



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
31.05.2023 Bulletin 2023/22

(51) International Patent Classification (IPC):
F04B 39/06 ^(2006.01)

(21) Application number: **21864239.5**

(52) Cooperative Patent Classification (CPC):
F04B 39/06

(22) Date of filing: **27.08.2021**

(86) International application number:
PCT/JP2021/031462

(87) International publication number:
WO 2022/050181 (10.03.2022 Gazette 2022/10)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **03.09.2020 JP 2020148523**

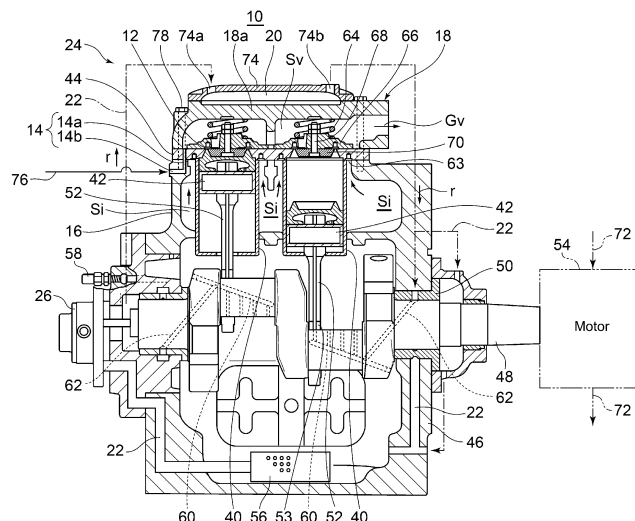
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(54) **COMPRESSOR AND COMPRESSOR SYSTEM**

(57) A compressor according to an embodiment includes: a discharge valve; a discharge space formed downstream of the discharge valve; a liquid injection hole for injecting a refrigerant liquid into the discharge space;

and a heat medium flow path located opposite to the discharge space across a partition wall forming the discharge space.

FIG. 1



Description

TECHNICAL FIELD

[0001] The present disclosure relates to a compressor and a compressor system.

BACKGROUND

[0002] In a compressor, if the compressor is overheated by a compressed gas having a high temperature and a high pressure, the density of a gas to be compressed sucked into the compressor decreases, causing a decrease in efficiency of the compressor. Therefore, for example, in a reciprocating compressor, as a means for suppressing overheating of the compressor, a pipe for flowing cooling water is provided inside a crankcase or a head cover. For example, Patent Document 1, 2 discloses a configuration for suppressing overheating by injecting a refrigerant liquid into a discharge space in a head cover and cooling a compressed discharge gas with latent heat of vaporization of the refrigerant liquid.

Citation List

Patent Literature

[0003]

Patent Document 1: JP2010-53765A

Patent Document 2: JP2011-163192A

SUMMARY

Technical Problem

[0004] According to the configuration disclosed in Patent Document 1, 2, it is possible to cool the discharge gas, and it is possible to suppress overheating of the compressor. However, due to an influence of cooling, a large amount of frost may occur on a surface of the compressor (for example, a surface of the head cover or the casing). Such configuration where the large amount of frost occurs is not preferable.

[0005] The present disclosure has been made in view of the above-described problems, and the object of the present disclosure is to suppresses the occurrence of frost on the surface of the compressor when the compressed discharge gas is cooled by injecting the refrigerant liquid into the discharge space of the compressor.

Solution to Problem

[0006] In order to achieve the above object, a compressor according to the present disclosure includes: a discharge valve; a discharge space formed downstream of the discharge valve; a liquid injection hole for injecting

a refrigerant liquid into the discharge space; and a heat medium flow path located opposite to the discharge space across a partition wall forming the discharge space.

[0007] Further, a compressor system according to the present disclosure is a compressor system, including: a low-stage compression part; and a high-stage compression part. At least the low-stage compression part is constituted by the compressor as defined in the above.

[0008] Herein, the "low-stage compression part" and the "high-stage compression part" include a low-stage compressor and a high-stage compressor each having an independent casing, and a low-stage compressor and a high-stage compressor housed in a single housing casing, for example, a reciprocating compressor.

Advantageous Effects

[0009] With the compressor and the compressor system according to the present disclosure, since the above-described heat medium flow path is provided, it is possible to increase the temperature of the compressor casing which includes the partition wall forming the discharge space, making it possible to suppress the occurrence of frost on the surface of the compressor.

BRIEF DESCRIPTION OF DRAWINGS

[0010]

FIG. 1 is a front cross-sectional view of a reciprocating compressor according to an embodiment.

FIG. 2 is a system diagram showing a lubricant oil supply system for the reciprocating compressor according to an embodiment.

FIG. 3 is a system diagram showing the lubricant oil supply system for the reciprocating compressor according to an embodiment.

FIG. 4 is a system diagram of a compressor system according to an embodiment.

DETAILED DESCRIPTION

[0011] Some embodiments of the present invention will be described below with reference to the accompanying drawings. It is intended, however, that unless particularly specified, dimensions, materials, shapes, relative positions and the like of components described or shown in the drawings as the embodiments shall be interpreted as illustrative only and not intended to limit the scope of the present invention.

[0012] For instance, an expression of relative or absolute arrangement such as "in a direction", "along a direction", "parallel", "orthogonal", "centered", "concentric" and "coaxial" shall not be construed as indicating only the arrangement in a strict literal sense, but also includes a state where the arrangement is relatively displaced by a tolerance, or by an angle or a distance whereby it is

possible to achieve the same function.

[0013] For instance, an expression of an equal state such as "same", "equal", and "uniform" shall not be construed as indicating only the state in which the feature is strictly equal, but also includes a state in which there is a tolerance or a difference that can still achieve the same function.

[0014] Further, for instance, an expression of a shape such as a rectangular shape or a tubular shape shall not be construed as only the geometrically strict shape, but also includes a shape with unevenness or chamfered corners within the range in which the same effect can be achieved.

[0015] On the other hand, an expressions such as "comprising", "including", "having", "containing", and "constituting" one constitutional element are not intended to be exclusive of other constitutional elements.

[0016] FIG. 1 is a front cross-sectional view of a compressor 10 according to an embodiment, and FIG. 2 is a system diagram showing a lubricant oil supply system for the compressor 10 according to an embodiment. In FIGs. 1 and 2, the compressor 10 is, for example, a compressor incorporated in a refrigeration device or the like and configured to compress a refrigerant gas. The compressor 10 includes a discharge valve 12, and a discharge space Sv is formed downstream of the discharge valve 12. A liquid injection hole 14 for injecting the refrigerant liquid into the discharge space Sv is formed in a compressor casing 16. In the present embodiment, as in Patent Documents 1 and 2, a condensate liquid of the refrigerant gas, which is the gas to be compressed, is injected from the liquid injection hole 14 into the discharge space Sv. The condensate liquid evaporates in the high-temperature discharge space Sv, absorbs latent heat of vaporization from a discharge gas Gv, and cools the discharge gas Gv. Thus, it is possible to suppress overheating of the discharge gas Gv. However, as the case now stands, frost may occur on a surface of a casing 18 forming the discharge space Sv, as described above.

[0017] Therefore, in order to suppress the occurrence of frost on the casing 18, the compressor 10 includes a heat medium flow path 20 located opposite to the discharge space Sv across a partition wall 18a forming the discharge space Sv. By flowing a heat medium through the heat medium flow path 20, the temperature of the casing 18 including the partition wall 18a is increased, making it possible to suppress the occurrence of frost on the surface of the casing 18.

[0018] In an embodiment, the compressor 10 includes a lubricant oil flow path 22 through which lubricant oil r supplied to a part to be lubricated flows. The heat medium flow path 20 is disposed in series or parallel with the lubricant oil flow path 22. According to the present embodiment, since it is possible to cause the lubricant oil r, which has absorbed the heat of the part to be lubricated in the compressor 10 by lubricating and cooling the part to be lubricated, to flow through the heat medium flow path 20, the temperature of the casing 18, which includes

the partition wall 18a forming the discharge space Sv, can be increased by potential heat of the lubricant oil r. Therefore, it is possible to suppress the occurrence of frost on the surface of the casing 18 of the compressor 10. The part to be lubricated of the compressor 10 includes, as an example, at least either of a rotor or a rotor support portion. As a more specific example, the parts to be lubricated are a crank shaft 48 and a thrust bearing 50, which will be described later. The part to be lubricated may be either the crank shaft 48 or the thrust bearing 50.

[0019] In an embodiment, as shown in FIG. 2, the heat medium flow path 20 is arranged in series with the lubricant oil flow path 22, and a circulation path 24 for the lubricant oil r including the part to be lubricated of the compressor 10, the heat medium flow path 20, and the lubricant oil flow path 22 is formed. Further, the circulation path 24 is provided with an oil pump 26 for circulating the lubricant oil r. According to the present embodiment, since the lubricant oil r circulating in the circulation path 24 by the oil pump 26 is cooled in the heat medium flow path 20, a dedicated oil cooler is not required and a cost can be reduced.

[0020] FIG. 3 shows an embodiment in which the heat medium flow path 20 is disposed in parallel with the circulation path 24. In the present embodiment, an oil cooler 28 is provided in the circulation path 24 for the lubricant oil flowing through the part to be lubricated of the compressor 10. The lubricant oil r flowing through the circulation path 24 flows through the part to be lubricated of the compressor 10, cools the part to be lubricated, is heated, and is cooled by the oil cooler 28. Further, the compressor 10 includes a branch path 30 branching off from the circulation path 24, communicating with the heat medium flow path 20, and merging with the circulation path 24 again. The lubricant oil r flowing through the branch path 30 exchanges heat with the discharge gas Gv in the heat medium flow path 20 to heat the discharge gas Gv. According to the present embodiment, since the discharge gas Gv is heated by the heat medium flow path 20, it is possible to suppress frost generated on the partition wall 18a or the surface of the casing 18 including the partition wall 18a. Meanwhile, the oil cooler 28 plays the main role of cooling the lubricant oil r.

[0021] As shown in FIG. 3, the circulation path 24 and the branch path 30 may be provided with flow control valves 32 and 34, respectively. Only one of the flow control valve 32 and the flow control valve 34 may be provided. Since these flow control valves 32 and 34 are provided, it is possible to control the flow rate of the lubricant oil r flowing through the branch path 30, making it possible to control the heating capacity of the heat medium flow path 20. It is preferable that the branching portion and the merging portion of the branch path 30 with respect to the circulation path 24 are disposed such that the lubricant oil r having a temperature suitable for a heating condition of the heat medium flow path 20 flows through the heat medium flow path 20.

[0022] In an embodiment, as shown in FIGs. 1 and 2,

the compressor 10 is the reciprocating compressor. In this case, the compressor 10 is configured such that a cylinder 40 is housed inside the compressor casing 16 and a piston 42 reciprocates inside the cylinder 40. A valve plate 44 for supporting the discharge valve 12 is disposed at one end of the cylinder 40 (an upper end of the cylinder 40 in the figure) and further, a head cover is provided as the casing 18 which includes the partition wall 18a forming the discharge space Sv. According to the compressor 10 which is the reciprocating compressor, the temperature of the head cover serving as the casing 18 can be increased by the heat medium flowing through the heat medium flow path 20, making it possible to suppress the occurrence of frost on the surface of the head cover. In the present embodiment, the casing 18 of the compressor 10 is the head cover, but the casing 18 is not limited to the head cover. Hereinafter, the casing 18 may be called the head cover 18.

[0023] Further, as shown in FIGs. 1 and 2, a crankcase 46 is disposed below the compressor casing 16. The crank shaft 48 is supported by the crankcase 46 via the thrust bearing 50. An oil reservoir Os of the lubricant oil r is formed at the bottom of the crankcase 46. The piston 42 is connected to the crank shaft 48 via a connecting rod 52, and the piston 42 reciprocates inside the cylinder 40 as the crank shaft 48 rotates. In the exemplary embodiments shown in FIGs. 1 and 2, two cylinders 40 are disposed in parallel, and the pistons 42 of the two cylinders 40 are connected to the crank shaft 48 so as to reciprocate in phases different by 180° at a rotation angle of the crank shaft 48. Further, a motor 54 for rotary driving the crank shaft 48 is disposed at one end of the crank shaft 48 outside the crankcase 46. The oil pump 26 is disposed at another end of the crank shaft 48 and is operated by the rotation of the crank shaft 48.

[0024] As shown in FIG. 2, an oil filter 56 is disposed in the oil reservoir Os, and the oil pump 26 sucks up the lubricant oil r from the oil reservoir Os into the lubricant oil flow path 22. A pressure regulating valve 58 disposed at a terminating end of the lubricant oil flow path 22 regulates an oil pressure of the lubricant oil r flowing through the circulation path 24. The parts to be lubricated, such as the crank shaft 48 and the thrust bearing 50, are formed with oil passages 60 and 62. The lubricant oil r discharged from the oil pump 26 to the lubricant oil flow path 22 is supplied to these oil passages. As shown in FIG. 2, a part of the oil passage 60 is introduced to the piston 42 via a crank pin 53. Further, the lubricant oil r is supplied from the lubricant oil flow path 22 to the heat medium flow path 20 to heat the discharge gas Gv. The lubricant oil r that has passed through the heat medium flow path 20 returns to the oil reservoir Os via the oil passages 60 and 62, or the like. Thus, the circulation path 24 for the lubricant oil r described above is formed.

[0025] As shown in FIG. 1, the suction space Si is formed outside the cylinder 40, and if the piston 42 descends and a compression space in the cylinder 40 is decompressed, the refrigerant gas, which is the gas to

be compressed, is sucked from the suction space Si into a compression space in the cylinder 40 through a suction valve 63. The refrigerant gas sucked into the compression space is compressed in the compression space and discharged to the discharge space Sv. A disc-shaped valve cage 66 is pressed and fixed to an upper surface of the valve plate 44 by a coil spring 64 to block an opening of the valve plate 44. A truncated conical valve plate 70 is joined to a lower surface of the valve cage 66 by a bolt 68. A discharge gas passage is formed in the valve cage 66 and the discharge valve 12 is mounted thereon. If the piston 42 rises and a gas pressure in a cylinder chamber increases, the discharge valve 12 is pushed up to discharge the refrigerant gas into the discharge gas passage.

[0026] In an embodiment, as shown in FIGs. 1 and 2, the compressor 10 includes a coolant flow path 72 for cooling the compressor driving motor 54. The coolant flow path 72 communicates with the heat medium flow path 20. In the present embodiment, a liquid coolant, which has cooled the motor 54 and sucked a potential heat of the motor 54, is flowed through the heat medium flow path 20 and the casing 18, which includes the partition wall 18a forming the discharge space Sv, can be increased in temperature by potential heat of the coolant, making it possible to suppress the occurrence of frost on the surface of the casing 18 of the compressor 10.

[0027] Furthermore, as another embodiment, for example, heated hot water, an antifreeze liquid, or the like, which is used as a cooling liquid in another part of the compressor 10, may be supplied to the heat medium flow path 20 to heat the discharge space Sv.

[0028] In an embodiment, as shown in FIG. 1, a jacket cover 74 internally having a heat medium introduction space is disposed on an outer surface of the head cover serving as the casing 18. The heat medium introduction space forms the heat medium flow path 20. According to the present embodiment, the heat medium flow path 20 can be formed simply by mounting the jacket cover 74 on the existing compressor and the other parts do not need modification, making it possible to easily form the heat medium flow path 20.

[0029] In the exemplary embodiment shown in FIG. 1, the jacket cover 74 is formed with an inlet hole 74a and an outlet hole 74b of the heat medium flow path 20, and the lubricant oil flow path 22 is connected to the inlet hole 74a and the outlet hole 74b. Then, the lubricant oil r is supplied from the inlet hole 74a to the heat medium introduction space (heat medium flow path 20) and is discharged from the outlet hole 74b to the lubricant oil flow path 22. As shown in FIG. 1, the inlet hole 74a and the outlet hole 74b are, respectively, formed at both end portions of the jacket cover 74 away from each other. Thus, it is possible to increase a residence time of the lubricant oil r in the heat medium introduction space, and it is possible to improve the heat exchange rate with the discharge gas Gv.

[0030] In an embodiment, as shown in FIG. 1, the liquid

injection hole 14 for injecting the refrigerant liquid into the discharge space Sv includes a through hole 14a formed in the valve plate 44, and a communication hole 14b disposed in a wall portion of the compressor casing 16 and communicating with the through hole 14a to cause the through hole 14a to communicate with an external space. As will be described later, in a heat pump device including the compressor 10, the communication hole 14b is connected to a refrigerant path 76 branching off from an outlet-side refrigerant path of the liquid receiver 88, and the refrigerant liquid is supplied from the refrigerant path 76 to the liquid injection hole 14.

[0031] In an embodiment, as shown in FIG. 1, one end of the through hole 14a is open to the discharge space Sv, and another end of the through hole 14a is formed so as to communicate with the communication hole 14b.

[0032] According to the present embodiment, the liquid injection hole 14 can be formed at a position avoiding the head cover 18. If the heat medium flow path 20 needs to be disposed on the head cover 18 side and the liquid injection hole 14 is disposed on the head cover 18 side, the installation positions of the heat medium flow path 20 and the liquid injection hole 14 interfere. In the present embodiment, since the liquid injection hole 14 can be formed at the position on the valve plate 44 side avoiding the head cover 18, it is possible to realize a layout of the liquid injection hole 14 that can avoid the interference with the heat medium flow path 20.

[0033] In the exemplary embodiment shown in FIG. 1, the communication hole 14b is formed in an upper end portion of the casing surrounding the cylinder 40, which is a part of the compressor casing 16. On the other hand, the communication hole 14b may be formed in the valve plate 44. Further, the installation position of the liquid injection hole 14 is not limited to that of the above embodiment, and may be formed in another position, for example, in the head cover 18.

[0034] In an embodiment, as shown in FIG. 1, an outer peripheral edge portion of the valve plate 44 is interposed between the compressor casing 16 and an outer peripheral edge portion of the head cover 18. If the outer peripheral edge portion of the valve plate 44 is thus disposed in such a manner as to be exposed to the external space of the compressor 10, processing for opening the liquid injection hole 14 to the external space of the compressor 10 is facilitated. Further, as shown in FIG. 1, since the outer peripheral edge portions of the compressor casing 16, the valve plate 44, and the head cover 18 are laminated in three layers, the outer peripheral edge portions of these three layers can easily be joined by fastening together with a bolt 78. Thus, the valve plate 44 is mounted easily.

[0035] In an embodiment, a compressor system 80 shown in FIG. 4 is a two-stage compressor system which includes a low-stage compressor 82 and a high-stage compressor 84, and in which the refrigerant gas is the gas to be compressed, and the low-stage compressor 82 is constituted by the compressor 10 according to the

above embodiment. Since the low-stage compressor 82 is constituted by the compressor 10, it is possible to suppress the occurrence of frost on the surface of the casing 18, which includes the partition wall forming the discharge space, in the low-stage compressor 82.

[0036] In the exemplary compressor system 80 shown in FIG. 4, the low-stage compressor 82 and the high-stage compressor 84 are each constituted by the reciprocating compressor. A liquid receiver 88 is disposed on a refrigerant circulation path 86, and the refrigerant liquid in the liquid receiver 88 is decompressed by an expansion valve 90 through the refrigerant circulation path 86, and evaporates by absorbing latent heat of vaporization from a load in an evaporator 92. The refrigerant gas evaporated in the evaporator 92 is sucked into a suction chamber 94 of the low-stage compressor 82, is further sucked into a cylinder 98 via a suction valve 96, and is compressed.

[0037] The refrigerant gas compressed by the cylinder 98 is discharged to a discharge chamber 102 via a discharge valve 100 and discharged from the discharge chamber 102 to the refrigerant circulation path 86. The refrigerant gas discharged to the refrigerant circulation path 86 is sucked into the suction chamber 94 of the high-stage compressor 84 after the lubricant oil is separated by an oil separator 104. The refrigerant gas sucked into the suction chamber 94 of the high-stage compressor 84 is further sucked into the cylinder 98 via the suction valve 96, is compressed, and is discharged from the discharge chamber 102 to the refrigerant circulation path 86. The refrigerant gas discharged to the refrigerant circulation path 86 is cooled and liquefied by the condenser 106 after the lubricant oil is separated by the oil separator 104.

[0038] A branch path 108 branching off from the refrigerant circulation path 86 is disposed downstream of the liquid receiver 88, and the branch path 108 is provided with a liquid pump 110 and a pressure regulating valve 112. The branch path 108 is connected to the discharge chamber 102 of the high-stage compressor 84, and the refrigerant liquid is pressurized to have a higher pressure than the discharge chamber 102 of the high-stage compressor 84 by controlling a rotation speed of the oil pump 26 and the pressure control with the pressure regulating valve 112, and is injected into the discharge chamber 102 from an injection nozzle 114 disposed in the discharge chamber 102. The injected refrigerant liquid evaporates under the temperature and pressure conditions of the discharge chamber 102 to cool the discharge space.

[0039] Further, the refrigerant circulation path 86 is provided with a branch path 116 branching off from the refrigerant circulation path 86 at a downstream position of the branch path 108. The branch path 116 is connected to the injection nozzle 114 disposed on an inner wall surface of the discharge chamber 102 of the low-stage compressor 82. Since the discharge chamber 102 of the low-stage compressor 82 has the lower pressure than the branch path 116, the refrigerant liquid can be supplied to the discharge chamber 102 at the same pressure with-

out increasing the pressure. The discharge chamber 102 of the low-stage compressor 82 is cooled by evaporation of the refrigerant liquid injected from the injection nozzle 114 under the temperature and pressure conditions of the discharge chamber 102. In the present embodiment, since the low-stage compressor 82 is constituted by the compressor 10 according to each of the above-described embodiments, it is possible to suppress frost generated on the surface of the casing (head cover) 18 of the compressor 10.

[0040] In the compressor system 80 shown in FIG. 4, the low-stage compressor 82 and the high-stage compressor 84 may constitute a single-machine two-stage compressor in which the low-stage compressor and the high-stage compressor are housed in one casing. For example, in the compressor 10 shown in FIG. 1, a compressor system may be configured in which one cylinder 40 is the low-stage compressor and the another cylinder is the high-stage compressor.

[0041] The contents described in the above embodiments would be understood as follows, for instance.

1) A compressor (10) according to one aspect includes: a discharge valve (12); a discharge space (Sv) formed downstream of the discharge valve; a liquid injection hole (14) for injecting a refrigerant liquid into the discharge space; and a heat medium flow path (20) located opposite to the discharge space across a partition wall (18a) forming the discharge space.

With such configuration, since the above-described heat medium flow path is provided, it is possible to increase the temperature of the compressor casing which includes the partition wall forming the discharge space, making it possible to suppress the occurrence of frost on the surface of the compressor.

2) A compressor according to another aspect is the compressor as defined in 1), including: a lubricant oil flow path (22) through which lubricant oil (r) supplied to a part to be lubricated of the compressor flows. The heat medium flow path (20) is disposed in series or parallel with the lubricant oil flow path (22).

With such configuration, since it is possible to cause the lubricant oil, which has been used to lubricate the part to be lubricated of the compressor and absorbed the heat of the part to be lubricated, to flow through the heat medium flow path, the temperature of the partition wall forming the discharge space can be increased by potential heat of the lubricant oil. Therefore, it is possible to suppress the occurrence of frost in the compressor casing including the partition wall.

3) A compressor according to still another aspect is the compressor as defined in 2), wherein the heat medium flow path is arranged in series with the lubricant oil flow path such that a circulation path (24) for the lubricant oil including the part to be lubricated,

the lubricant oil flow path (22), and the heat medium flow path is formed, and wherein the compressor comprises an oil pump (26) for circulating the lubricant oil in the circulation path.

With such configuration, since the lubricant oil flowing through the lubricant oil circulation path exchanges heat with the discharge gas in the heat medium flow path and is cooled by the discharge gas, the heat medium flow path doubles as an oil cooler. Therefore, a dedicated oil cooler is not required, making it possible to reduce a cost.

4) A compressor according to yet another aspect is the compressor as defined in any one of 1) to 3), including: a compressor driving motor (54); and a coolant flow path (72) for cooling the compressor driving motor. The coolant flow path communicates with the heat medium flow path (20).

With such configuration, since the coolant for cooling the compressor driving motor flows through the heat medium flow path, the temperature of the compressor casing which includes the partition wall forming the discharge space can be increased by potential heat of the coolant that has cooled the compressor driving motor and absorbed heat, making it possible to suppress the occurrence of frost on the surface of the compressor.

5) A compressor according to yet another aspect is the compressor as defined in any one of 1) to 4), including: a compressor casing (16); a cylinder (40) disposed in the compressor casing; a piston (42) for reciprocating inside the cylinder; a valve plate (44) disposed at one end of the cylinder and configured to support the discharge valve; and a head cover (18) which includes the partition wall (18a) forming the discharge space.

With such configuration, the temperature of the above-described head cover can be increased by the heat medium flowing through the heat medium flow path, making it possible to suppress the occurrence of frost on the surface of the head cover.

6) A compressor according to yet another aspect is the compressor as defined in 5), including: a jacket cover (74) disposed on an outer surface of the head cover and internally having a heat medium introduction space. The heat medium introduction space forms the heat medium flow path (20).

With such configuration, the heat medium flow path can be formed simply by mounting the above-described jacket cover on the existing compressor and the other parts do not need modification, making it possible to easily form the heat medium flow path.

7) A compressor according to yet another aspect is the compressor as defined in 5) or 6), wherein the liquid injection hole (14) includes: a through hole (14a) formed in the valve plate (44); and a communication hole (14b) disposed in a wall portion of the compressor casing (16) and communicating with the through hole (14a) to cause the through hole (14a)

to communicate with an external space.

With such configuration, since the heat medium flow path needs to be disposed on the head cover side and the liquid injection hole is formed not on the head cover side but on the valve plate side, it is possible to avoid interference with the heat medium flow path and it is possible to realize the layout of injection hole.

8) A compressor according to yet another aspect is the compressor as defined in any one of 5) to 7), wherein an outer peripheral edge portion of the valve plate (44) is interposed between the compressor casing (16) and an outer peripheral edge portion of the head cover (18).

With such configuration, the outer peripheral edge portions of the compressor casing, the valve plate, and the head cover are fastened together with a fastener such as a bolt, making it easier to install the valve plate. Further, since the end face of the outer peripheral edge portion of the valve plate is exposed to the external space, it is easy to form the liquid injection hole through which the discharge space and the external space communicate with each other.

9) A compressor system (80) according to one aspect is a compressor system (80), including: a low-stage compression part (82); and a high-stage compression part (84). At least the low-stage compression part (82) is constituted by the compressor (10) as defined in any one of 5) to 8).

With such configuration, since the low-stage compression part is constituted by the compressor according to each embodiment, it is possible to suppress the occurrence of frost on the surface of the compressor in the low-stage compression part.

Reference Signs List

[0042]

10	Compressor
12, 100	Discharge valve
14	Liquid injection hole
14a	Through hole
14b	Communication hole
16	Compressor casing
18	Casing (head cover)
18a	Partition wall (partition wall forming discharge space)
20	Heat medium flow path
22	Lubricant oil flow path
24	Circulation path
26	Oil pump
28	Oil cooler
30, 108, 116	Branch path
32, 34	Flow control valve
40, 98	Cylinder
42	Piston
44	Valve plate
46	Crankcase

48	Crank shaft
50	Thrust bearing
52	Connecting rod
53	Crank pin
5 54	Compressor driving motor
56	Oil filter
58	Pressure regulating valve
60, 62	Oil passage
63, 96	Suction valve
10 64	Coil spring
66	Valve cage
68, 78	Bolt
70	Valve plate
72	Coolant flow path
15 74	Jacket cover
74a	Inlet hole
74b	Outlet hole
76	Refrigerant path
80	Compressor system
20 82	Low-stage compressor
84	High-stage compressor
86	Refrigerant circulation path
88	Liquid receiver
90	Expansion valve
25 92	Evaporator
94	Suction chamber
102	Discharge chamber
104	Oil separator
106	Condenser
30 110	Liquid pump
112	Pressure regulating valve
114	Injection nozzle
Gv	Discharge gas
Os	Oil reservoir
35 Si	Suction space
Sv	Discharge space
r	Lubricant oil

40 Claims

1. A compressor, comprising:

a discharge valve;
a discharge space formed downstream of the discharge valve;
a liquid injection hole for injecting a refrigerant liquid into the discharge space; and
a heat medium flow path located opposite to the discharge space across a partition wall forming the discharge space.

2. The compressor according to claim 1, comprising:

a lubricant oil flow path through which lubricant oil supplied to a part to be lubricated of the compressor flows,
wherein the heat medium flow path is disposed

- in series or parallel with the lubricant oil flow path.
3. The compressor according to claim 2,
- wherein the heat medium flow path is arranged in series with the lubricant oil flow path such that a circulation path for the lubricant oil including the part to be lubricated, the lubricant oil flow path, and the heat medium flow path is formed, and wherein the compressor comprises an oil pump for circulating the lubricant oil in the circulation path.
4. The compressor according to any one of claims 1 to 3, comprising:
- a compressor driving motor; and
a coolant flow path for cooling the compressor driving motor,
wherein the coolant flow path communicates with the heat medium flow path.
5. The compressor according to any one of claims 1 to 4, comprising:
- a compressor casing;
a cylinder disposed in the compressor casing;
a piston for reciprocating inside the cylinder;
a valve plate disposed at one end of the cylinder and configured to support the discharge valve;
and
a head cover which includes the partition wall forming the discharge space.
6. The compressor according to claim 5, comprising:
- a jacket cover disposed on an outer surface of the head cover and internally having a heat medium introduction space,
wherein the heat medium introduction space forms the heat medium flow path.
7. The compressor according to claim 5 or 6, wherein the liquid injection hole includes:
- a through hole formed in the valve plate; and
a communication hole disposed in a wall portion of the compressor casing and communicating with the through hole to cause the through hole to communicate with an external space.
8. The compressor according to any one of claim 5 to 7, wherein an outer peripheral edge portion of the valve plate is interposed between the compressor casing and an outer peripheral edge portion of the head cover.
9. A compressor system, comprising:
- a low-stage compression part; and
a high-stage compression part,
wherein at least the low-stage compression part is constituted by the compressor according to any one of claims 5 to 8.

FIG. 1

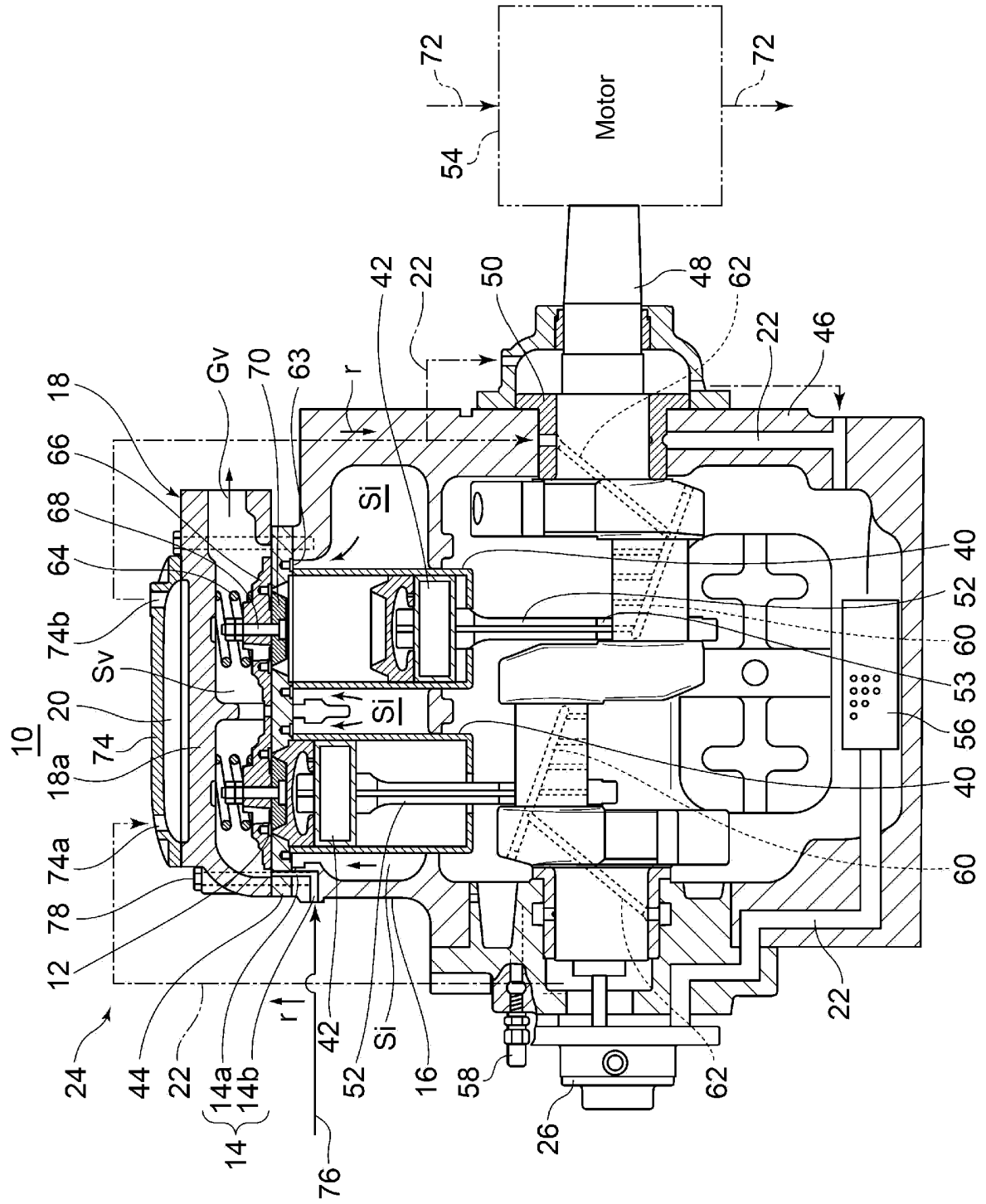


FIG. 2

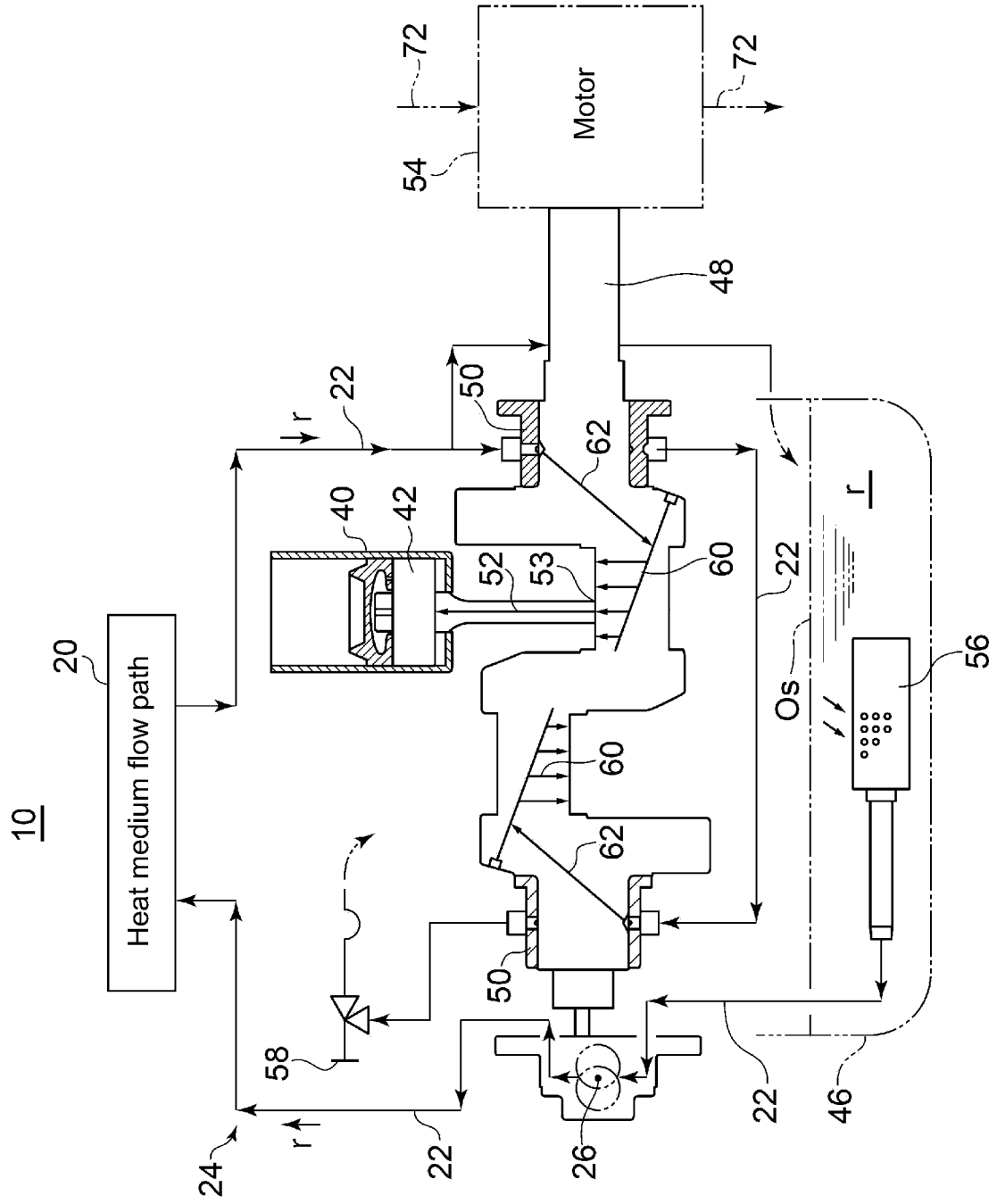


FIG. 3

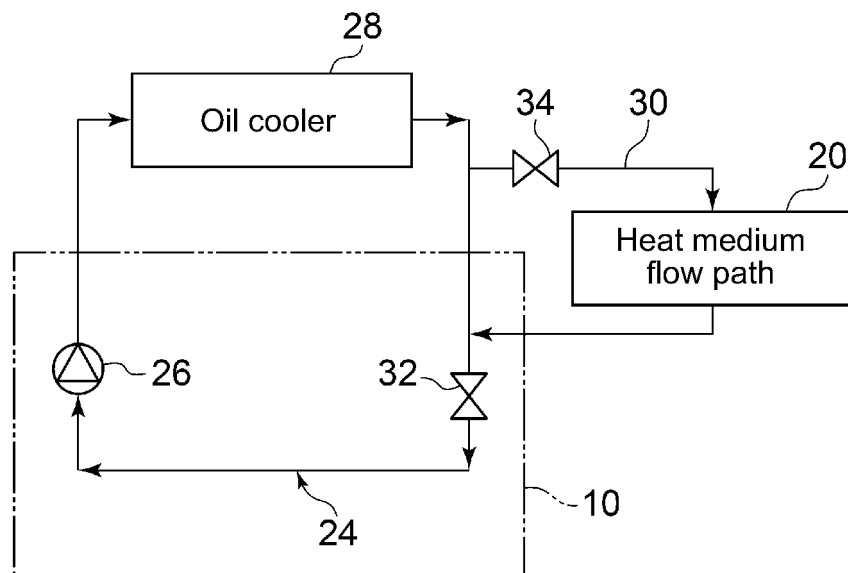
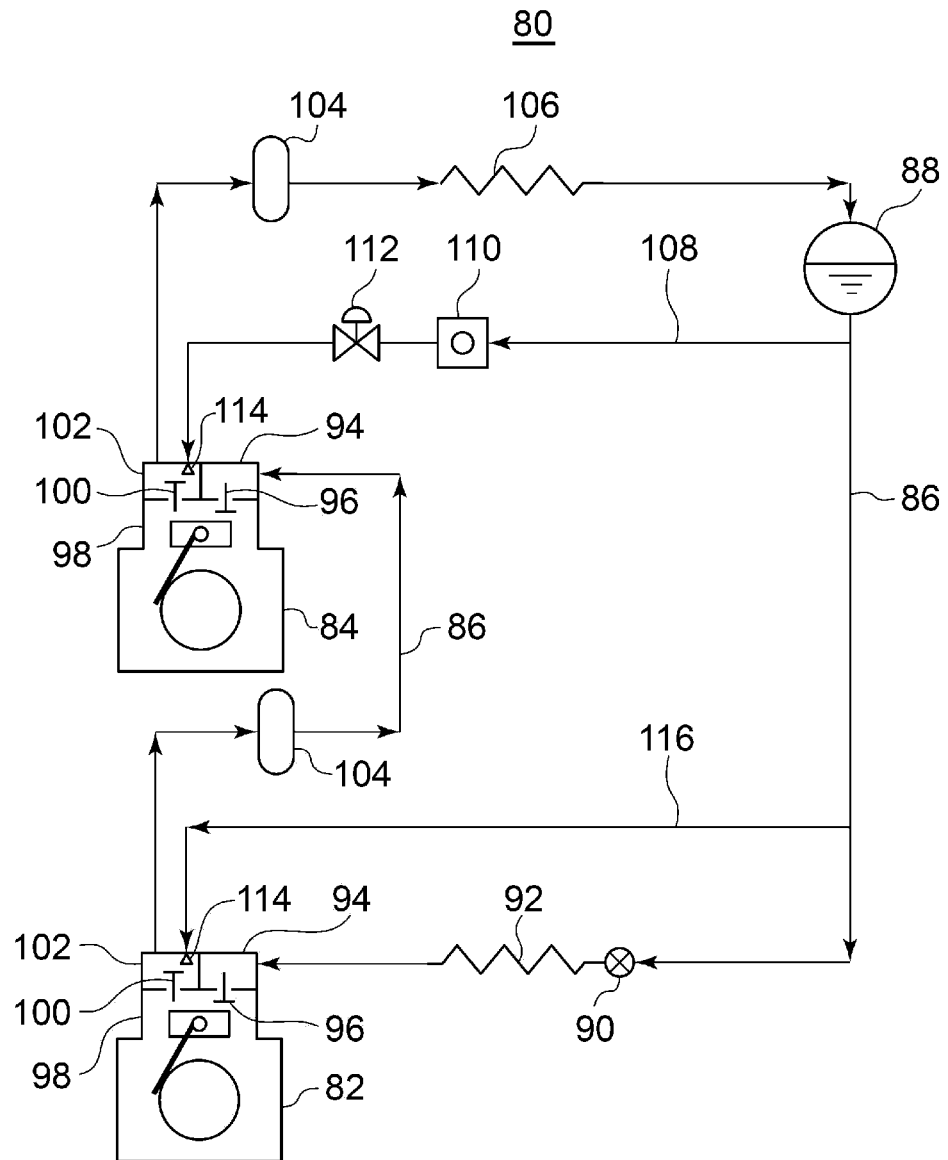


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/031462

A. CLASSIFICATION OF SUBJECT MATTER

F04B 39/06(2006.01)i

FI: F04B39/06 M; F04B39/06 R

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)

F04B39/06

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 2010-53765 A (MAYEKAWA MFG CO., LTD.) 11 March 2010 (2010-03-11) paragraphs [0052], [0073]-[0078], fig. 4, 9	1-9
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 126313/1977 (Laid-open No. 55503/1979) (HITACHI, LTD.) 17 April 1979 (1979-04-17), specification, page 3, line 17 to page 4, line 3, drawings	1-9
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 78199/1973 (Laid-open No. 26405/1975) (TOKYO SHIBAURA DENKI KABUSHIKI KAISHA) 26 March 1975 (1975-03-26), specification, page 3, line 1 to page 6, line 16, drawings	2-4
Y	JP 4-164177 A (SANYO ELECTRIC CO.) 09 June 1992 (1992-06-09) page 2, lower left column, line 10 to lower right column, line 10, fig. 1-3	7
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 71890/1972 (Laid-open No. 29504/1974) (TOKYO SHIBAURA DENKI KABUSHIKI KAISHA) 14 March 1974 (1974-03-14), specification, page 3, line 8 to page 4, line 20, fig. 1-2	8

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

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Date of the actual completion of the international search 17 September 2021	Date of mailing of the international search report 05 October 2021
Name and mailing address of the ISA/JIP Japan Patent Office (ISA/JIP) 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915 Japan	Authorized officer Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/031462

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2010-53765 A	11 March 2010	(Family: none)	
JP 54-55503 U1	17 April 1979	(Family: none)	
JP 50-26405 U1	26 March 1975	(Family: none)	
JP 4-164177 A	09 June 1992	(Family: none)	
JP 49-29504 U1	14 March 1974	(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 2010053765 A [0003]
- JP 2011163192 A [0003]