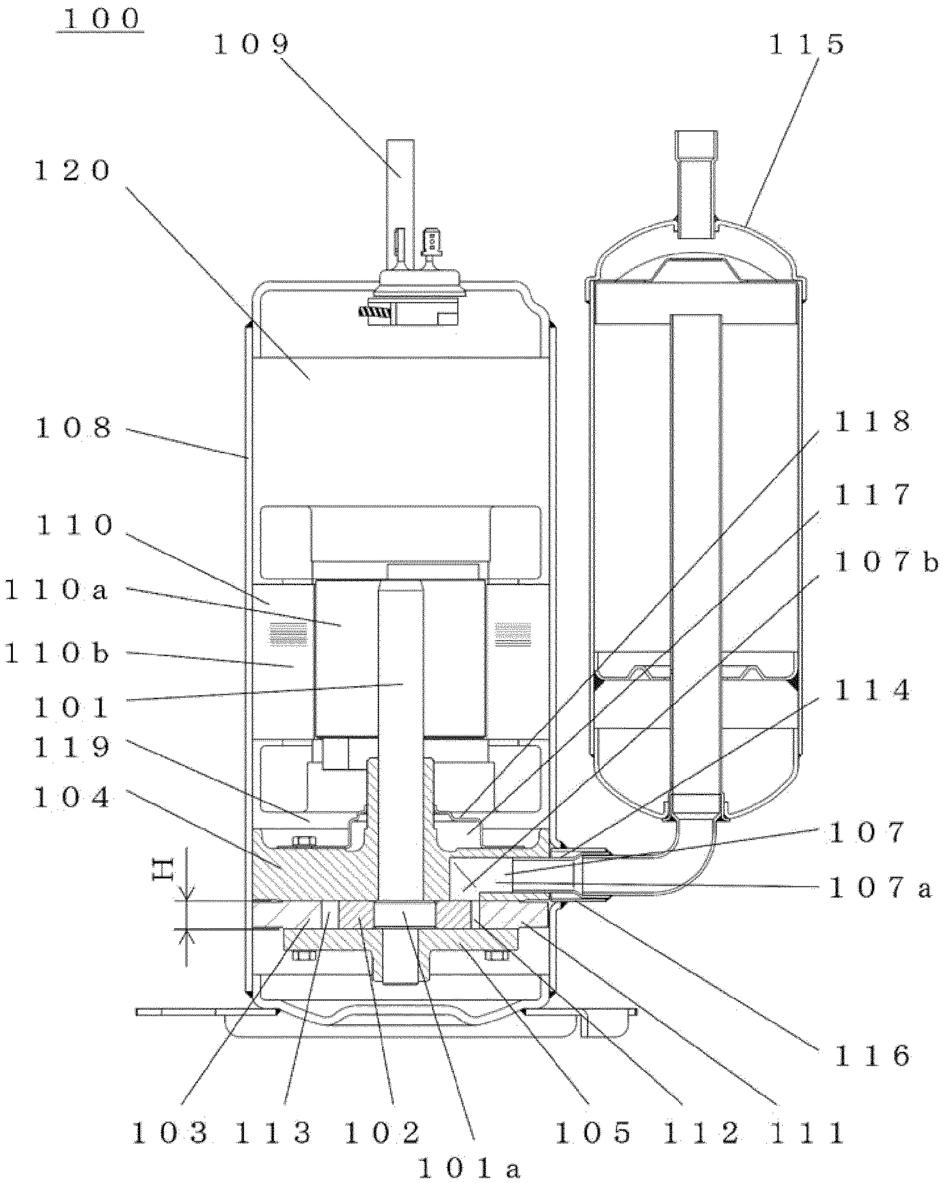
5. The rotary compressor according to any one of claims 1 to 4, further comprising:

an engaging groove formed in the piston; and
an engaging portion provided on a tip end of the vane and swingably fitted into and connected to the engaging groove.

6. A refrigeration cycle device comprising the rotary compressor according to any one of claims 1 to 5.

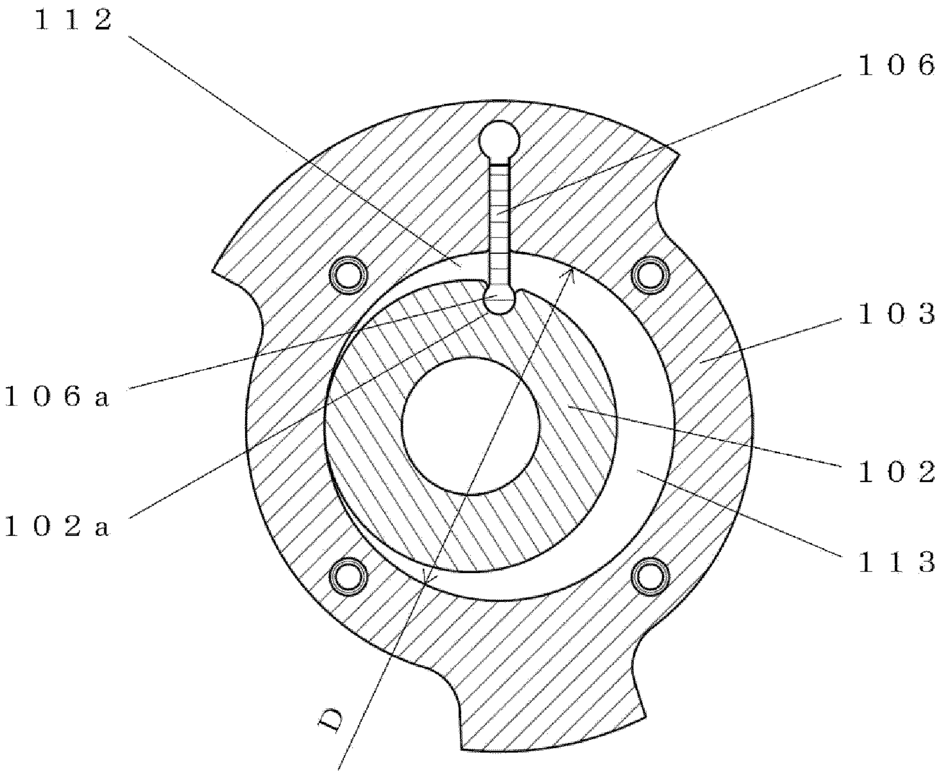
7. The refrigeration cycle device according to claim 6, wherein the refrigeration cycle device is a heat pump hot water supply system.

[Fig. 1]

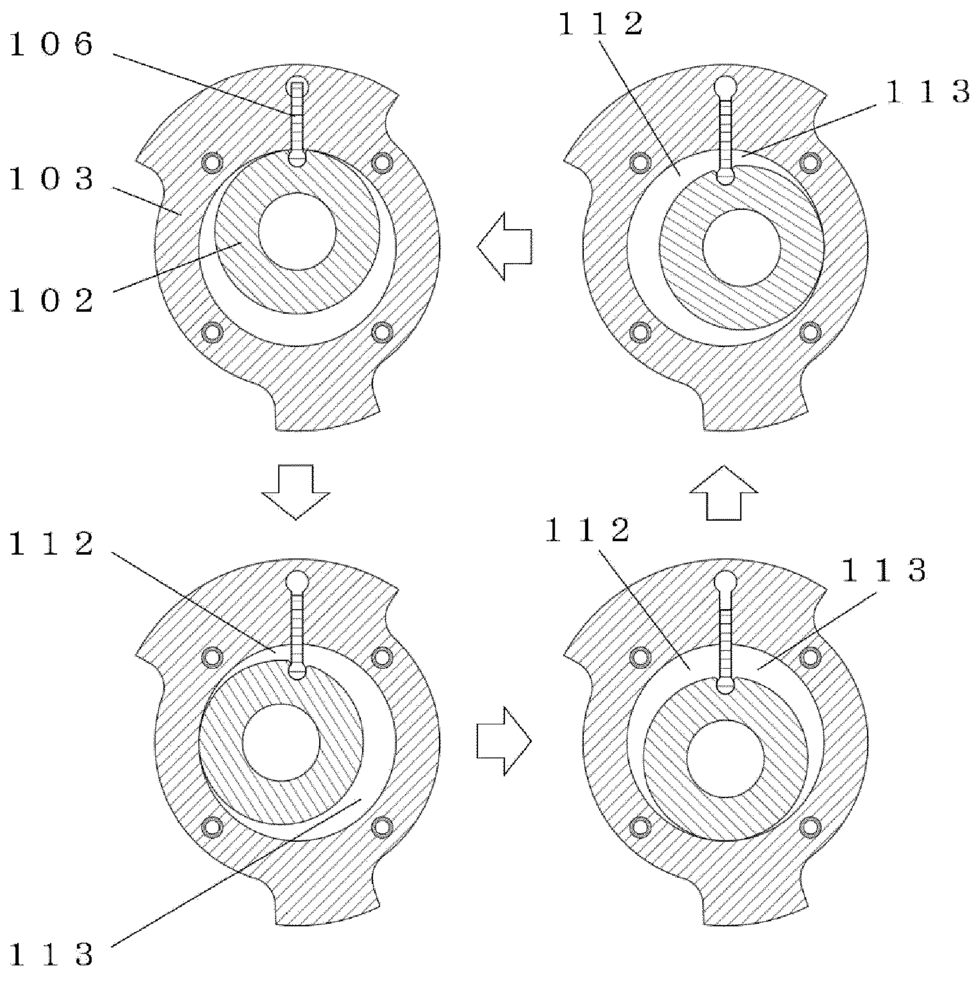


101 Drive shaft
102 Piston
103 Cylinder
104 Upper end plate (upper bearing)
105 Lower end plate (lower bearing)
107a Intake hole

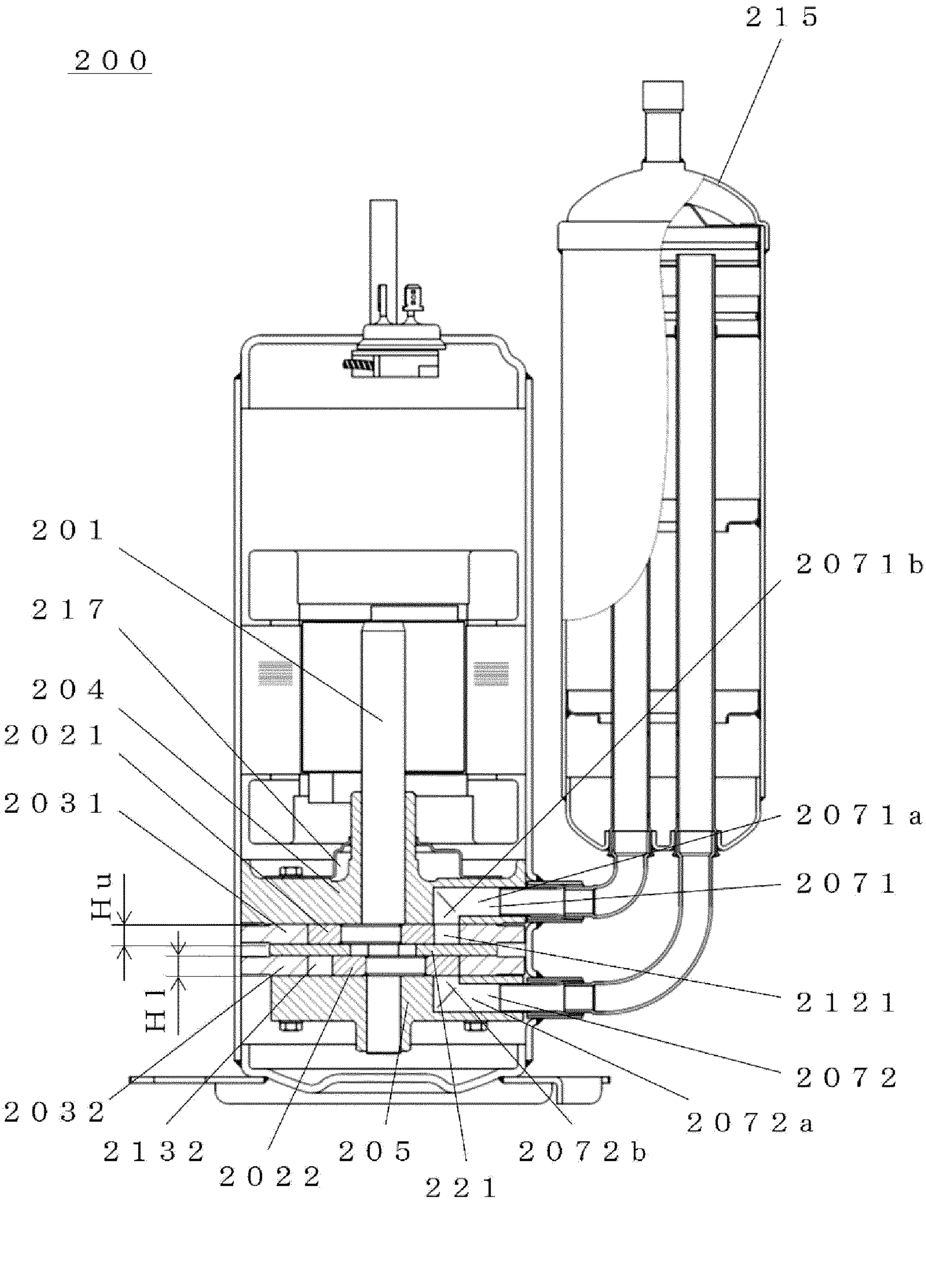
[Fig. 2]



[Fig. 3]



[Fig. 4]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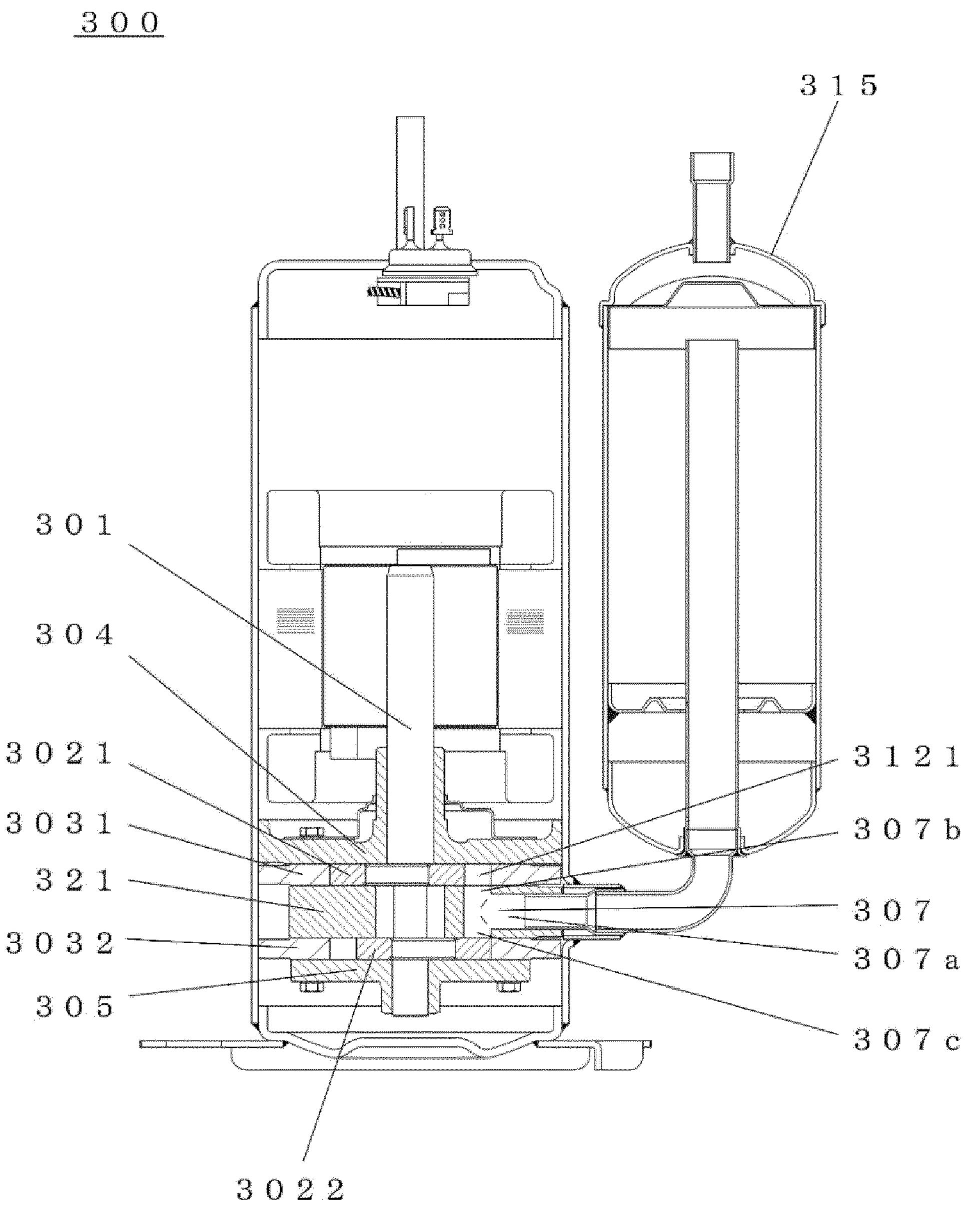
[Fig. 5]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INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2021/001772

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. F04C29/00(2006.01)i, F04C18/324(2006.01)i, F04C18/356(2006.01)i
FI: F04C29/00 C, F04C18/356 J, F04C18/356 L, F04C18/324

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. F04C29/00, F04C18/324, F04C18/356

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 3-81592 A (MITSUBISHI ELECTRIC CORP.) 05 April 1991, p. 1, lower left column, line 20 to p. 2, lower left column, line 14, fig. 1	1-7
Y	JP 2010-255624 A (PANASONIC CORP.) 11 November 2010, paragraphs [0017]-[0023], fig. 1, 2	1-7
Y	JP 2005-139973 A (SANYO ELECTRIC CO., LTD.) 02 June 2005, paragraphs [0008], [0029]	3-7
Y	JP 9-250477 A (TOSHIBA CORP.) 22 September 1997, paragraphs [0014]-[0028], fig. 1-3	1-7

☐ Further documents are listed in the continuation of Box C.   ☒ See patent family annex.

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- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11.03.2021	30.03.2021

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/001772

Patent Documents referred to in the Report	Publication Date	Patent Family	Publication Date
JP 3-81592 A	05.04.1991	(Family: none)	
JP 2010-255624 A	11.11.2010	(Family: none)	
JP 2005-139973 A	02.06.2005	US 2005/0069423 A1 paragraphs [0074], [0134] EP 1520990 A2 CN 1603625 A	
JP 9-250477 A	22.09.1997	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2000120572 A **[0003]**