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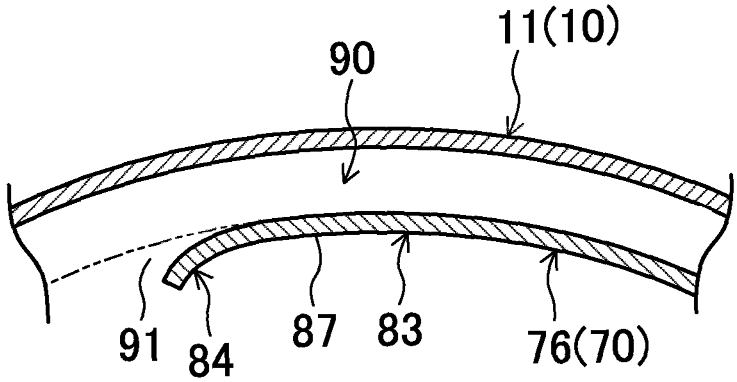
(54) **SCROLL COMPRESSOR**

(57) A scroll compressor (1) includes a tubular casing (10) and a circumferential guide (83) formed on an inner peripheral surface of the casing (10) to guide a compressed refrigerant. The circumferential guide (83) and the inner peripheral surface define therebetween a circumferential flow path (90) configured to guide the compressed refrigerant in a circumferential direction and cause the compressed refrigerant to flow out through an outlet (91). The circumferential guide (83) includes an outlet region (84) formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91). This configuration can reduce oil loss of the scroll compressor.

FIG.5



EP 3 919 742 A1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a scroll compressor.

BACKGROUND ART

[0002] Scroll compressors that include a casing for housing a compression mechanism, and a gas guide formed on an inner peripheral surface of the casing to guide a compressed refrigerant have been known (e.g., Patent Document 1). The gas guide has a circumferential guide portion that guides the compressed refrigerant in the circumferential direction of the casing. The compressed refrigerant guided by the circumferential guide portion flows while swirling in the casing.

CITATION LIST

PATENT DOCUMENT

[0003] Patent Document 1: Japanese Unexamined Patent Publication No. 2017-218945

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0004] Drops of oil contained in the compressed refrigerant may be deposited on the circumferential guide portion and forms an oil film. The turbulent flow generated at an outlet region of the circumferential guide portion can cause this oil film to form mist. The resultant mist can be discharged to the outside of the casing together with the compressed refrigerant. This can increase oil loss, which is a phenomenon in which oil is discharged together with the compressed refrigerant.

[0005] An object of the present disclosure is to reduce oil loss from a scroll compressor.

SOLUTION TO THE PROBLEM

[0006] A first aspect of the present disclosure is directed to a scroll compressor (1). The scroll compressor (1) includes: a casing (10) having a tubular shape for housing a compression mechanism (40); and a circumferential guide (83) formed on an inner peripheral surface of the casing (10) to guide a compressed refrigerant that has been compressed by the compression mechanism (40), wherein the circumferential guide (83) and the inner peripheral surface define therebetween a circumferential flow path (90) configured to guide the compressed refrigerant in a circumferential direction of the casing (10) and cause the compressed refrigerant to flow out through an outlet (91), and the circumferential guide (83) includes an outlet region (84) formed in a shape that allows the circumferential flow path (90) to widen toward the outlet (91).

[0007] According to the first aspect, the compressed refrigerant flows through the circumferential flow path (90) formed between the inner peripheral surface of the casing (10) and the circumferential guide (83), and flows out of the outlet (91) of the circumferential flow path (90) into the casing (10). In this aspect, the outlet region (84) of the circumferential guide (83) is formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91). Drops of oil in the compressed refrigerant move in a direction away from the inner peripheral surface of the casing (10) along such a shape of the outlet region (84). The drops of oil that have moved away from the inner peripheral surface of the casing (10) are less likely to be entrained in the turbulent flow that may be generated at the outlet (91) of the circumferential flow path (90). This configuration reduces oil loss.

[0008] The "outlet region" of the circumferential guide (83) herein means a portion of the circumferential guide (83) corresponding to the outlet (91) of the circumferential flow path (90) and its vicinity.

[0009] A second aspect of the present disclosure is an embodiment of the first aspect. In the second aspect, the outlet region (84) is curved so that the circumferential flow path (90) widens toward the outlet (91).

[0010] The second aspect allows the circumferential flow path (90) in the outlet region (84) to gently widen toward the outlet (91). It is therefore possible to substantially prevent the turbulent flow of the compressed refrigerant without abruptly reducing the flow rate of the compressed refrigerant flowing through the circumferential flow path (90).

[0011] A third aspect of the present disclosure is an embodiment of the first or second aspect. In the third aspect, the casing (10) is formed into a tubular shape extending vertically, and the outlet region (84) has a bottom portion (86) formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91).

[0012] According to the third aspect, drops of oil accumulate on the bottom portion (86) of the outlet region (84) by gravitation more easily than on the other portions. Forming the bottom portion (86) of the outlet region (84) where the drops of oil accumulate easily into a predetermined shape can substantially and effectively prevent the drops of oil from forming mist, and can in turn effectively reduce oil loss.

[0013] A fourth aspect of the present disclosure is an embodiment of any one of the first to third aspects. In the fourth aspect, the outlet region (84) includes an intermediate portion (87) in an axial direction of the casing (10), the intermediate portion (87) being formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91).

[0014] According to the fourth aspect, the intermediate portion (87) of the outlet region (84) in the axial direction of the casing (10) can substantially prevent the drops of oil from forming mist.

[0015] A fifth aspect of the present disclosure is an embodiment of any one of the first to fourth aspects. In the fifth aspect, an entirety of the outlet region (84) is formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91).

[0016] According to the fifth aspect, the entire outlet region (84) can substantially prevent the drops of oil from forming mist, and can thus further reduce oil loss.

[0017] A sixth aspect of the present disclosure is directed to a refrigeration apparatus (100). The refrigeration apparatus (100) includes a refrigerant circuit (101) having the scroll compressor (1) of any one of the first to fifth aspects and performing a refrigeration cycle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a refrigerant circuit diagram showing a schematic configuration of a refrigeration apparatus according to an embodiment.
FIG. 2 is a vertical cross-sectional view of a scroll compressor according to the embodiment.
FIG. 3 is a perspective view of a gas guide according to the embodiment as viewed from inside.
FIG. 4 is a perspective view of the gas guide according to the embodiment as viewed from outside.
FIG. 5 is a cross-sectional view taken along line V-V of FIG. 3 and showing an outlet region of a circumferential guide according to the embodiment.
FIG. 6 illustrates the shape of the outlet region of the circumferential guide according to the embodiment; a left portion of FIG. 6 illustrates the outlet region as viewed from the outlet; and a right portion thereof illustrates the outlet region and its surrounding area as viewed from side.
FIG. 7 is a cross-sectional view showing an outlet region of a circumferential guide according to another embodiment.

DESCRIPTION OF EMBODIMENTS

[0019] An embodiment will be described. A scroll compressor (1) according to this embodiment is used for a refrigeration apparatus (100). Examples of the refrigeration apparatus (100) include an air conditioner that adjusts the temperature and humidity of air, a cooling apparatus that cools its internal space, and a hot water supply apparatus that produces hot water.

[0020] As shown in FIG. 1, the refrigeration apparatus (100) includes a refrigerant circuit (101) that performs a refrigeration cycle. The refrigerant circuit (101) includes the scroll compressor (1), a condenser (102), an expansion mechanism (103), and an evaporator (104). In the refrigerant circuit (101), a refrigerant compressed by the scroll compressor (1) dissipates heat in the condenser (102) and is decompressed in the expansion mechanism (103). The decompressed refrigerant evaporates in the evaporator (104), and is sucked into the scroll compressor (1).

[0021] As illustrated in FIG. 2, the scroll compressor (1) includes a casing (10), an electric motor (20), a drive shaft (30), and a compression mechanism (40). The electric motor (20), the drive shaft (30), and the compression mechanism (40) are housed in the casing (10). The electric motor (20) is disposed below the compression mechanism (40). The drive shaft (30) connects the electric motor (20) and the compression mechanism (40).

<Casing>

[0022] The casing (10) is a hollow closed container. The casing (10) is in the shape of a tube (a substantial cylinder) extending vertically with upper and lower ends closed. The casing (10) includes a barrel (11), a first closing part (12), and a second closing part (13). The barrel (11) is formed in the shape of a vertically long cylinder. The first closing part (12) is fixed to an upper portion of the barrel (11) to close the upper opening of the barrel (11). The second closing part (13) is fixed to a lower portion of the barrel (11) to close the lower opening of the barrel (11).

[0023] The inside of the casing (10) is filled with a compressed refrigerant that has been compressed by the compression mechanism (40). The casing (10) has therein an upper space (S1), an intermediate space (S2), and a lower space (S3). The upper space (S1) is formed above the compression mechanism (40). The intermediate space (S2) is formed between the compression mechanism (40) and the electric motor (20). The upper space (S1) and the intermediate space (S2) communicate with each other through an internal passage (40a) of the compression mechanism (40). The lower space (S3) is formed below the electric motor (20). Lubricant (hereinafter referred to also as "oil") for lubricating sliding portions of the compression mechanism (40) and other components is stored at the bottom of the lower space (S3).

<Suction Pipe and Discharge Pipe>

[0024] The scroll compressor (1) includes a suction pipe (14) and a discharge pipe (15). The suction pipe (14) passes vertically through the first closing part (12) of the casing (10). An inlet end of the suction pipe (14) is connected to a low-pressure gas line of the refrigerant circuit. An outlet end of the suction pipe (14) is connected to a compression chamber (S40) of the compression mechanism (40). The discharge pipe (15) passes radially through the barrel (11) of the casing (10). An inlet end of the discharge pipe (15) communicates with the intermediate space (S2). An outlet end of the discharge pipe (15) is connected to a high-pressure gas line of the refrigerant circuit.

<Electric Motor>

[0025] The electric motor (20) is a drive source of the compression mechanism (40). The electric motor (20) is disposed in an axially intermediate portion of the barrel (11). The electric motor (20) includes a stator (21) and a rotor (23). The stator (21) and the rotor (23) are formed into a substantially cylindrical shape. The stator (21) is fixed to the inner peripheral surface of the barrel (11) of the casing (10). The rotor (23) is inserted into the stator (21). The rotor (23) is fixed to the outer peripheral surface of the drive shaft (30). The rotor (23) of the electric motor (20) rotates inside the stator (21).

[0026] The outer peripheral surface of the stator (21) has a plurality of core cuts (22) (notches). In this example, the outer peripheral surface of the stator (21) has four core cuts (22) arranged side by side in the circumferential direction. FIG. 2 illustrates only one of the four core cuts (22).

<Drive Shaft>

[0027] The drive shaft (30) extends along the axis of the casing (10). The drive shaft (30) extends vertically. The drive shaft (30) is rotatably supported by an upper bearing (B1) and a lower bearing (B2). The drive shaft (30) has therein an oil supply passage (31). The drive shaft (30) includes a main shaft portion (32) and an eccentric shaft portion (33). The main shaft portion (32) extends along the axis of the casing (10) to pass through the electric motor (20). A pump (34) serving as an oil conveyor is provided at the lower end of the main shaft portion (32). The pump (34) pumps up oil at the bottom of the lower space (S3). The oil pumped up by the pump (34) flows through the oil supply passage (31), and is supplied to the sliding portions of the upper and lower bearings (B1) and (B2) and other components.

[0028] The eccentric shaft portion (33) projects upward from the upper end of the main shaft portion (32). The axis of the eccentric shaft portion (33) is radially offset from the axis of the main shaft portion (32). The outer diameter of the eccentric shaft portion (33) is smaller than that of the main shaft portion (32). A weight (35) is provided at the upper end of the main shaft portion (32). The weight (35) is configured to dynamically balance the rotation of the drive shaft (30).

<Schematic Configuration of Compression Mechanism>

[0029] The compression mechanism (40) is driven by the electric motor (20) via the drive shaft (30). When driven, the compression mechanism (40) compresses the refrigerant. The compression mechanism (40) includes a housing (41), an Oldham coupling (50), a fixed scroll (51), and a movable scroll (56). In the compression mechanism (40), the housing (41), the Oldham coupling (50), the movable scroll (56), and the fixed scroll (51) are arranged sequentially from bottom to top. The compression chamber (S40) where the refrigerant is compressed is formed between the movable scroll (56) and the fixed scroll (51).

<Housing>

[0030] The housing (41) has a first frame (42) and a second frame (49). The first frame (42) is fixed to the inner peripheral surface of the casing (10). The second frame (49) is provided above the first frame (42).

[0031] As illustrated in FIG. 2, the first frame (42) is formed into a substantially cylindrical shape through which the drive shaft (30) passes. The first frame (42) includes a base portion (43) fixed to the casing (10), and a protrusion (48) protruding downward from the base portion (43). The base portion (43) has therein a first chamber (45) and a second chamber (47). The first chamber (45) is formed inside a lower portion of the base portion (43). The weight (35) is rotatably housed in the first chamber (45).

[0032] The second chamber (47) is formed inside an upper portion of the base portion (43). The second chamber (47) is formed above the first chamber (45). The base portion (43) has therein an annular bottom surface (44) facing the second chamber (47). The second frame (49) is placed on the annular bottom surface (44). The second frame (49) is formed into a substantially tubular shape. The eccentric shaft portion (33) is disposed inside the second frame (49) to be capable of rotating eccentrically.

[0033] The protrusion (48) protrudes downward from an inner peripheral portion of the base portion (43). The protrusion (48) is formed into a substantially cylindrical shape. The upper bearing (B1) is provided inside the protrusion (48). The upper bearing (B1) rotatably supports the main shaft portion (32). The upper bearing (B1) is configured as a bearing metal.

[0034] An annular groove (46) is formed on the bottom surface of the first chamber (45). The annular groove (46) constitutes a so-called elastic groove. Rotation of the drive shaft (30) allows the upper bearing (B 1) to be slightly inclined in the radial direction. This causes an inner portion of the annular groove (46) to be elastically deformed along the drive shaft (30). It is therefore possible to reduce the uneven contact between the upper bearing (B1) and the drive shaft (30).

[0035] The oil supplied through the oil supply passage (31) to the respective sliding portions flows into the first chamber (45). The first chamber (45) is in a pressure atmosphere equivalent to the pressure of high-pressure oil. In other words, the first chamber (45) is in a pressure atmosphere equivalent to the pressure of the high-pressure refrigerant compressed by the compression mechanism (40).

<Oldham Coupling>

[0036] The Oldham coupling (50) is arranged between the second frame (49) and the movable scroll (56). The

Oldham coupling (50) is formed in the shape of a ring. The Oldham coupling (50) has a lower surface having a first key fitted into a groove of the second frame (49). The Oldham coupling (50) has an upper surface having a second key fitted into a groove of a second end plate (57) of the movable scroll (56). The Oldham coupling (50) constitutes an anti-rotation mechanism that restricts the rotation of the movable scroll (56) on its axis.

<Fixed Scroll>

[0037] The fixed scroll (51) is placed at an upper end of the housing (41). The fixed scroll (51) is fixed to the base portion (43) of the housing (41) via bolts serving as fastening members.

[0038] The fixed scroll (51) includes a first end plate (52), an outer peripheral wall (54), and a first wrap (55). The first end plate (52) has a generally circular disk shape in plan view. The outer peripheral wall (54) is formed into a substantially tubular shape continuous with an outer peripheral portion of the first end plate (52). The outer peripheral wall (54) projects downward from the first end plate (52) toward the fixed scroll (51). The first wrap (55) is located inside the outer peripheral wall (54). The first wrap (55) is formed into a spiral wall shape that draws an involute curve. The first wrap (55) projects downward from the first end plate (52) toward the movable scroll (56). The distal ends of the outer peripheral wall (54) and the first wrap (55) are in substantial contact with the second end plate (57) of the movable scroll (56).

[0039] The outer peripheral wall (54) has a suction port (not shown). The suction port is connected to the outlet end of the suction pipe (14). The first end plate (52) has, at its center, a discharge port (53). The discharge port (53) allows the compression chamber (S40) and the upper space (S1) to communicate with each other.

<Movable Scroll>

[0040] The movable scroll (56) is arranged between the fixed scroll (51) and the housing (41).

[0041] The movable scroll (56) includes the second end plate (57), a second wrap (58), and a boss (59). The second end plate (57) has a generally circular disk shape in plan view. The second wrap (58) is formed into a spiral wall shape that draws an involute curve. The second wrap (58) projects upward from the second end plate (57) toward the fixed scroll (51). The distal end of the second wrap (58) is in substantial contact with the first end plate (52) of the fixed scroll (51).

[0042] The boss (59) projects downward from a central portion of the back surface of the second end plate (57). The eccentric shaft portion (33) of the drive shaft (30) is fitted into the boss (59). The "back surface" of the second end plate (57) herein means a lower surface of the second end plate (57) in FIG. 2.

[0043] The second wrap (58) meshes with the first wrap (55). In the compression mechanism (40), the compression chamber (S40) is defined by the first end plate (52), the second end plate (57), the first wrap (55), and the second wrap (58). The compression mechanism (40) of this example has a so-called asymmetric spiral structure.

<Lower Bearing Member>

[0044] The scroll compressor (1) includes a lower bearing member (60). The lower bearing member (60) includes a bearing body (61) provided with the lower bearing (B2), and a plurality of fixing portions (62) extending radially outward from the bearing body (61). The fixing portions (62) are arranged side by side in the circumferential direction of the casing (10). The fixing portions (62) are fixed to the barrel (11) of the casing (10) via fastening members or other suitable members.

<Gas Guide>

[0045] The scroll compressor (1) includes a gas guide (70). As illustrated in FIG. 2, the gas guide (70) is provided between the housing (41) and the electric motor (20) in the vicinity of the inner peripheral surface of the barrel (11) of the casing (10). The gas guide (70) constitutes a guide member that guides, in a predetermined direction, the compressed refrigerant discharged from the compression mechanism (40).

[0046] As illustrated in FIGS. 3 and 4, the gas guide (70) has a recessed portion (71), and a pair of curved plate portions (75, 76) respectively continuous with both lateral ends of the recessed portion (71). The recessed portion (71) is recessed toward the center of curvature of the pair of curved plate portions (75, 76) (in other words, radially inward of the casing (10)). The recessed portion (71) is formed between the pair of curved plate portions (75, 76).

[0047] The recessed portion (71) includes an upper recess (72), a lower recess (73), and an inclined portion (74). The upper recess (72) is formed near the upper end of the gas guide (70). The lower recess (73) is formed near the lower end of the gas guide (70). A bottom portion (72a) of the upper recess (72) has a plate shape curved along the outer peripheral surface of the protrusion (48) of the first frame (42). A bottom portion (73a) of the lower recess (73) has a curved plate shape. The lower recess (73) is shallower than the upper recess (72). The inclined portion (74) extends from the lower end of the bottom portion (72a) of the upper recess (72) to the upper end of the bottom portion (73a) of the lower recess (73). The inclined portion (74) is inclined with respect to the bottom portions (72a, 73a) of the upper and lower recesses (72) and (73). An axial flow path through which the compressed refrigerant is guided in the axial direction of the casing (10) to flow out of an outlet is formed between the lower recess (73) and the inner peripheral surface of the casing (10). The lower recess (73) constitutes an axial guide for guiding the compressed refrigerant.

[0048] The pair of curved plate portions (75, 76) include a first curved plate portion (75) formed at one of lateral ends (the right end in FIG. 3) of the recessed portion (71) in the circumferential direction, and a second curved plate portion (76) formed at the other lateral end (the left end in FIG. 3) of the recessed portion (71) in the circumferential direction.

[0049] The entire outer peripheral surface of the first curved plate portion (75) is in tight contact with the barrel (11) of the casing (10). The circumferential width of the first curved plate portion (75) is smaller than that of the second curved plate portion (76).

[0050] The second curved plate portion (76) includes an upper curved portion (81), a lower curved portion (82), and an intermediate recess (83). The upper curved portion (81) is configured as an upper portion of the second curved plate portion (76). The lower curved portion (82) is configured as a lower portion of the second curved plate portion (76). The entire outer peripheral surfaces of the upper and lower curved portions (81) and (82) are in tight contact with the barrel (11) of the casing (10).

[0051] The intermediate recess (83) is recessed toward the center of curvature of the second curved plate portion (76). The intermediate recess (83) is formed between the upper curved portion (81) and the lower curved portion (82). The intermediate recess (83) extends circumferentially across the second curved plate portion (76). The intermediate recess (83) has an upper portion (85), a lower portion (86), and an intermediate portion (87).

[0052] The upper portion (85) is formed near the upper end of the intermediate recess (83), and constitutes an upper portion of the intermediate recess (83). The lower portion (86) is formed near the lower end of the intermediate recess (83), and constitutes a bottom portion of the intermediate recess (83). The upper portion (85) is inclined from the lower end of the upper curved portion (81) to the upper end of the intermediate portion (87). The lower portion (86) is inclined from the lower end of the intermediate portion (87) to the upper end of the lower curved portion (82). The intermediate portion (87) is formed between the upper portion (85) and the lower portion (86). The intermediate portion (87) is curved along the barrel (11) of the casing (10) so as to keep a predetermined distance from the barrel (11).

[0053] A circumferential flow path (90) extending circumferentially is formed between the intermediate recess (83) and the barrel (11). An inlet of the circumferential flow path (90) communicates with the inside of the recessed portion (71). An outlet (91) of the circumferential flow path (90) communicates with the intermediate space (S2). A portion of the refrigerant guided by the gas guide (70) flows through the circumferential flow path (90) and flows into the intermediate space (S2). The intermediate recess (83) constitutes a circumferential guide.

[0054] As illustrated in FIGS. 3 to 6, an outlet region (84) of the intermediate recess (83) is curved so that the circumferential flow path (90) widens toward the outlet (91) of the circumferential flow path (90). In other words, the outlet region (84) of the intermediate recess (83) is curved so that the cross-sectional area of the circumferential flow path (90) taken along the plane perpendicular to the circumferential flow path (90) increases toward the outlet (91).

[0055] Specifically, the upper portion (85), the lower portion (86), and the intermediate portion (87) of the intermediate recess (83) are each curved in the outlet region (84) so as to be further away from a central portion of the circumferential flow path (90) as the intermediate recess (83) is closer to the outlet (91). At the outlet region (84), the upper portion (85) and the lower portion (86) are curved in a direction perpendicular to their respective inclined surfaces. At the outlet region (84), the intermediate portion (87) is curved radially inward of the casing (10). FIG. 5 illustrates the shape of the intermediate portion (87) in the outlet region (84). A circular arc along the inner peripheral surface of the barrel (11) of the casing (10) is indicated by the chain double-dashed line.

-Operation-

[0056] An operation of the scroll compressor (1) will be described below. During the operation of the scroll compressor (1), the electric motor (20) is energized and driven. Rotation of the rotor (23) of the electric motor (20) allows the drive shaft (30) to rotate, and allows the movable scroll (56) to orbit relative to the fixed scroll (51).

[0057] The orbiting motion of the movable scroll (56) of the compression mechanism (40) causes a refrigerant to be sucked into the compression mechanism (40) through the suction pipe (14). This refrigerant is compressed in the compression chamber (S40). The refrigerant compressed in the compression chamber (S40) is discharged from the discharge port (53) to the upper space (S1). The compressed refrigerant discharged to the upper space (S1) is transferred through the internal passage (40a) to the intermediate space (S2).

[0058] A portion of the refrigerant that has flowed out of the internal passage (40a) flows through the axial flow path of the gas guide (70), and the remaining portion thereof flows through the circumferential flow path (90) of the gas guide (70). The refrigerant flowing through the axial flow path flows into the core cuts (22), flows downward along the inner peripheral surface of the casing (10), and then flows into the lower space (S3). The refrigerant in the lower space (S3) flows upward through the gap between the stator (21) and the rotor (23) and an internal passage of the stator (21), and is used to cool the electric motor (20). The refrigerant flowing through the circumferential flow path (90) flows out of the outlet (91) to form a swirl flow in the circumferential direction along the inner circumferential surface of the casing (10). The swirl flow of the refrigerant causes oil contained in the refrigerant to be centrifugally separated from the refrigerant. The refrigerant used to cool the electric motor (20) and the refrigerant separated from the oil flow out of the discharge pipe (15) into the refrigerant circuit.

[0059] The refrigerant flowing through the circumferential flow path (90) of the gas guide (70) contains oil. Such oil moves in a direction away from the inner peripheral surface of the barrel (11) of the casing (10) along the shape of the outlet region (84) of the intermediate recess (83) widening toward the outlet (91). The oil that has moved away from the inner peripheral surface of the barrel (11) is less likely to be entrained in a turbulent flow that may be generated at the outlet (91) of the circumferential flow path (90), and is therefore less likely to form mist.

- Advantages of Embodiment -

[0060] The scroll compressor (1) according to this embodiment include: a casing (10) having a tubular shape for housing a compression mechanism (40); and an intermediate recess (83) formed on an inner peripheral surface of the casing (10) to guide a compressed refrigerant that has been compressed by the compression mechanism (40), wherein the intermediate recess (83) and the inner peripheral surface define therebetween a circumferential flow path (90) configured to guide the compressed refrigerant in a circumferential direction of the casing (10) and cause the compressed refrigerant to flow out through an outlet (91), and the intermediate recess (83) include an outlet region (84) formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91). Thus, the compressed refrigerant flows through the circumferential flow path (90) formed between the inner peripheral surface of the casing (10) and the intermediate recess (83), and flows out of the outlet (91) of the circumferential flow path (90) into the casing (10). In this embodiment, the outlet region (84) of the intermediate recess (83) is shaped so that the circumferential flow path (90) widens toward the outlet (91). Drops of oil in the compressed refrigerant move in a direction away from the inner peripheral surface of the casing (10) along such a shape of the outlet region (84). The drops of oil that have moved away from the inner peripheral surface of the casing (10) are less likely to be entrained in the turbulent flow that may be generated at the outlet (91) of the circumferential flow path (90). This configuration substantially prevents such a turbulent flow from causing the drops of oil in the compressed refrigerant to form mist, and in turn, reduces oil loss.

[0061] In the scroll compressor (1) according to this embodiment, the outlet region (84) is curved so that the circumferential flow path (90) widens toward the outlet (91). This configuration allows the circumferential flow path (90) in the outlet region (84) to gently widen toward the outlet (91). It is therefore possible to substantially prevent the turbulent flow of the compressed refrigerant without abruptly reducing the flow rate of the compressed refrigerant flowing through the circumferential flow path (90).

[0062] In the scroll compressor (1) according to this embodiment, the casing (10) is formed into a tubular shape extending vertically, and the outlet region (84) includes a lower portion (86) formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91). In this embodiment, drops of oil accumulate on the lower portion (86) in the outlet region (84) by gravitation more easily than on the other portions. Forming the lower portion (86) in the outlet region (84) where the drops of oil accumulate easily into a predetermined shape can substantially and effectively prevent the drops of oil from forming mist, and can in turn effectively reduce oil loss.

[0063] In the scroll compressor (1) according to this embodiment, the outlet region (84) includes an intermediate portion (87) in an axial direction of the casing (10), the intermediate portion (87) being formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91). Thus, the intermediate portion (87) in the outlet region (84) in the axial direction of the casing (10) can substantially prevent the drops of oil from forming mist.

[0064] In the scroll compressor (1) according to this embodiment, an entirety of the outlet region (84) is formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91). Thus, the entire outlet region (84) can substantially prevent the drops of oil from forming mist, and can thus further reduce oil loss.

«Other Embodiments»

[0065] The above-described embodiment may be modified as follows.

[0066] As illustrated in, for example, FIG. 7, the outlet region (84) of the intermediate recess (83) may have a shape that allows the circumferential flow path (90) to widen linearly toward the outlet (91). The outlet region (84) with a curved shape or a straight shape is merely an example.

[0067] For example, only a portion of the outlet region (84) of the intermediate recess (83) may be formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91). As a specific example, only the upper portion (85), only the lower portion (86), or only the intermediate portion (87) of the outlet region (84) may be formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91). In one preferred embodiment, such a portion of the outlet region (84) includes the lower portion (86). The reason for this is that oil in the compressed refrigerant accumulates easily by gravitation on the lower portion (86) in the outlet region (84); therefore, the lower portion (86) included in the widened shape contributes to reducing the oil loss relatively easily.

[0068] While the embodiment and the variations thereof have been described above, it will be understood that various changes in form and details may be made without departing from the spirit and scope of the claims. The foregoing embodiments and variations thereof may be combined and replaced with each other without deteriorating the intended functions of the present disclosure.

INDUSTRIAL APPLICABILITY

[0069] As described above, the present disclosure is useful for a scroll compressor.

DESCRIPTION OF REFERENCE CHARACTERS

[0070]

1	Scroll Compressor
10	Casing
40	Compression Mechanism
83	Intermediate Recess (Circumferential Guide)
84	Outlet Region
86	Lower Portion (Bottom Portion)
87	Intermediate Portion
90	Circumferential Flow Path
91	Outlet
100	Refrigeration Apparatus
101	Refrigerant Circuit

Claims

1. A scroll compressor comprising:

a casing (10) having a tubular shape for housing a compression mechanism (40); and
a circumferential guide (83) formed on an inner peripheral surface of the casing (10) to guide a compressed refrigerant that has been compressed by the compression mechanism (40), wherein
the circumferential guide (83) and the inner peripheral surface define therebetween a circumferential flow path (90) configured to guide the compressed refrigerant in a circumferential direction of the casing (10) and cause the compressed refrigerant to flow out through an outlet (91), and
the circumferential guide (83) includes an outlet region (84) formed in a shape that allows the circumferential flow path (90) to widen toward the outlet (91).

2. The scroll compressor of claim 1, wherein
the outlet region (84) is curved so that the circumferential flow path (90) widens toward the outlet (91).

3. The scroll compressor of claim 1 or 2, wherein

the casing (10) is formed into a tubular shape extending vertically, and
the outlet region (84) includes a bottom portion (86) formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91).

4. The scroll compressor of any one of claims 1 to 3, wherein
the outlet region (84) includes an intermediate portion (87) in an axial direction of the casing (10), the intermediate portion (87) being formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91).

5. The scroll compressor of any one of claims 1 to 4, wherein
an entirety of the outlet region (84) is formed into a shape that allows the circumferential flow path (90) to widen toward the outlet (91).

6. A refrigeration apparatus comprising:
a refrigerant circuit (101) having the scroll compressor (1) of any one of claims 1 to 5 and performing a refrigeration cycle.

FIG.1

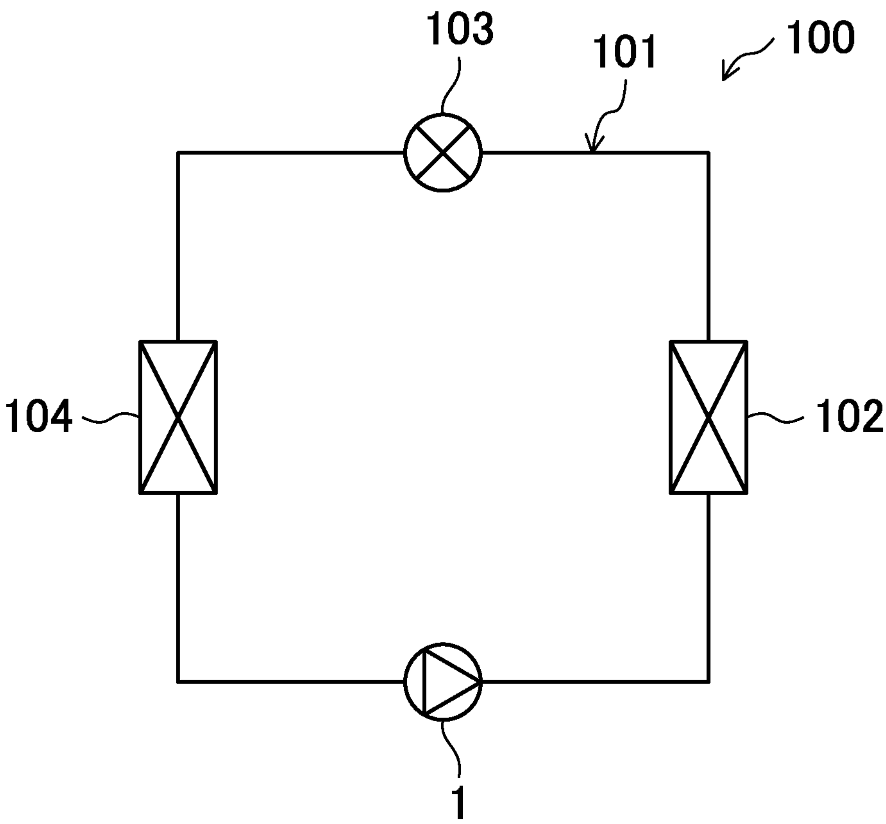
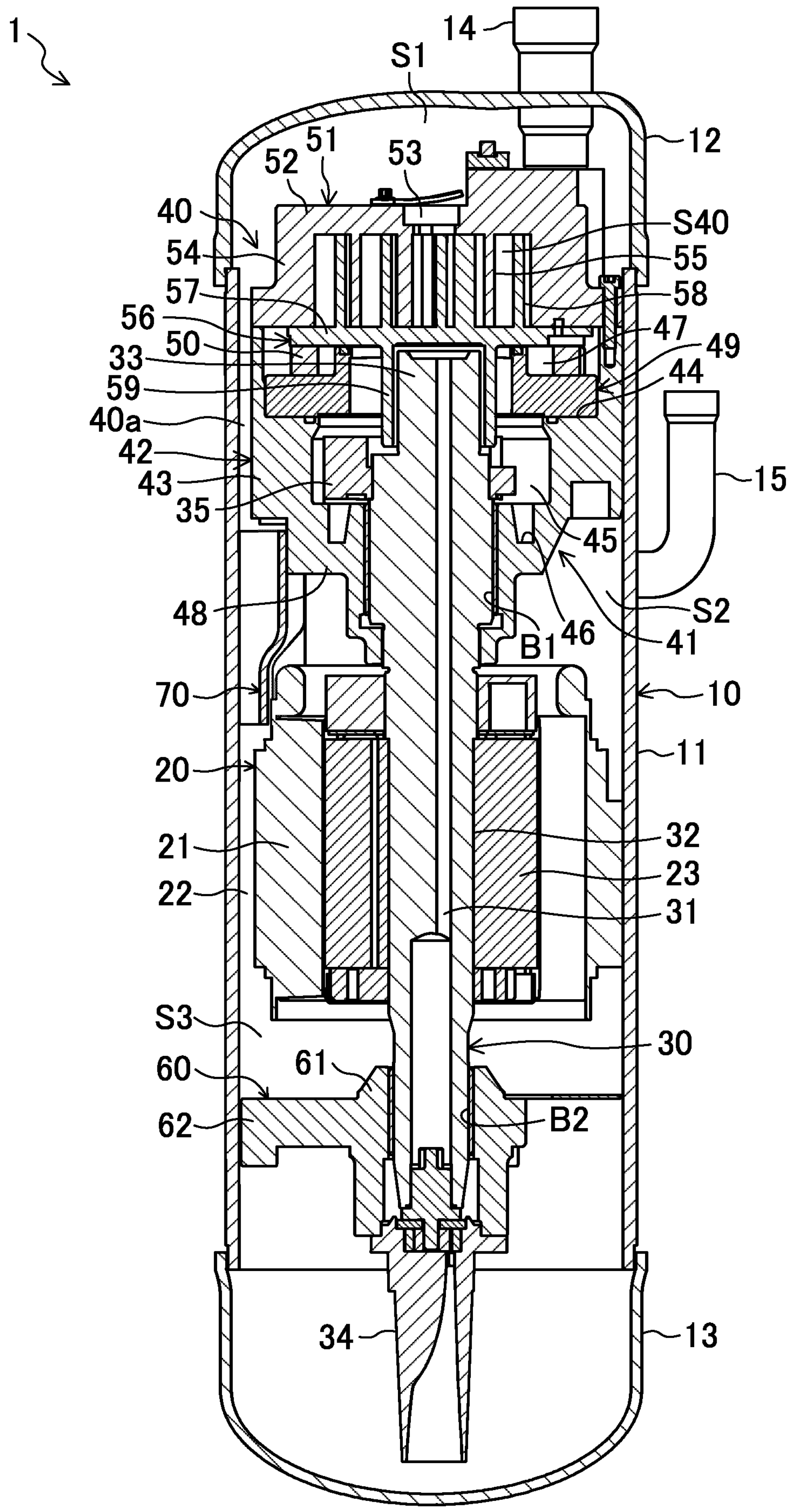


FIG.2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S40
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42
15
43
35
45
48
S2
B1
46
41
70
10
20
11
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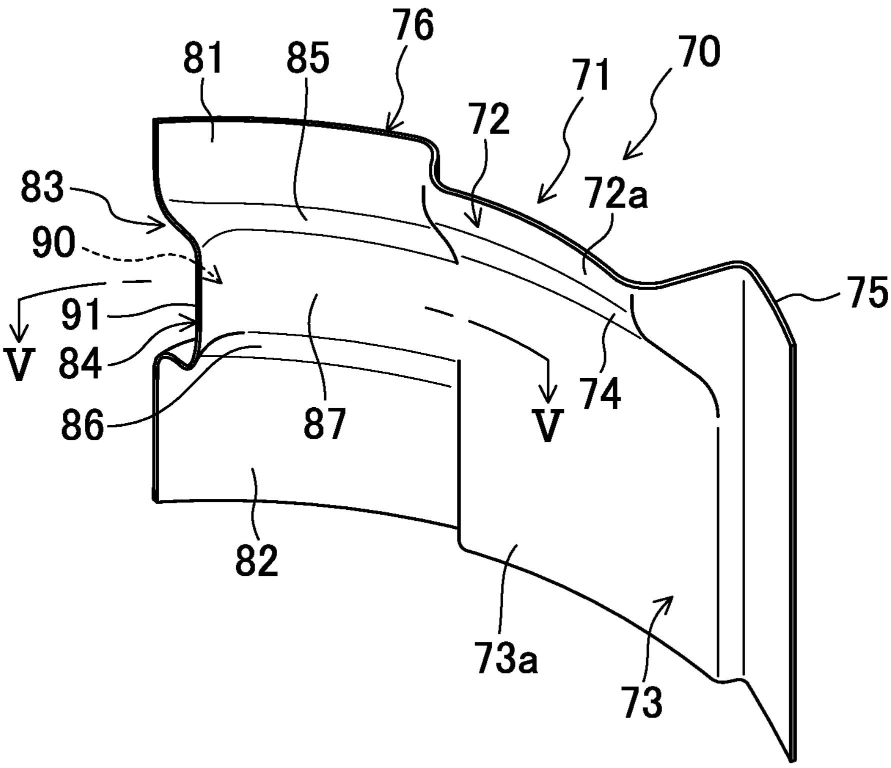
23
31
S3
30
61
60
B2
62
34
13

FIG.3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91
V
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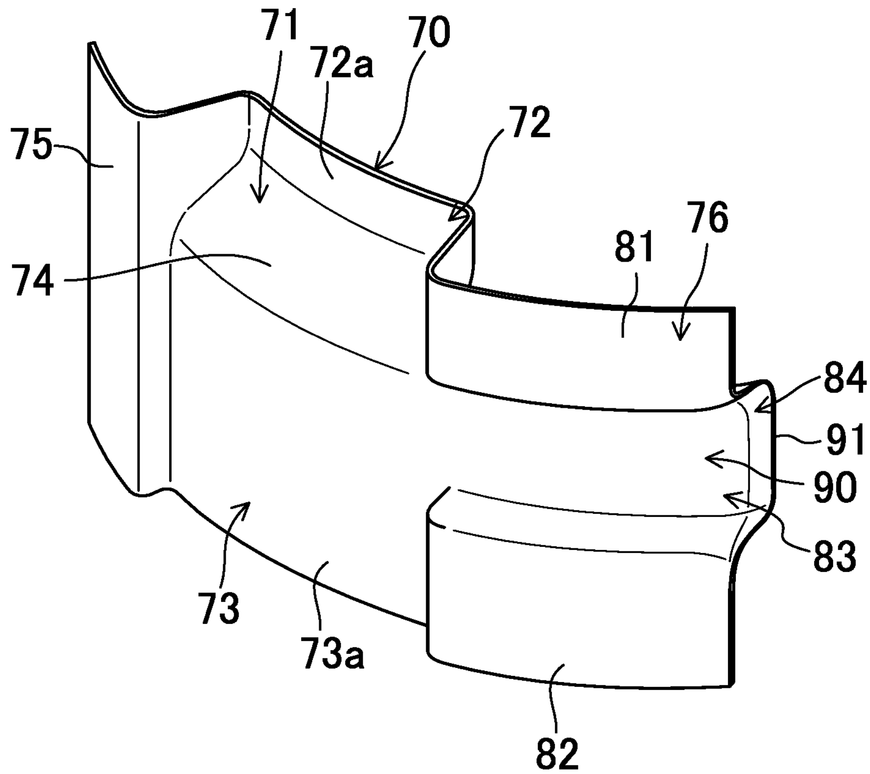
86
87
V
82
73a
73

FIG.4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73a
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FIG.5

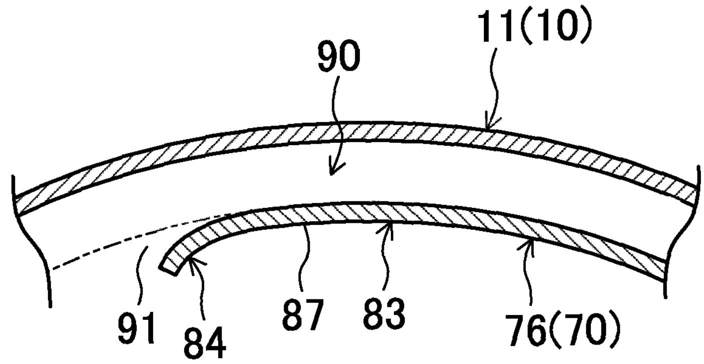


FIG.6

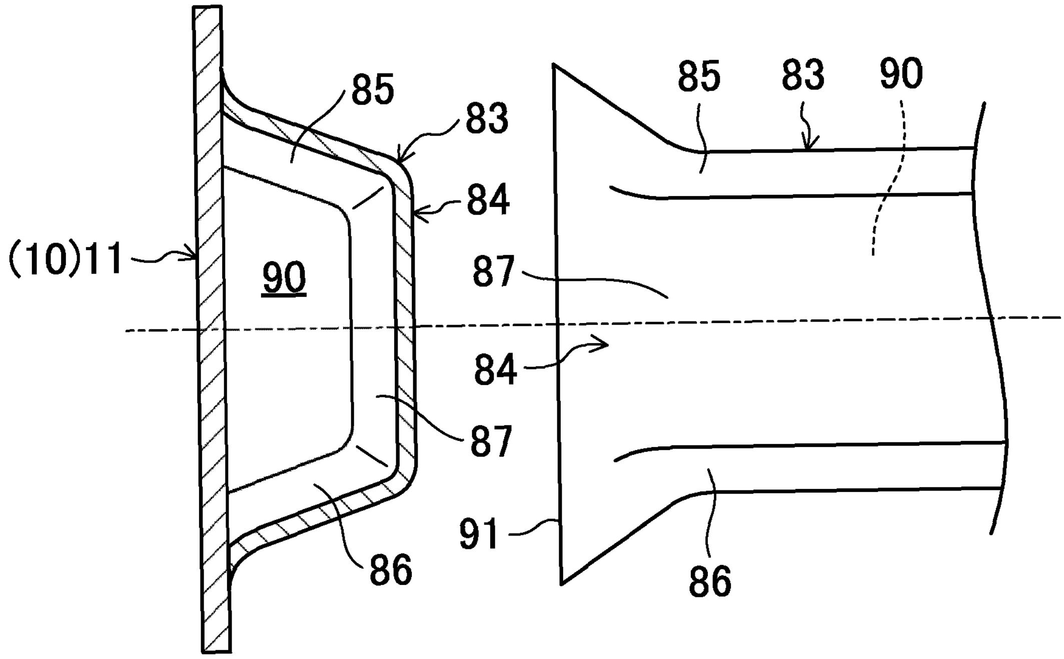
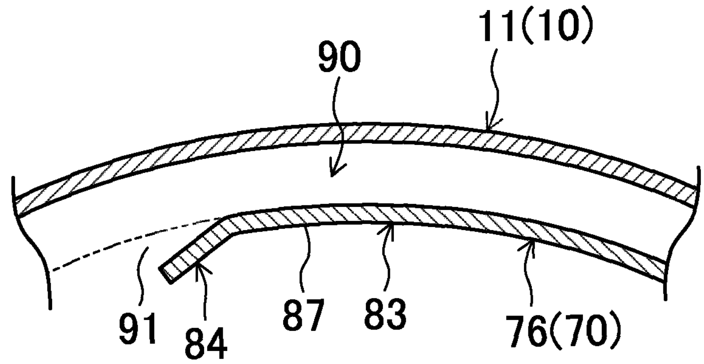


FIG.7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/000319

A. CLASSIFICATION OF SUBJECT MATTER
F04C 18/02(2006.01)i; F04C 29/02(2006.01)i
FI: F04C29/02 361A; F04C18/02 311Y; F04C29/02 351B

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)
F04C2/00-2/077; F04C18/00-18/077; F04C23/00-29/12

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	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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 2011-149315 A (DAIKIN INDUSTRIES, LTD.) 04.08.2011 (2011-08-04) paragraphs [0043], [0045], [0068], [0089], [0001], fig. 1, 7, 9	1-3, 5-6 4

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 February 2020 (27.02.2020)	10 March 2020 (10.03.2020)

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

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/000319

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
JP 2011-149315 A	04 Aug. 2011	(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 2017218945 A **[0003]**