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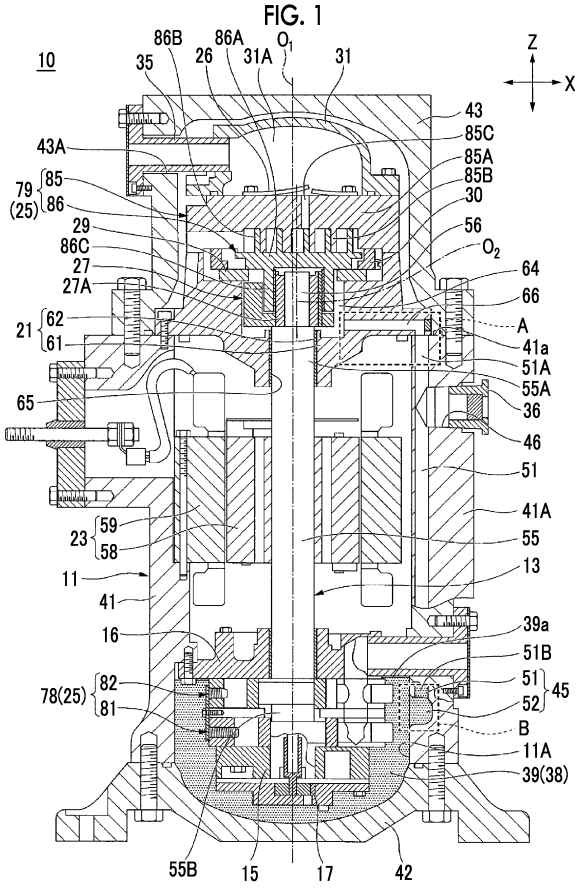
(54) **COMPRESSOR**

(57) A compressor (10) provided with a housing (11), which extends in the vertical direction and in a bottom portion (11A) of which an oil reservoir (39) formed by the accumulation of oil (38) is arranged, and a compression mechanism (25), which is driven by a motor (23) and compresses the refrigerant, wherein a first oil return passage (45) for leading oil that has moved to an upper portion inside the housing (11) to the bottom portion (11A) inside the housing (11) is provided, and the first oil return passage (45) has an oil return passage main body (51) provided inside the housing (11) and extending in the vertical direction, and an oil outlet portion (52) formed in the housing (11) and connecting the lower end of the oil return passage main body (51) and the bottom portion (11A) inside the housing (11).

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a compressor.

Background Art

[0002] As a vertical compressor, for example, there is a compressor disclosed in PTL 1.

[0003] The compressor disclosed in PTL 1 includes a housing, a rotary compression portion, a scroll compression portion, a motor, and an oil discharge pipe.

[0004] The housing extends in a vertical direction. The rotary compression portion is disposed at a bottom portion in the housing. The scroll compression portion is disposed at an upper portion in the housing.

[0005] The motor includes a motor stator and a motor rotor. A stator cut for returning oil downward is formed in the motor stator.

[0006] The oil discharge pipe is disposed above the motor stator. The oil discharge pipe returns the oil from the upper portion of the housing to the bottom portion via the stator cut. A lower end of the oil discharge pipe is disposed at a position away from an upper end of the stator cut.

Citation List

Patent Literature

[0007] [PTL 1] Japanese Unexamined Patent Application Publication No. 2013-24153

Summary of Invention

Technical Problem

[0008] As described above, the lower end of the oil discharge pipe is disposed at the position away from the upper end of the stator cut. For this reason, in the compressor disclosed in PTL 1, it is difficult to efficiently guide the oil from the lower end of the oil discharge pipe to the upper end of the stator cut. Accordingly, there is a possibility that it is difficult to efficiently return the oil, which has moved to the upper portion in the housing, to the bottom portion of the housing.

[0009] Additionally, in the case of the compressor disclosed in PTL 1, since the rotary compression portion immersed in the oil is disposed below the motor, the oil is guided to the upper portion in the housing together with the compressed refrigerant by driving the rotary compression portion.

[0010] For this reason, the oil flowing out from the lower end of the oil discharge pipe comes into contact with the refrigerant moving upward, and does not easily move downward. Accordingly, there is a possibility that it is even more difficult to efficiently return the oil, which has moved to the upper portion in the housing, to the bottom portion of the housing.

[0011] Thus, an object of the present invention is to provide a compressor capable of efficiently returning the oil, which has moved to an upper portion of a housing, to a bottom portion of the housing.

Solution to Problem

[0012] In order to solve the above problems, a compressor according to one aspect of the present invention includes a housing which extends in a vertical direction and in which an oil reservoir formed by accumulation of oil is disposed at a bottom portion; a rotary shaft that is housed in the housing, extends in the vertical direction, and rotates around an axis; a motor having a motor rotor that is provided on an outer peripheral surface of the rotary shaft and rotates together with the rotary shaft, and a motor stator that is provided on an inner peripheral surface of the housing so as to surround the motor rotor from an outer peripheral side; a compression mechanism that is housed in the housing and driven by the motor to compress a refrigerant; and a first oil return path that guides the oil, which has moved to an upper portion in the housing, to the bottom portion. The first oil return path has an oil return path main body that is internally provided in the housing and extends in the vertical direction, and an oil outlet portion that is formed in the housing to allow a lower end of the oil return path main body and the bottom portion in the housing to communicate with each other.

[0013] According to the present invention, the compressor includes the first oil return path having the oil return path main body that is internally provided in the housing and extends in the vertical direction, and the oil outlet portion that is formed in the housing main body to allow the lower end of the oil return path main body and the bottom portion in the housing to communicate with each other and guiding the oil, which has moved to the upper portion in the housing, to the bottom portion of the housing, it is possible to suppress the contact between the oil flowing through the first oil return path and the oil flowing out from the oil outlet portion and the refrigerant.

[0014] Accordingly, since it is possible to suppress the interference of the refrigerant with the movement of the oil from the upper portion to the bottom portion in the housing, the oil recovered from the upper portion in the housing can be efficiently returned to the bottom portion in the housing.

[0015] Additionally, in the compressor according to the one aspect of the present invention, the housing has a tubular housing main body that extends in the vertical direction and has open ends at both ends, an upper lid portion that closes the open end located on an upper end side of the housing main body, and a lower lid portion that closes the open end located on a lower end side of the housing main body, the housing main body includes a thick wall portion that extends in the vertical direction

and is thicker in a radial direction than other portions, and the first oil return path is formed in the thick wall portion.

[0016] In this way, by forming the thick wall portion extending in the vertical direction and having a thickness in the radial direction larger than the other portions in the housing main body, the oil return path main body can be internally provided in the housing main body, and the oil outlet portion can be formed on the housing main body.

[0017] Additionally, in the compressor according to one aspect of the present invention, an upper end of the oil return path main body may be exposed from an upper end surface of the housing main body, and the upper lid portion may be disposed so as to expose at least a part of the upper end of the oil return path main body.

[0018] By disposing the upper lid portion so as to expose at least a part of the upper end of the oil return path main body in this way, the oil that has moved to the upper portion in the housing can be recovered from the upper end of the oil return path main body.

[0019] Additionally, in the compressor according to the one aspect of the present invention, the compressor may further include a radial bearing portion that is housed in the housing and rotatably supports an upper portion of the rotary shaft, wherein the radial bearing portion may include a bearing main body that rotatably supports the upper portion of the rotary shaft, and a support that supports the bearing main body and is disposed so as to close the upper end of the oil return path main body, a recessed portion, which is recessed in a direction from the upper lid portion toward the lower lid portion, may be formed on a side of the support facing the upper lid portion, a through-hole into which a part of the rotary shaft may be inserted and which communicates with the recessed portion is formed on a side of the support facing the lower lid portion, and a second oil return path may be formed in the support to allow the recessed portion and the upper end of the oil return path main body to communicate with each other.

[0020] By forming the second oil return path for allowing the recessed portion and the upper end of the oil return path main body to communicate with each other in the support in this way, the oil present in the recessed portion can be efficiently returned to the bottom portion of the housing via the first and second oil return paths.

[0021] Additionally, in the compressor according to the one aspect of the present invention, the second oil return path may include a first path portion that penetrates the support in the radial direction, and a second path portion that is formed in a portion of the support located between the first path portion and the upper end of the oil return path main body in the vertical direction and allows the first path portion and the upper end of the oil return path main body to communicate with each other.

[0022] Since the second oil return path has the first and second path portions having such a configuration, the oil present in the recessed portion can be guided to the upper end of the oil return path main body.

[0023] Additionally, by forming the shape of the first path portion so as to penetrate the support in the radial direction in this way, the first path portion can be easily formed.

[0024] Additionally, in the compressor according to the one aspect of the present invention, the compressor may further include a lid portion that closes an end portion, which is located on a radial outer side, out of two end portions of the first path portion.

[0025] By having the lid portion that closes the end portion, located on the radial outer side, out of two end portions of the first path portion in this way, it is possible to suppress outflow of oil to the outside of the radial bearing portion via the end portion located on the radial outer side.

[0026] Additionally, in the compressor according to the one aspect of the present invention, the oil outlet portion may be recessed radially outward from the formation position of the oil return path main body.

[0027] In this way, the volume of the oil outlet portion can be increased by forming the oil outlet portion so as to be recessed radially outward from the formation position of the oil return path main body. Accordingly, the oil can be easily guided from the oil outlet portion to the bottom portion in the housing.

[0028] Additionally, in the compressor according to the one aspect of the present invention, the compression mechanism may include a rotary compression portion that is disposed below the motor and compresses the refrigerant in a state of being immersed in the oil reservoir, and a scroll compression portion that is disposed above the motor and compresses the refrigerant compressed by the rotary compression portion, and the rotary shaft may include a rotary shaft main body that extends in the vertical direction and penetrates the rotary compression portion, and an eccentric shaft portion that is provided at an upper end of the rotary shaft main body and causes an orbiting scroll constituting the scroll compression portion to orbit.

[0029] In this way, in a case where the compressor has the rotary compression portion disposed below the motor and the scroll compression portion disposed above the motor to further compress the refrigerant compressed by the rotary compression portion, a flow of the refrigerant is formed in the direction from the bottom portion to the upper portion in the housing in order to supply the refrigerant compressed by the rotary compression portion to the scroll compression portion.

[0030] Meanwhile, the oil return path main body is internally provided in the housing main body, and the oil outlet portion is immersed in the oil reservoir disposed at the bottom portion in the housing. For this reason, it is possible to prevent the contact of the oil flowing through the first oil return path with the flow of the refrigerant.

[0031] Accordingly, since it is possible to suppress a situation in which the movement of the oil flowing through the first oil return path in the direction toward the bottom portion in the housing becomes difficult due to the affect of the flow of the refrigerant, the oil can be efficiently

returned to the bottom portion in the housing.

[0032] Additionally, the compressor according to the one aspect of the present invention may further include a sight glass that is provided in the housing and through which a state of the oil return path main body is observed from an outside of the housing.

[0033] By having the sight glass having such a configuration, an operator can check whether or not the oil is flowing downward through the oil return path main body.

[0034] Additionally, the operator can determine whether or not a problem has occurred in the oil return path main body located above the position where the sight glass is disposed.

Advantageous Effects of Invention

[0035] According to the present invention, the oil that has moved to the upper portion in the housing can be efficiently returned to the bottom portion in the housing.

Brief Description of Drawings

[0036]

Fig. 1 is a cross-sectional view schematically showing a compressor according to an embodiment of the present invention.

Fig. 2 is an enlarged cross-sectional view of a portion of the compressor shown in Fig. 1 surrounded by a region A.

Fig. 3 is an enlarged cross-sectional view of a portion of the compressor shown in Fig. 1 surrounded by a region B.

Fig. 4 is a cross-sectional view showing another example of an oil outlet portion.

Description of Embodiments

[0037] Hereinafter, embodiments to which the present invention is applied will be described in detail with reference to the drawings.

[Embodiment]

[0038] A compressor 10 according to an embodiment of the present invention will be described with reference to Figs. 1 to 3.

[0039] In Fig. 1, O_1 represents an axis of a rotary shaft main body 55 (hereinafter, referred to as "axis O_1"), and O_2 represents indicates an axis of the eccentric shaft portion 56 (hereinafter, referred to as "axis O_2") .

[0040] Additionally, in Fig. 1, an X direction represents a radial direction of the compressor 10, and a Z direction represents a vertical direction orthogonal to the X direction.

[0041] In Fig. 1, a two-cylinder rotary compression portion 78 is taken as an example of a rotary compression portion.

[0042] The compressor 10 includes a housing 11, a rotary shaft 13, a lower bearing portion 15, an upper bearing portion 16, an oil supply pump 17, a radial bearing portion 21, a lid portion 22, a motor 23, a compression mechanism 25, an discharge valve 26, a bush assembly 27, a thrust plate 29, an Oldham ring 30, a cover 31, a discharge pipe 35, and a sight glass 36.

[0043] The housing 11 has a semi-sealed structure. An oil reservoir 39 formed by accumulation of oil 38 is disposed at a bottom portion 11A in the housing 11.

[0044] The housing 11 includes a housing main body 41, a lower lid portion 42, and an upper lid portion 43.

[0045] The housing main body 41 is formed in a tubular shape and extends in the Z direction. Both ends (upper end and lower end) of the housing main body 41 are open ends.

[0046] The housing main body 41 has a thick wall portion 41A that extends in the Z direction and has a wall thickness in the X direction (radial direction) that is larger than other portions. The housing main body 41 can be manufactured by, for example, a casting method.

[0047] By manufacturing the housing main body 41 by using the casting method in this way, the thick wall portion 41A can be easily formed.

[0048] A first oil return path 45 and a mounting hole 46 are formed in the thick wall portion 41A of the housing main body 41.

[0049] The first oil return path 45 is a path for guiding the oil that has moved to an upper portion in the housing 11 to the bottom portion 11A in the housing 11.

[0050] The first oil return path 45 includes an oil return path main body 51 and an oil outlet portion 52.

[0051] The oil return path main body 51 is internally provided in the thick wall portion 41A and extends in the Z direction. The oil return path main body 51 has an upper end 51A disposed on the upper lid portion 43 side and a lower end 51B disposed on a lower lid portion 42 side.

[0052] The upper end 51A is exposed from an upper end surface 41Aa of the thick wall portion 41A (a part of the upper end surface 41a of the housing main body 41). The lower end 51B is disposed in the thick wall portion 41A.

[0053] The oil return path main body 51 having the above configuration is a path main body for guiding the oil that has moved to the upper portion in the housing 11 to the bottom portion 11A in the housing 11.

[0054] The oil outlet portion 52 is formed in the thick wall portion 41A located directly below the lower end 51B of the oil return path main body 51.

[0055] The oil outlet portion 52 is exposed from an inner peripheral surface of the thick wall portion 41A. The oil outlet portion 52 extends radially outward from the inner peripheral surface of the thick wall portion 41A. The oil outlet portion 52 allows the lower end 51B of the oil return path main body 51 to communicate with the bottom portion 11A in the housing 11.

[0056] The oil that has passed through the oil return path main body 51 is returned to the bottom portion 11A in the housing 11 via the oil outlet portion 52.

[0057] The oil outlet portion 52 constitutes the com-

pression mechanism 25 and is disposed below an upper end surface of the two-cylinder rotary compression portion 78 disposed below a liquid level 39a of the oil reservoir 39. Accordingly, the oil outlet portion 52 is covered with the oil 38 constituting the oil reservoir 39.

[0058] The oil outlet portion 52 may be formed by being recessed radially outward from the formation position of the oil return path main body 51.

[0059] By forming the oil outlet portion 52 so as to be recessed radially outward from the formation position of the oil return path main body 51 in this way, the volume of the oil outlet portion 52 can be increased. Accordingly, the oil can be easily guided from the oil outlet portion 52 to the bottom portion 11A in the housing 11.

[0060] The lower lid portion 42 is provided on the housing main body 41 so as to close an open end located on a lower end side of the housing main body 41.

[0061] The upper lid portion 43 is provided on the housing main body 41 so as to close an open end located on an upper end side of the housing main body 41.

[0062] The rotary shaft 13 is housed in the housing 11 in a state of extending in the Z direction. The rotary shaft 13 has a rotary shaft main body 55 and an eccentric shaft portion 56.

[0063] The rotary shaft main body 55 has a columnar shape and rotates around the axis O_1. The rotary shaft main body 55 has an upper end portion 55A and a lower end portion 55B. The lower end portion 55B penetrates the two-cylinder rotary compression portion 78 in the Z direction.

[0064] The rotary shaft main body 55 having the above configuration is supported in a rotatable state by the lower bearing portion 15, the upper bearing portion 16, and the radial bearing portion 21.

[0065] The eccentric shaft portion 56 is provided at an upper end of the rotary shaft main body 55. The eccentric shaft portion 56 has the axis O_2 offset (eccentric) with respect to the axis O_1 as a central axis. The eccentric shaft portion 56 is a columnar shaft smaller than the outer diameter of the rotary shaft main body 55.

[0066] When the rotary shaft main body 55 rotates around the axis O_1, the eccentric shaft portion 56 having such a configuration revolves around the axis O_1 to orbit an orbiting scroll 86 constituting the scroll compression portion 79.

[0067] The lower bearing portion 15 is disposed on a lower side of the two-cylinder rotary compression portion 78. The upper bearing portion 16 is disposed to an upper side of the two-cylinder rotary compression portion 78.

[0068] That is, the lower bearing portion 15 and the upper bearing portion 16 are disposed so as to sandwich the two-cylinder rotary compression portion 78 from above and below.

[0069] The oil supply pump 17 is internally provided in the lower bearing portion 15. The oil supply pump 17 supplies a part of the oil 38 reserved at the bottom portion 11A in the housing 11 to a scroll compression portion 79 via a through-hole (not shown) formed in the rotary shaft 13.

[0070] The motor 23 is housed in the housing 11 and has a motor rotor 58 and a motor stator 59.

[0071] The motor rotor 58 is fixed to an outer peripheral surface located at an intermediate region of the rotary shaft main body 55 in the Z direction. The motor stator 59 is fixed to an inner peripheral surface of the housing main body 41.

[0072] The motor 23 having the above configuration drives the two-cylinder rotary compression portion 78 and the scroll compression portion 79 via the rotary shaft 13.

[0073] The radial bearing portion 21 has a support 61 and a bearing main body 62.

[0074] The support 61 is a member that supports the bearing main body 62, and is housed in the housing 11. The support 61 is fixed to the housing main body 41 in a state of coming into contact with the inner portion of the upper end surface 41a of the housing main body 41.

[0075] The support 61 is formed with a recessed portion 64, a through-hole 65, and a second oil return path 66.

[0076] The recessed portion 64 is formed at a central portion on an upper side of the support 61 facing the upper lid portion 43. The recessed portion 64 is recessed in a direction from the upper lid portion 43 to the lower lid portion 42. The recessed portion 64 is a columnar space.

[0077] The through-hole 65 is formed at a central portion on a lower side of the support 61 facing the lower lid portion 42. An upper end side of the through-hole 65 communicates with the recessed portion 64. The through-hole 65 is a hole having a columnar shape. The opening diameter of the through-hole 65 is smaller than the opening diameter of the recessed portion 64. The upper end portion 55A of the rotary shaft main body 55 is disposed in the through-hole 65.

[0078] The second oil return path 66 is internally provided in the support 61. The second oil return path 66 has a first path portion 71 and a second path portion 72.

[0079] The first path portion 71 is formed by penetrating the support 61 located on the radial outer side of the recessed portion 64 in the radial direction such that a part of the first path portion 71 on a radially outer side is disposed above the upper end 51A of the oil return path main body 51.

[0080] By forming the shape of the first path portion 71 so as to penetrate the support 61 in the radial direction in this way, the first path portion 71 can be easily formed.

[0081] The first path portion 71 has an end portion 71A disposed on a radial inner side and communicating with the recessed portion 64, and an end portion 71B disposed on the radial outer side.

[0082] A female threaded portion 71C is formed on an inner peripheral surface of the end portion 71B. The end portion 71B is closed by the lid portion 22.

[0083] The first path portion 71 having the above configuration guides the oil present in the recessed portion 64 to the radial outer side of the support 61.

[0084] The second path portion 72 is formed so as to extend in the Z direction at a portion of the support 61 located between the first path portion 71 and the upper end 51A of the oil return path main body 51 in the Z direction.

[0085] The second path portion 72 allows the first path portion 71 to communicate with the upper end 51A of the oil return path main body 51.

[0086] By including the second oil return path 66 having the first and second path portions 71 and 72 having such a configuration, the oil present in the recessed portion 64 can be guided to the upper end 51A of the oil return path main body 51.

[0087] By including the first oil return path 45 having the oil return path main body 51 and the oil outlet portion 52 described above, the oil flowing through the first oil return path 45 and the oil flowing out from the oil outlet portion 52 no longer come into contact with the refrigerant. Therefore, the oil is no longer adversely affected by the refrigerant. Accordingly, the oil recovered from the upper portion in the housing 11 can be efficiently returned to the bottom portion 11A in the housing 11.

[0088] In addition, in the case of the structure shown in Fig. 1, it is necessary to form the second oil return path 66 described above. However, for example, in a case where an oil introduction port for allowing a region (not shown) directly below the radial bearing portion 21 to communicate with the oil return path main body 51 is formed to recover the oil located below the radial bearing portion 21, it is not necessary to form the second oil return path 66.

[0089] That is, the second oil return path 66 may be appropriately formed according to the structure of the compressor to which the first oil return path 45 is applied.

[0090] The bearing main body 62 is provided on a surface of the support 61 that partitions the through-hole 65. The bearing main body 62 faces an outer peripheral surface of the upper end portion 55A of the rotary shaft main body 55. The bearing main body 62 supports the radial direction of the rotary shaft main body 55 in a rotatable state.

[0091] The lid portion 22 is a set screw 75 and is fastened to the female threaded portion 71C formed at the end portion 71B. The lid portion 22 is a member for closing the end portion 71B.

[0092] By having the lid portion 22 that closes the end portion 71B, located on the radial outer side, out of two end portions 71A and 71B of the first path portion 71 in this way, it is possible to suppress outflow of oil to the outside of the radial bearing portion 21 via the end portion 71B.

[0093] In addition, in Fig. 2, the set screw 75 has been described as an example of the lid portion 22. However, another member (lid portion) may be used to close the end portion 71B instead of the set screw 75 without forming the female threaded portion 71C on the end portion 71B.

[0094] The compression mechanism 25 includes the two-cylinder rotary compression portion 78 and the scroll compression portion 79.

[0095] The two-cylinder rotary compression portion 78 is disposed at the bottom portion 11A in the housing 11. The two-cylinder rotary compression portion 78 is immersed in the oil reservoir 39.

[0096] The two-cylinder rotary compression portion 78 includes a first rotary compression portion 81 and a second rotary compression portion 82.

[0097] A gas-phase refrigerant (hereinafter, simply referred to as "refrigerant") is supplied to the first rotary compression portion 81 and the second rotary compression portion 82 from an accumulator (not shown) that separates the refrigerant into gas and liquid. The first rotary compression portion 81 and the second rotary compression portion 82 compress the refrigerant supplied from the accumulator.

[0098] The second rotary compression portion 82 is disposed to be stacked on the first rotary compression portion 81. The refrigerants compressed by the first rotary compression portion 81 and the second rotary compression portion 82, respectively, are supplied to the scroll compression portion 79 disposed above the two-cylinder rotary compression portion 78.

[0099] The scroll compression portion 79 is provided at the upper portion in the housing 11 and is disposed between the cover 31 and the radial bearing portion 21.

[0100] The scroll compression portion 79 has a fixed scroll 85 and an orbiting scroll 86.

[0101] The fixed scroll 85 is disposed between the cover 31 and the orbiting scroll 86. The fixed scroll 85 has an end plate 85A and a fixed wrap 85B.

[0102] The end plate 85A has a disk shape. The end plate 85A is fixed on the radial bearing portion 21.

[0103] The end plate 85A has an upper surface, a lower surface, and a discharge port 85C. The discharge port 85C is formed so as to extend in the Z direction so as to penetrate the center of the end plate 85A.

[0104] The discharge port 85C is a through-hole for discharging the refrigerant compressed by the scroll compression portion 79 to the outside of the scroll compression portion 79.

[0105] The fixed wrap 85B protrudes downward from a lower surface of the end plate 85A. The fixed wrap 85B is a wall body formed in a scroll shape when viewed from the direction of the axis O_1.

[0106] The orbiting scroll 86 is disposed between the fixed scroll 85 and the radial bearing portion 21. The orbiting scroll 86 has an end plate 86A, an orbiting wrap 86B, and a boss part 86C.

[0107] The end plate 86A has a disk shape. The end plate 86A is disposed on the support 61 via the thrust plate 29. The end plate 86A is disposed to face the end plate 85A in the Z direction. The end plate 86A has an upper surface, and a lower surface facing the upper surface of the end plate 85A.

[0108] The orbiting wrap 86B is provided on the upper surface of the end plate 86A and protrudes upward. The

orbiting wrap 86B is a wall body formed in a scroll shape when viewed from the direction of the axis O_1.

[0109] The orbiting wrap 86B having the above configuration is disposed so as to mesh with the fixed wrap 85B. Accordingly, a compression chamber for compressing the refrigerant is formed between the orbiting wrap 86B and the fixed wrap 85B. Then, as the orbiting wrap 86B orbits with respect to the fixed scroll 85, the volume of the compression chamber changes, and the refrigerant in the compression chamber is compressed.

[0110] The boss part 86C is provided on the lower surface of the end plate 86A and protrudes downward. The boss part 86C is a member having a cylindrical shape, and a lower side thereof is disposed in the recessed portion 64.

[0111] As described above, in a case where the compressor has the two-cylinder rotary compression portion 78 disposed below the motor 23 and the scroll compression portion 79 disposed above the motor 23 to further compress the refrigerant compressed by the two-cylinder rotary compression portion 78, a flow of the refrigerant is formed in the direction from the bottom portion 11A to the upper portion in the housing 11 in order to supply the refrigerant compressed by the two-cylinder rotary compression portion 78 to the scroll compression portion 79.

[0112] As described earlier, the oil return path main body 51 is internally provided in the thick wall portion 41A, and the oil outlet portion 52 is immersed in the oil reservoir 39 disposed at the bottom portion 11A in the housing 11. The second oil return path 66 communicating with the oil return path main body 51 is internally provided in the support 61 constituting the radial bearing portion 21.

[0113] Therefore, it is possible to suppress the contact of the oil flowing through the first and second oil return paths 45 and 66 with the flow of the refrigerant, and it is possible to suppress a situation in which the movement of the oil flowing through the first and second oil return paths 45 and 66 in the direction toward the bottom portion 11A in the housing 11 becomes difficult. Accordingly, the oil that has moved to the upper portion in the housing 11 can be efficiently returned to the bottom portion 11A in the housing 11.

[0114] The discharge valve 26 is provided on the upper surface of the end plate 86A. The discharge valve 26 is disposed at a position where the discharge port 85C is openable and closable.

[0115] The bush assembly 27 is provided between the orbiting scroll 86 and the rotary shaft 13. The bush assembly 27 connects the orbiting scroll 86 and the rotary shaft 13 to each other. The bush assembly 27 has a bush 27A provided between the eccentric shaft portion 56 and the boss part 86C.

[0116] The thrust plate 29 is provided between the end plate 86A and the radial bearing portion 21. The thrust plate 29 is a member for holding a thrust load generated in the orbiting scroll 86.

[0117] The Oldham ring 30 is provided between the end plate 86A and the end plate 85A. The Oldham ring 30 has a protrusion fitted into grooves (not shown) formed in the end plate 86A and the end plate 85A. The Oldham ring 30 is a member for suppressing the rotation of the orbiting scroll 86 (rotation around the axis O_2) and converting the rotary motion of the rotary shaft main body 55 into an orbiting motion.

[0118] The cover 31 is housed in the housing 11 and is provided on the upper surface of the end plate 85A. The cover 31 forms a discharge chamber 31A between an inner surface of the cover 31 and the upper surface of the end plate 85A.

[0119] When the discharge port 85C is opened by the discharge valve 26, the refrigerant compressed by the scroll compression portion 79 is discharged into the discharge chamber 31A.

[0120] The discharge pipe 35 is provided in the housing 11 in a state of communicating with the discharge chamber 31A. The discharge pipe 35 discharges the refrigerant compressed by the compressor 10 to the outside of the compressor 10.

[0121] The sight glass 36 is fixed to the thick wall portion 41A in a state of being mounted in the mounting hole 46. The sight glass 36 is for observing the state of the oil return path main body 51 from the outside of the housing 11.

[0122] By having the sight glass 36 having such a configuration, an operator can check whether or not the oil is flowing downward through the oil return path main body 51.

[0123] Additionally, the operator can determine whether or not a problem has occurred in the oil return path main body 51 located above the position where the sight glass 36 is disposed.

[0124] According to the compressor 10 of the present embodiment, by having the first and second oil return paths 45 and 66 described above, the oil flowing out from the oil outlet portion 52 of the first oil return path 45 to the bottom portion 11A in the housing 11 via the second oil return path 66 and the first oil return path 45 does not come into contact with the refrigerant. Therefore, it is possible to prevent the refrigerant from adversely affecting the recovery of the oil. Accordingly, the oil recovered from the upper portion in the housing 11 can be efficiently returned to the bottom portion 11A in the housing 11.

[0125] Here, another example of the first oil return path (first oil return path 91) will be described with reference to Fig. 4. In Fig. 4, the same components as those of the structure illustrated in Fig. 3 are designated by the same reference signs.

[0126] The first oil return path 91 is configured similarly to the first oil return path 45 except that the first oil return path 91 has an oil outlet portion 92 instead of the oil outlet portion 52 constituting the first oil return path 45.

[0127] The oil outlet portion 92 is a flow path main body formed so as to be inclined obliquely downward from the lower end 51B of the oil return path main body 51 toward the oil reservoir 39. The diameter of the oil outlet portion

92 can be, for example, a size equal to or larger than the diameter of the oil return path main body 51.

[0128] The oil outlet portion 92 having such a configuration can obtain the same effects as the oil outlet portion 52 described earlier.

[0129] Although the preferred embodiments of the present invention have been described in detail above, the present invention is not limited to such specific embodiments, and various modifications and changes can be made within the spirit of the present invention described within the claims.

[0130] In addition, in the present embodiment, a case where the two-cylinder rotary compression portion 78 is used as an example of the rotary compression portion has been described as an example. However, instead of this, a single-cylinder rotary compression portion may be used.

[0131] Additionally, the first oil return paths 45 and 91 and the second oil return path 66 are also applicable to a compressor having either one of the two-cylinder rotary compression portion 78 and the scroll compression portion 79.

Industrial Applicability

The present invention is applicable to compressors. Reference Signs List

[0132]

10:	Compressor
11:	Housing
11A:	Bottom portion
13:	Rotary shaft
15:	Lower bearing portion
16:	Upper bearing portion
17:	Oil supply pump
21:	Radial bearing portion
22:	Lid portion
23:	Motor
25:	Compression mechanism
26:	Discharge valve
27:	Bush assembly
27A:	Bush
29:	Thrust plate
30:	Oldham ring
31:	Cover
31A:	Discharge chamber
35:	Discharge pipe
36:	Sight glass
38:	Oil
39:	Oil reservoir
41:	Housing main body
41a, 41Aa:	Upper end surface
41A:	Thick wall portion
42:	Lower lid portion
43:	Upper lid portion
45, 91:	First oil return path
46:	Mounting hole
51:	Oil return path main body
51A:	Upper end
51B:	Lower end
52, 92:	Oil outlet portion
55:	Rotary shaft main body
55A:	Upper end portion
55B:	Lower end portion
56:	Eccentric shaft portion
58:	Motor rotor
59:	Motor stator
61:	Support
62:	Bearing main body
64:	Recessed portion
65:	Through-hole
66:	Second oil return path
71:	First path portion
71A, 71B:	End portion
71C:	Female threaded portion
72:	Second path portion
75:	Set screw
78:	Two-stage rotary compression portion
79:	Scroll compression portion
81:	First rotary compression portion
82:	Second rotary compression portion
85:	Fixed scroll
85A, 86A:	End plate
85B:	Fixed wrap
85c:	Discharge port
86:	Orbiting scroll
86B:	Orbiting wrap
86C:	Boss part
A, B:	Regions
O_1, O_2:	Axis

Claims

1. A compressor comprising:

a housing which extends in a vertical direction and in which an oil reservoir formed by accumulation of oil is disposed at a bottom portion;

a rotary shaft that is housed in the housing, extends in the vertical direction, and rotates around an axis;

a motor having a motor rotor that is provided on an outer peripheral surface of the rotary shaft and rotates together with the rotary shaft, and a motor stator that is provided on an inner peripheral surface of the housing so as to surround the motor rotor from an outer peripheral side;

a compression mechanism that is housed in the housing and driven by the motor to compress a refrigerant; and

a first oil return path that guides the oil, which has moved to an upper portion in the housing, to the bottom portion,

wherein the first oil return path has an oil return path main body that is internally provided in the housing and extends in the vertical direction, and an oil outlet portion that is formed in the housing to allow a lower end of the oil return path main body and the bottom portion in the housing to communicate with each other.

2. The compressor according to claim 1,

wherein the housing has a tubular housing main body that extends in the vertical direction and has open ends at both ends, an upper lid portion that closes the open end located on an upper end side of the housing main body, and a lower lid portion that closes the open end located on a lower end side of the housing main body,
the housing main body includes a thick wall portion that extends in the vertical direction and is thicker in a radial direction than other portions, and
the first oil return path is formed in the thick wall portion.

3. The compressor according to claim 2,

wherein an upper end of the oil return path main body is exposed from an upper end surface of the housing main body, and
the upper lid portion is disposed so as to expose at least a part of the upper end of the oil return path main body.

4. The compressor according to claim 3, further comprising:

a radial bearing portion that is housed in the housing and rotatably supports an upper portion of the rotary shaft,
wherein the radial bearing portion includes a bearing main body that rotatably supports the upper portion of the rotary shaft, and a support that supports the bearing main body and is disposed so as to close the upper end of the oil return path main body,
a recessed portion, which is recessed in a direction from the upper lid portion toward the lower lid portion, is formed on a side of the support facing the upper lid portion,
a through-hole into which a part of the rotary shaft is inserted and which communicates with the recessed portion is formed on a side of the support facing the lower lid portion, and
a second oil return path is formed in the support to allow the recessed portion and the upper end of the oil return path main body to communicate with each other.

5. The compressor according to claim 4,

wherein the second oil return path includes a first path portion that penetrates the support in the radial direction, and
a second path portion that is formed in a portion of the support located between the first path portion and the upper end of the oil return path main body in the vertical direction and allows the first path portion and the upper end of the oil return path main body to communicate with each other.

6. The compressor according to claim 5, further comprising:
a lid portion that closes an end portion, which is located on a radial outer side, out of two end portions of the first path portion.

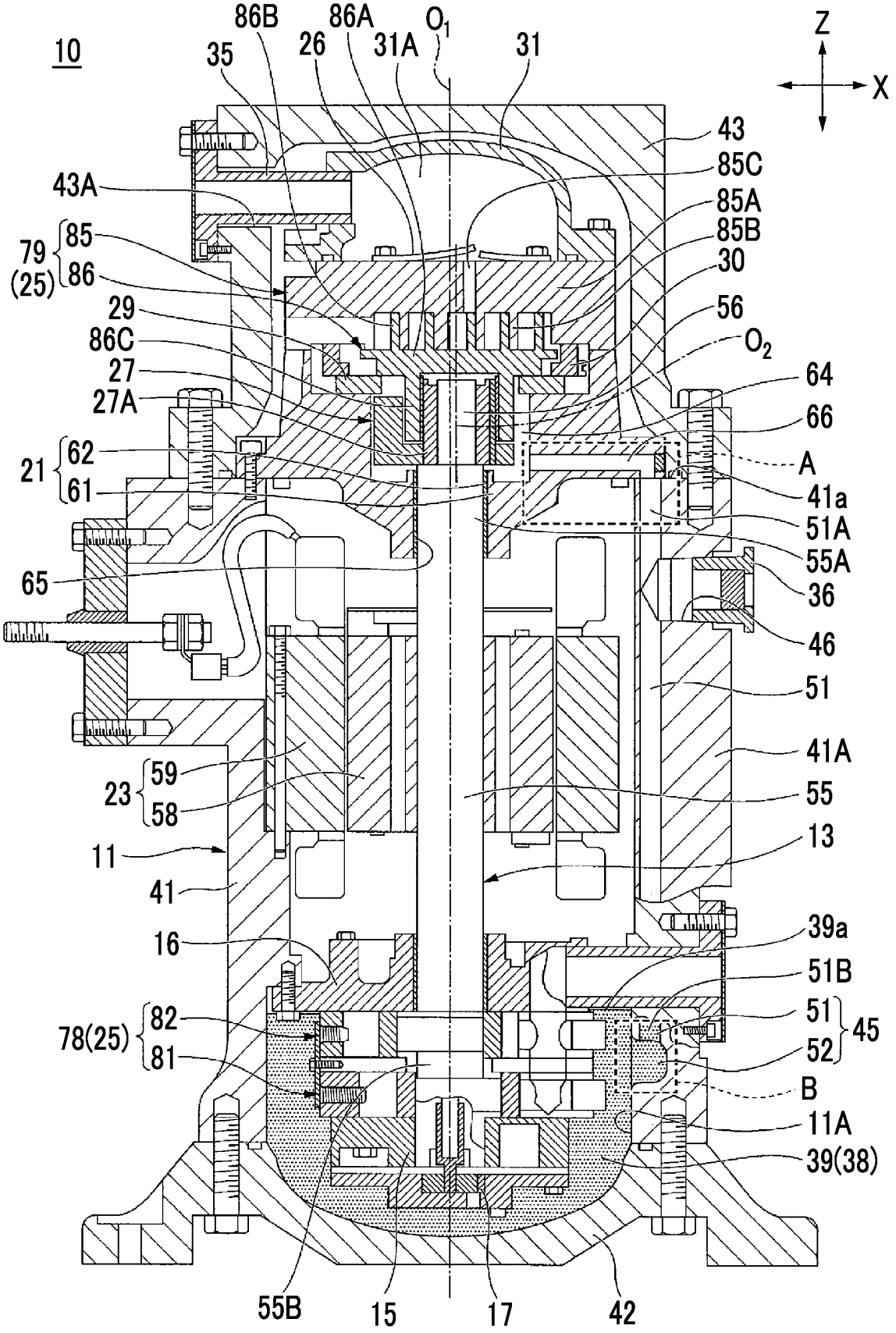
7. The compressor according to any one of claims 1 to 6,
wherein the oil outlet portion is recessed radially outward from a formation position of the oil return path main body.

8. The compressor according to any one of claims 1 to 7,

wherein the compression mechanism includes a rotary compression portion that is disposed below the motor and compresses the refrigerant in a state of being immersed in the oil reservoir, and
a scroll compression portion that is disposed above the motor and compresses the refrigerant compressed by the rotary compression portion, and
the rotary shaft includes a rotary shaft main body that extends in the vertical direction and penetrates the rotary compression portion, and an eccentric shaft portion that is provided at an upper end of the rotary shaft main body and causes an orbiting scroll constituting the scroll compression portion to orbit.

9. The compressor according to any one of claims 1 to 8, further comprising:
a sight glass that is provided in the housing and through which a state of the oil return path main body is observed from an outside of the housing.

FIG. 1


10
86B
86A
O_1
35
26
31A
31
Z
X
43
43A
85C
85A
85B
79
(25)
85
86
30
29
56
86C
O_2
27
64
27A
66
21
62
61
A
41a
51A
55A
65
36
46
51
41A
23
59
58
55
11
13
41
16
39a
51B
78(25)
82
81
51
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11A
39(38)
55B
15
17
42

FIG. 2

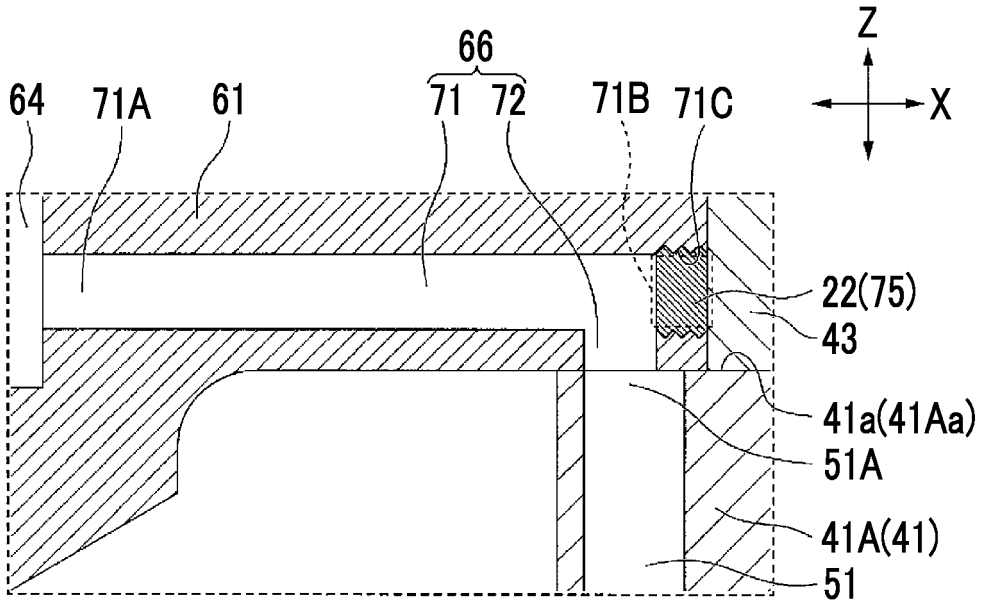

64
71A
61
66
71
72
71B
71C
Z
X
22(75)
43
41a(41Aa)
51A
41A(41)
51

FIG. 3

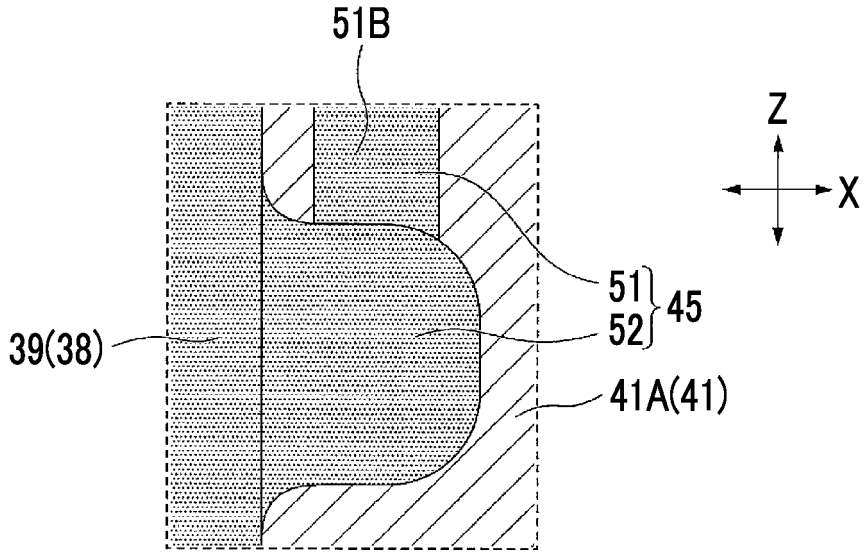
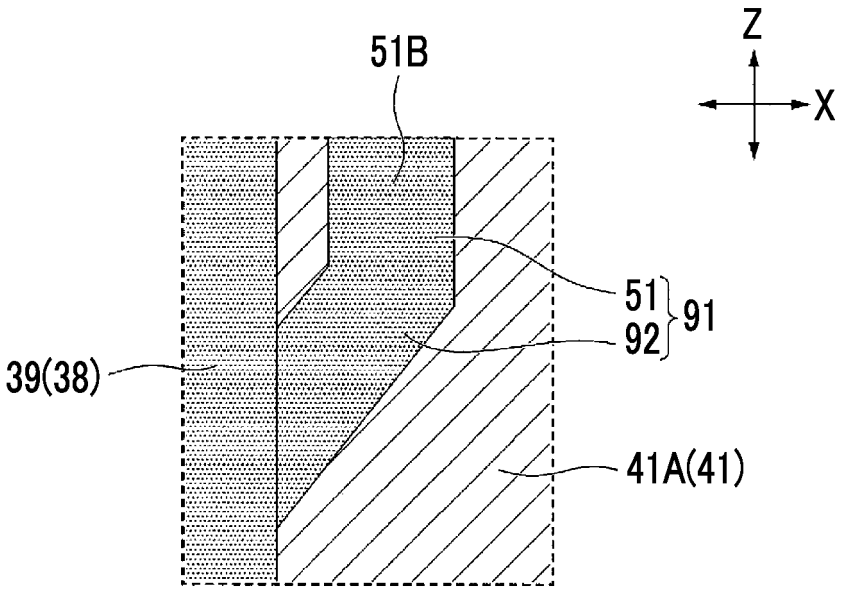

51B
Z
X
51
52
45
39(38)
41A(41)

FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/014605

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. F04B39/02(2006.01)i, F04C29/02(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. F04B39/02, F04C29/02

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 1971-2019
Registered utility model specifications of Japan 1996-2019
Published registered utility model applications of Japan 1994-2019

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.
X A	JP 2012-193619 A (MITSUBISHI HEAVY INDUSTRIES, LTD.) 11 October 2012, paragraphs [0019], [0026], fig. 1 (Family: none)	1, 8-9 2-7
A	JP 2009-097486 A (MITSUBISHI HEAVY INDUSTRIES, LTD.) 07 May 2009, paragraph [0025], fig. 4 & US 2009/0104062 A1, paragraph [0047], fig. 4	1-9
A	JP 2018-021493 A (DAIKIN INDUSTRIES, LTD.) 08 February 2018, paragraph [0064], fig. 1 (Family: none)	1-9

☐ 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
24.06.2019	02.07.2019
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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Patent documents cited in the description

- JP 2013024153 A **[0007]**