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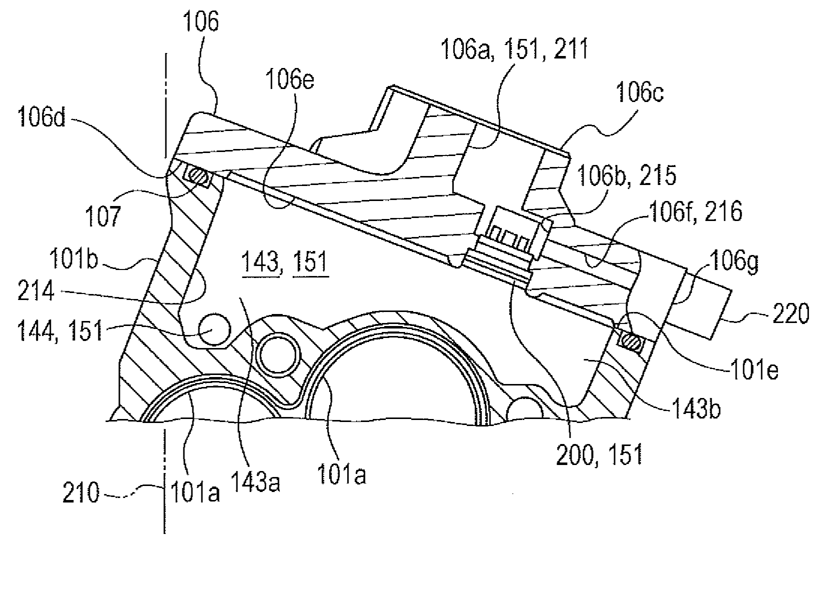
(54) Compressor

(57) An object of the invention is reducing production costs of housings and compressors. A compressor (100) includes: a housing (102, 104) having an attachment surface (210) for an attached member; a cylindrical protrusion wall (101b) protruding from an outer peripheral surface (101f) of the housing and includes a communication path (144) opened for a working fluid; a cover member (106) including an abutment surface (106d) on which the protrusion wall abuts, a connection end surface (106c) to which piping of an external circuit for the working fluid is connected, and a connection port (106a) penetrating through the connection end surface; and a muffler chamber (143) defined by the outer peripheral surface, the protrusion wall, and the cover member. An inner peripheral surface (211) of the connection port includes a predetermined inclination angle (β) with respect to the attachment surface, and is orthogonal to the abutment surface and connection end surface.

FIG. 2



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Description

BACKGROUND

1. Technical Field

[0001] The present invention relates to compressors.

2. Related Art

[0002] Compressors are used, for example, in vehicle air-conditioner systems. Such a kind of compressor includes, as disclosed in JP-A-2007-205165 or the like, a variable capacity clutch-less compressor having a muffler chamber on an outer peripheral surface of a housing.

[0003] In this compressor, a cylindrical protrusion wall is protruded from the outer peripheral surface of a housing (cylinder block). A cover member abuts at its abutment surface on an opening end surface of the protrusion wall. Thus, the muffler chamber is defined by the outer peripheral surface, the protrusion wall, and the cover member. The muffler chamber includes a discharge path opened for refrigerant as a working fluid in the compressor. The discharge path attenuates pressure pulsation of the refrigerant generated in the discharge chamber.

[0004] The cover member includes a discharge port for refrigerant opened to the muffler chamber. The discharge port is connected to, for example, a piping of a discharge-side refrigerant circuit (external circuit) in the vehicle air-conditioner system. In addition, a check valve is disposed in the cover member between the muffler chamber and the discharge port. Further, a relief valve (safety valve) is attached to the outer peripheral surface of the cover member.

[0005] Furthermore, the compressor includes about three or four attachment parts with respect to attached members, integrally formed with the housing on the outer peripheral surface of the housing. The attached members are, for example, an engine and a frame as an engine-side member. The attachment parts have bolt holes. Therefore, the compressor is fixed to the attached members by inserting bolts into the bolt holes and tightening the attachment parts to the attached members.

[0006] The attachment parts of the housing have their respective attachment surfaces for the corresponding attached members to attach the compressor to the attached members. In the above conventional compressor, the inner peripheral surface of the protrusion wall is formed in parallel to the attachment surfaces. On the other hand, on the upper sides of the attachment surfaces, the inner peripheral surface of the discharge port is inclined at a predetermined inclination angle with respect to the attachment surfaces. In addition, the opening end surface of the protrusion wall and the abutment surface of the cover member abutting on the opening end surface are formed orthogonal to the attachment surfaces. At the same time, in the cover member, the connection end surface around the discharge port on the side to which the piping of the refrigerant circuit is connected is formed orthogonal to the inner peripheral surface of the discharge port.

[0007] Hence, as described below, significant is the formation of the inner peripheral surface of the discharge port in non-parallel to the attachment surfaces of the compressor, or the formation of the connection end surface of the cover member non-orthogonal to the attachment surfaces of the compressor. Specifically, the formation is an action to meet layout constraints related to attachment of the compressor, or an action to improve routing workability of the piping of the refrigerant circuit to facilitate connection of the piping to the discharge port.

[0008] However, the cover member is formed such that the abutment surface for the protrusion wall is orthogonal to the attachment surfaces. At the same time, the cover member is formed such that the connection end surface for the piping and the inner peripheral surface of the discharge port are inclined for the attachment surfaces. Thus, when using the attachment surfaces as reference surfaces, the machining surfaces of the cover member exist with a plurality of machining angles. Therefore, procedures for cutting and machining the cover member and the like are prone to be complicated, and machining error is likely to occur.

[0009] In general, for machining an inclined surface not orthogonal to a reference surface, it is necessary to manage the inclination angle in a strict manner. Thus, in the machining of the inclined surface, the machining procedure becomes complicated and machining error occurs in many cases. In the above conventional compressor, no special consideration is given to any of these matters. Therefore, the machining procedure for the cover member defining the muffler chamber can be prevented from being simplified. In addition, the machining procedure for the compressor housing and suppression occurrence of machining error can be prevented from being performed. Thus, there is still a problem to be solved for reduction of production costs of compressors.

[0010] The present invention has been made in consideration of the above problems. One object of the present invention is to provide a compressor that allows significant reduction of production costs of the compressor housing and the compressor by simplifying the machining procedure for the cover member defining the muffler chamber and suppression of occurrence of machining error.

SUMMARY

[0011] To achieve the object, a compressor of a first embodiment of the present invention, includes: a housing having an attachment surface for an attached member; a cylindrical protrusion wall protruding from an outer peripheral surface of the housing and includes a communication path opened for a working fluid; a cover member including an abutment surface on which the protrusion wall abuts, a connection end surface to which piping of an external circuit for the working fluid is connected, and a connection port penetrating through the connection end surface; and a muffler chamber defined by the outer peripheral surface, the protrusion wall, and the cover member. An inner peripheral surface of the connection port includes a predetermined inclination angle with respect to the attachment surface, and is orthogonal to the abutment surface and the connection end surface.

[0012] In the compressor of a second embodiment according to the first embodiment, the connection port is a discharge port for the working fluid, the communication path includes a discharge path for the working fluid ranging from the discharge chamber for the working fluid through the muffler chamber to the discharge port, the muffler chamber includes a large region and a small region that are formed by providing the inner peripheral surface of the connection port with the inclination angle with respect to the attachment surface, and the communication path is opened to the large region side of the muffler chamber.

[0013] In the compressor of a third embodiment according to the second embodiment, the connection port communicates with the small region side of the muffler chamber.

[0014] In the compressor of a fourth embodiment according to the third embodiment, the cover member includes a check valve disposed in the discharge path between the discharge port and the muffler chamber and an accommodation chamber that accommodates the check valve in the discharge path, and an inner peripheral surface of the accommodation chamber is parallel to the inner peripheral surface of the connection port.

[0015] In the compressor of a fifth embodiment according to the fourth embodiment, the cover member includes a relief valve attached to the outer peripheral surface thereof and a pressure release path providing communication between the relief valve and a downstream side of the check valve in the discharge path, and an inner peripheral surface of the pressure release path is parallel to the abutment surface and the connection end surface.

[0016] In the compressor of a sixth embodiment according to any one of the first to fifth embodiments, the housing includes a plurality of housing members, and the attachment surface and the protrusion wall are formed at different housing members.

[0017] According to the compressor according to a first embodiment of the present invention, the inner peripheral surface of the connection port has a predetermined inclination angle with respect to the attachment surface. Thus, the piping of the external circuit for the working fluid can be connected to the cover member to have an inclination angle with respect to the attachment surface. The compressor of the first embodiment can therefore overcome layout constraints related to attachment of the compressor and enhance routing workability of the piping of the external circuit.

[0018] In addition, the inner peripheral surface of the connection port is orthogonal to both the abutment surface of the cover member with respect to the protrusion wall and the connection end surface of the cover member with respect to the piping. Thus, the abutment surface and the connection end surface are substantially parallel to each other. As a result, the machining directions of these surfaces in the cover member can be aligned into one direction.

[0019] In general, in machining of an inclined surface not orthogonal to a reference surface, an inclination angle is managed in a strict manner. Thus, in the machining of the inclined surface, the machining procedure becomes complicated and machining error occurs in many cases. However, in the compressor according to the first embodiment, the inner peripheral surface of the connection port is orthogonal to the abutment surface and the connection end surface. Thus, complication of the machining procedure and occurrence of machining error can be avoided or suppressed. The compressor of the first embodiment can therefore achieve simplification of the machining procedure for the cover member defining the muffler chamber and suppression of occurrence of machining error. As a result, production costs of the housing and the compressor can be reduced.

[0020] According to the compressor according to a second embodiment of the present invention, the communication path is opened to the large region side of the muffler chamber. Thus, pressure pulsation of the working fluid discharged to the muffler chamber in the wider large region can be efficiently attenuated. Therefore, the production costs of the housing and the compressor can be reduced, and the performance of the muffler chamber can be enhanced.

[0021] According to the compressor according to the third embodiment of the present invention, the connection port is opened to the small region side of the muffler chamber. Thus, the working fluid discharged to the muffler chamber is attenuated in pressure pulsation in the large region, and then is rectified in the narrower small region. After that, the working fluid is discharged from the discharge port to the external circuit. Thus, the production costs of the housing and the compressor can be reduced, while the performance of the muffler chamber can be further enhanced.

[0022] According to the compressor according to a fourth embodiment of the present invention, the inner peripheral surface of the accommodation chamber for the check valve is parallel to the inner peripheral surface of the connection port. Thus, the machining directions of the inner peripheral surface of the accommodation chamber for the check valve and the inner peripheral surface of the connection port can be aligned into one direction. The compressor of the fourth embodiment can therefore further facilitate simplification of the machining procedure for the cover member and suppression of occurrence of machining error. As a result, the production costs of the housing and the compressor can be further reduced.

[0023] According to the compressor according to a fifth embodiment of the present invention, the inner peripheral surface of the pressure release path is parallel to the abutment surface and the connection end surface of the cover member. Thus, the machining directions of the inner peripheral surface of the pressure release path and the abutment surface and the connection end surface of the cover member can be aligned into one direction. The compressor of the fifth embodiment can therefore further facilitate simplification of the machining procedure for the cover member and suppression of occurrence of machining error. As a result, the production costs of the housing and the compressor can be further reduced.

[0024] According to the compressor according to a sixth embodiment of the present invention, the attachment surface and the protrusion wall are formed at different housing members. Thus, machinability of the housing member in which the muffler chamber is formed can be prevented from being deteriorated due to the need for formation of the attachment surface. The compressor of the fifth embodiment can therefore further facilitate simplification of the machining procedure for the housing in which the muffler chamber is formed and suppression of occurrence of machining error.

BRIEF DESCRIPTION OF DRAWINGS

[0025]

FIG. 1 is a vertical cross-sectional view of a variable capacity compressor according to one embodiment of the present invention;

FIG. 2 is a cross-sectional view of a major part of a housing viewed from a direction of line A-A shown in FIG. 1;

FIG. 3 is a front view of the compressor viewed from B direction shown in FIG. 1; and

FIG. 4 is a cross-sectional view of a major part of the housing according to a modification example of FIG. 3.

DETAILED DESCRIPTION

[0026] In the following detailed description, for purpose of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are schematically shown in order to simplify the drawing.

[0027] One embodiment of the present invention will be described below with reference to the drawings.

[0028] A variable capacity compressor 100 illustrated in FIG. 1 is a clutch-less compressor for use in a vehicle air-conditioner system. The compressor 100 includes a cylinder block 101, a front housing 102, and a cylinder head 104. The cylinder block 101 includes a plurality of cylinder bores 101a. The front housing 102 is disposed at one end of the cylinder block 101. The cylinder head 104 is disposed at the other end of the cylinder block 101 via a valve plate 103.

[0029] A crank chamber 140 is defined by the cylinder block 101 and the front housing 102. A drive shaft 110 is disposed across the inside of the crank chamber 140. A swash plate 111 is longitudinally disposed around the center of the drive shaft 110. The swash plate 111 is coupled to a rotor 112 fixed to the drive shaft 110 via a link mechanism 120. An inclination angle of the swash plate 111 varies along the drive shaft 110.

[0030] The link mechanism 120 includes a first arm 112a protruded from the rotor 112, a second arm 111a protruded from the swash plate 111, and a link arm 121. One end of the link arm 121 is rotatably coupled to the first arm 112a via a first coupling pin 122. The other end of the link arm 121 is rotatably coupled to the second arm 111a via a second coupling pin 123.

[0031] A through hole 111b is formed at the radial center of the swash plate 111. The through hole 111b is shaped such that the swash plate 111 can be inclined within a range of a maximum inclination angle (θ_{max}) to a minimum inclination angle (θ_{min}). The through hole 111b has a maximum inclination angle regulation part and a minimum inclination angle regulation part that abut on the drive shaft 110.

[0032] More specifically, if the swash plate 111 has an inclination angle of zero degrees (0°) when the swash plate 111 is orthogonal to the drive shaft 110, the minimum inclination angle regulation part of the through hole 111b is formed such that the swash plate 111 is substantially 0°. The maximum inclination angle regulation part of the through hole 111b is formed such that the swash plate 111 has an inclination angle of substantially 20°.

[0033] An inclination angle decreasing spring 114 is fitted between the rotor 112 and the swash plate 111. The inclination angle decreasing spring 114 includes a compression coil spring that biases the swash plate 111 to the minimum inclination angle. In addition, a spring support member 116 is fixed to the side of the drive shaft 110 opposite to the inclination angle decreasing spring 114 across the swash plate 111. An inclination angle increasing spring 115 is fitted between the swash plate 111 and the spring support member 116. The inclination angle increasing spring 115 includes a compression coil spring that biases the swash plate 111 in a direction in which the inclination angle of the swash plate 111 increases up to a predetermined inclination angle smaller than the maximum inclination angle. The biasing force of the inclination angle increasing spring 115 is set larger than the biasing force of the inclination angle decreasing spring 114 at the minimum inclination angle. Therefore, when the drive shaft 110 does not rotate, the swash plate 111 is positioned at a predetermined inclination angle that makes the resultant force of the biasing force of the inclination angle decreasing spring 114 and the biasing force of the inclination angle increasing spring 115 zero.

[0034] The one end of the drive shaft 110 extends up to the outside through the inside of a boss part 102a projected to the outside of the front housing 102. In addition, the one end of the drive shaft 110 is coupled to a power transmission device 150.

[0035] A shaft sealing device 130 is inserted into between the drive shaft 110 and the boss part 102a. The shaft sealing device 130 shuts down the inside and outside of the front housing 102. The drive shaft 110 is supported by the front housing 102 via a bearing 131, and is supported by the cylinder block 101 via a bearing 132 in a radial direction. In addition, the drive shaft 110 is supported by the front housing 102 via a bearing 133, and is supported by the cylinder block 101 via a thrust plate 134 in a thrust direction. Power from an external drive source is transmitted to the power transmission device 150. The drive shaft 110 can rotate in synchronization with rotation of the power transmission device 150. A clearance between the drive shaft 110 and the thrust plate 134 is adjusted to a predetermined clearance by an adjustment screw 135.

[0036] A piston 136 is disposed in the cylinder bores 101a. The outer peripheral part of the swash plate 111 is accommodated in an inside space of the piston 136 at an end part protruded toward the crank chamber 140. The swash plate 111 is configured to cooperate with the piston 136 via a pair of shoes 137. Therefore, when the swash plate 111 rotates, the piston 136 can reciprocate within the cylinder bores 101a.

[0037] A suction chamber 141 is defined in the cylinder head 104 at center of the inside. In addition, a discharge chamber 142 is defined by surrounding the suction chamber 141 in an annular shape. The suction chamber 141 communicates with a communication hole 103a formed in the valve plate 103 and the cylinder bores 101a via a suction valve (not shown). The discharge chamber 142 communicates with the cylinder bores 101a via a discharge valve (not shown) and a communication hole 103b formed in the valve plate 103.

[0038] The front housing 102, the cylinder block 101, the valve plate 103, and the cylinder head 104 are tightened together by a plurality of through bolts 105 via a gasket (not shown). The front housing 102, the cylinder block 101, the valve plate 103, and the cylinder head 104 constitute a housing of the compressor 100.

[0039] As illustrated in FIG. 2, a muffler chamber 143 is disposed at the cylinder block 101. The muffler chamber 143 is defined by an outer peripheral surface 101f of the cylinder block 101, a cylindrical protrusion wall 101b protruded from the outer peripheral surface 101f to the radial outside, and the cover member 106. The cover member 106 includes an abutment surface 106d that abuts on an opening end surface 101e of the protrusion wall 101b. The center of the protrusion wall 101b is orthogonal to the opening end surface 101e. The cylinder block 101 is formed by die casting. Thus, the inner and outer wall surfaces of the protrusion wall 101b are slightly inclined due to a draft angle formed during die casting.

[0040] The protrusion wall 101b includes a refrigerant communication path 144 that communicates with the discharge chamber 142. The cover member 106 includes a connection end surface 106c. Piping of a discharge-side refrigerant circuit (external circuit, not shown) in the vehicle air-conditioner system is connected to the cover member 106 at a flange of the connection end surface 106c. The connection end surface 106c is provided with a discharge port (connection port) 106a to which the piping of the discharge-side refrigerant circuit is connected. The discharge port 106a is opened to the muffler chamber 143. The cover member 106 is tightened and joined to the opening end surface 101e of the protrusion wall 101b by a bolt 108 via a seal member 107.

[0041] The muffler chamber 143 communicates with the discharge-side refrigerant circuit via a check valve 200 and the discharge port 106a. The muffler chamber 143 also communicates with the discharge chamber 142 via the communication path 144. Therefore, the discharge chamber 142 communicates with the discharge-side refrigerant circuit via the refrigerant discharge path 151 including the communication path 144, the muffler chamber 143, the check valve 200, and the discharge port 106a.

[0042] The check valve 200 is disposed in an accommodation chamber 106b formed between the muffler chamber 143 and the discharge port 106a. The check valve 200 operates in response to a pressure difference between the muffler chamber 143 on the upstream side of the discharge path 151 of the check valve 200 and the discharge port 106a on the downstream side of the discharge path 151 of the check valve 200. The check valve 200 closes the discharge path 151 if the pressure difference is smaller than a predetermined value, and opens the discharge path 151 if the pressure difference is larger than the predetermined value.

[0043] A relief valve 220 is attached to an outer peripheral surface 106g of the cover member 106. The accommodation chamber 106b for the check valve 200 is disposed with displacement from the discharge port 106a to the relief valve 220 side. The accommodation chamber 106b is formed so as to have a portion radially overlapping the discharge port 106a. A pressure release path 106f for guiding refrigerant to the relief valve 220 communicates with the accommodation chamber 106b for the check valve 200. That is, the pressure release path 106f is disposed on the downstream side of the check valve 200 in the discharge path 151.

[0044] A suction path (not shown) is formed at one end of the cylinder head 104. The suction path includes a suction port (connection port) 104a that communicates with a suction-side refrigerant circuit (external circuit, not shown). The suction chamber 141 communicates with the suction-side refrigerant circuit in the air-conditioner system via the suction path.

[0045] The cylinder head 104 is further provided with a control valve 300. The control valve 300 controls the amount of discharge gas introduced to the crank chamber 140 by adjusting the degree of opening of a pressure supply path 145 providing communication between the discharge chamber 142 and the crank chamber 140 serving as a control pressure chamber. Refrigerant in the crank chamber 140 flows into the suction chamber 141 via a pressure release path 146 including a communication path 101c, a space 101d, and an orifice 103c formed on the valve plate 103. Therefore, the pressure in the crank chamber 140 can be changed by opening or closing the control valve 300.

[0046] The action of changing the angle of the swash plate 111 is performed by breaking down the balance between inclination angle decrease moment and inclination angle increase moment. The inclination angle decrease moment is based on the pressure in the crank chamber 140 that acts on the surface of the piston 136 on the crank chamber 140 side. The inclination angle increase moment is based on the pressure in the cylinder that acts on the top surface of the piston 136. Thus, by opening or closing the control valve 300 to change the pressure in the crank chamber 140, the inclination angle of the swash plate 111, that is, the stroke of the piston 136 can be changed. Therefore, the discharge capacity of the compressor 100 can be variably controlled.

[0047] During operation of the air-conditioner, or during operation of the compressor 100, the amount of power distribution from the control valve 300 to the solenoid is adjusted according to air-conditioner settings and external environments. Thus, the discharge capacity is controlled such that the pressure in the suction chamber 141 reaches a set pressure corresponding with the amount of power distribution. During non-operation of the air-conditioner, or during non-operational state of the compressor 100, the power distribution from the control valve 300 to the solenoid is turned off to forcedly open the pressure supply path 145. Thus, the discharge capacity of the compressor 100 is controlled so as to be the minimum.

[0048] As illustrated in FIG. 1, in the compressor 100, attachment parts 102b and 102c are integrally formed on an outer peripheral surface of the front housing 102. An attachment part 104b is integrally formed on an outer peripheral surface of the cylinder head 104. The compressor 100 is attached by the attachment parts 102b, 102c, and 104b to the attached member such as a vehicle engine or a frame as an engine-side member.

[0049] As illustrated in FIG. 3, bolt holes 102b1, 102c1, and 104b1 are formed to penetrate through the attachment parts 102b, 102c, and 104b, respectively. Bolts for tightening the compressor 100 to the attached member are inserted into the bolt holes 102b1, 102c1, and 104b1.

[0050] Specifically, the attachment parts 102b and 102c have first end surfaces 102b2 and 102c2, and second end surfaces 102b3 and 102c3. The bolt holes 102b1 and 102c1 are formed in the first end surfaces 102b2 and 102c2. The first end surfaces 102b2 and 102c2 abut on the attached member. The bolt holes 102b1 and 102c1 are opened in the second end surfaces 102b3 and 102c3. The heads of the bolts abut on the second end surfaces 102b3 and 102c3. The first end surfaces 102b2 and 102c2 are formed on the same plane, thereby constituting an attachment surface 210 of the compressor 100.

[0051] The center line of the bolt hole 102b1 is orthogonal to the axial line of the drive shaft 110 and the first end surface 102b2. The center line of the bolt hole 102c1 is orthogonal to the axial line of the drive shaft 110 and the first end surface 102c2. The second end surfaces 102b3 and 102c3 are respectively formed on planes parallel to the first end surfaces 102b2 and 102c2. The attachment part 104b also includes a first end surface and a second end surface (not shown) similar to those of the attachment parts 102b and 102c. These first end surface and second end surface are also formed on planes parallel to the first end surfaces 102b2 and 102c2 and the second end surfaces 102b3 and 102c3, respectively, and are orthogonal to the center line of the bolt hole 104b1.

[0052] Here, as illustrated in FIGS. 2 and 3, the cover member 106 in the embodiment is shaped such that the inner peripheral surface 211 of the discharge port 106a has a predetermined inclination angle with respect to the attachment surface 210 and is orthogonal to the abutment surface 106d and the connection end surface 106c. In other words, in the cover member 106, a plane 212 including the connection end surface 106c is parallel to a plane 213 including both the abutment surface 106d and the opening end surface 101e. In addition, the plane 212 and the plane 213 are parallel to the axial line of the drive shaft 110 and are inclined so as to have an inclination angle α with respect to the attachment surface 210.

[0053] The inclination angle α and an inclination angle β ($\beta = 90 - \alpha$) between the inner peripheral surface 211 and the attachment surface 210 are preset to predetermined values. This configuration is intended to overcome layout constraints related to attachment of the compressor 100 and enhance routing workability for the piping of the discharge-side refrigerant circuit.

[0054] In addition, an inner peripheral surface 214 of the protrusion wall 101b is substantially parallel to the inner peripheral surface 211 of the discharge port 106a. Further, a top wall 106e of the cover member 106 defining the muffler chamber 143 includes a plane substantially parallel to the abutment surface 106d.

[0055] The cylinder block 101 includes the cylinder bores 101a substantially concentric to the drive shaft 110. Thus, a large region 143a is formed with large capacity in the space of the muffler chamber 143 on the side near the attachment surface 210, and the communication path 144 is opened on the large region 143a side. On the other hand, a small region 143b with small capacity is formed in the space of the muffler chamber 143 on the side distant from the attachment surface 210. In addition, an entrance hole to the check valve 200 is formed on the small region 143b side to communicate the discharge port 106a.

[0056] An inner peripheral surface 215 of the accommodation chamber 106b for the check valve 200 is formed in parallel to the inner peripheral surface 211 of the discharge port 106a. The accommodation chamber 106b and the discharge port 106a are formed so as to communicate with each other. An inner peripheral surface 216 of the pressure release path 106f is formed in parallel to the abutment surface 106d and the connection end surface 106c.

[0057] In addition, in the compressor 100 of the embodiment, an outer end of the relief valve 220 with a pressure release opening faces obliquely downward when the attachment surface 210 is vertically oriented.

[0058] As described above, in the compressor 100 of the embodiment, the inner peripheral surface 211 of the discharge port 106a has the inclination angle β with respect to the attachment surface 210. Thus, the piping of the discharge-side refrigerant circuit can be connected to the cover member 106 so as to have the inclination angle β with respect to the attachment surface 210. Therefore, layout constraints related to attachment of the compressor 100 can be overcome, and routing workability of the piping of the discharge-side refrigerant circuit can be enhanced.

[0059] In addition, the inner peripheral surface 211 of the discharge port 106a is orthogonal to the abutment surface 106d of the cover member 106 with respect to the protrusion wall 101b and the connection end surface 106c of the cover member 106 with respect to the piping. Accordingly, the abutment surface 106d and the connection end surface 106c are substantially parallel to each other. As a result, the machining directions of the abutment surface 106d and the connection end surface 106c in the cover member 106 can be aligned into one direction.

[0060] In general, in machining of an inclined surface not orthogonal to a reference surface, an inclination angle is managed in a strict manner. Thus, in the machining of the inclined surface, the machining procedure becomes complicated and machining error occurs in many cases. However, in the compressor 100 of the embodiment, the inner peripheral surface 211 of the discharge port 106a is orthogonal to the abutment surface 106d and the connection end surface 106c. Thus, complication of the machining procedure and occurrence of machining error can be avoided or suppressed. The cover member 106 includes a fixing bolt hole and a positioning pin hole (not shown) for the piping flange of the discharge-side refrigerant circuit. These holes are also formed in parallel to the inner peripheral surface 211 of the discharge port 106a. Thus, these holes are also orthogonal to the abutment surface 106d and the connection end surface 106c. Therefore, the machining procedure for the cover member 106 defining the muffler chamber 143 can be simplified, and occurrence of machining error can be suppressed. As a result, production costs of the cylinder block 101 serving as a housing member of the compressor 100 and the compressor 100 can be reduced.

[0061] The communication path 144 is opened to the large region 143a side of the muffler chamber 143. This makes it possible to efficiently attenuate pressure pulsation of the refrigerant discharged to the muffler chamber 143 in the wider large region 143a. Thus, the production costs of the compressor 100 can be reduced, and performance of the muffler chamber 143 can be enhanced. This allows the muffler chamber 143 to effectively act as an expansion muffler.

[0062] An entrance hole to the check valve 200 is opened to the small region 143b side of the muffler chamber 143. The discharge port 106a communicates with the entrance hole. Thus, pressure pulsation of the refrigerant discharged to the muffler chamber 143 is attenuated in the large region 143a. After that, the refrigerant is rectified on the inner peripheral surface 214 of the narrower small region 143b and discharged from the discharge port 106a to the discharge-side refrigerant circuit. Thus, the production costs of the compressor 100 can be reduced, and performance of the muffler chamber 143 can be further enhanced.

[0063] The inner peripheral surface 215 of the accommodation chamber 106b for the check valve 200 is parallel to the inner peripheral surface 211 of the discharge port 106a. Thus, the machining directions of the inner peripheral surfaces 211 and 215 can be aligned into one direction. Therefore, simplification of the machining procedure for the cover member 106 can be further facilitated, while occurrence of machining error can be suppressed. In addition, the production costs of the compressor 100 can be further reduced.

[0064] Further, the accommodation chamber 106b for the check valve 200 is disposed with displacement from the discharge port 106a to the relief valve 220 side. Thus, the path length of the pressure release path 106f can be shortened. The machining of the cover member 106 can be therefore further simplified.

[0065] Moreover, a portion of the accommodation chamber 106b radially overlaps the discharge port 106a and communicates directly with the discharge port 106a. Thus, there is no need for the communication path 101c providing communication between the accommodation chamber 106b and the discharge port 106a. The machining of the cover member 106 can be further simplified.

[0066] The outer end of the relief valve 220 faces obliquely downward. Thus, when the relief valve 220 is activated, the refrigerant is preferably discharged downward bypassing obstacle members including the attached member. Thus, the refrigerant can be readily discharged, for example, from below the engine room to the outside of the vehicle.

[0067] The description of one embodiment of the present invention is completed. However, the present invention is not limited to this but can be modified in various manners without deviating from the essence of the present invention.

[0068] For example, in the embodiment, the muffler chamber 143 is disposed in the discharge path 151. Alternatively, the muffler chamber 143 may be disposed in the suction path.

[0069] In addition, in the embodiment, the muffler chamber 143 is formed in the cylinder block 101. Alternatively, the muffler chamber 143 may be formed in another housing member (for example, the front housing 102 or the cylinder head 104). However, the muffler chamber 143 may be formed in a member such as the attachment part 102b, 102c, or 104b different from the housing members having the attachment members with respect to the attached member. Thus, the attachment surface 210 and the protrusion wall 101b are formed at different housing members. Thus, machinability of the housing member in which the muffler chamber 143 is formed can be prevented from being deteriorated due to the need for formation of the attachment surface 210. Therefore, simplification of the machining procedure for the housing member in which the muffler chamber 143 is formed can be further facilitated. In addition, occurrence of machining error can be suppressed.

[0070] In addition, as illustrated in FIG. 4, the present invention can also be applied to the cover member 106 without the check valve 200 and the relief valve 220.

[0071] Although the compressor 100 is a variable capacity compressor, the present invention is not limited to this but can also be applied to other various compressors.

[0072] The compressor in the present invention may be any of first to sixth compressor as described below.

[0073] The first compressor includes: a housing having an attachment surface for an attached member; a cylindrical protrusion wall protruding from an outer peripheral surface of the housing and including a communication path opened for a working fluid; a cover member including an abutment surface on which the protrusion wall abuts, a connection end surface to which piping of an external circuit for the working fluid is connected, and a connection port penetrating through the connection end surface; and a muffler chamber defined by the outer peripheral surface, the protrusion wall, and the cover member, wherein an inner peripheral surface of the connection port has a predetermined inclination angle with respect to the attachment surface, and is orthogonal to the abutment surface and the connection end surface.

[0074] The second compressor is configured such that, in the first compressor, the connection port is a discharge port for the working fluid, the communication path includes a discharge path for the working fluid ranging from the discharge chamber for the working fluid through the muffler chamber to the discharge port, the inner peripheral surface of the connection port has the inclination angle with respect to the attachment surface to form a large region and a small region in a space of the muffler chamber, and the communication path is opened to the large region side of the muffler chamber.

[0075] The third compressor is configured such that, in the second compressor, the connection port communicates with the small region side of the muffler chamber.

[0076] The fourth compressor is configured such that, in the third compressor, the cover member includes a check valve disposed in the discharge path between the discharge port and the muffler chamber and an accommodation chamber that accommodates the check valve in the discharge path, and an inner peripheral surface of the accommodation chamber is parallel to the inner peripheral surface of the connection port.

[0077] The fifth compressor is configured such that, in the fourth compressor, the cover member includes a relief valve attached to the outer peripheral surface thereof and a pressure release path providing communication between the relief valve and a downstream side of the check valve in the discharge path, and an inner peripheral surface of the pressure release path is parallel to the abutment surface and the connection end surface.

[0078] The sixth compressor is configured such that, in the first compressor, the housing includes a plurality of housing members, and the attachment surface and the protrusion wall are formed at different housing members.

[0079] The foregoing detailed description has been presented for the purposes of illustration and description. Many modifications and variations are possible in light of the above teaching. It is not intended to be exhaustive or to limit the subject matter described herein to the precise form disclosed. Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims appended hereto.

Claims

1. A compressor (100), comprising:

a housing (102, 104) having an attachment surface (210) for an attached member;
a cylindrical protrusion wall (101b) protruding from an outer peripheral surface (101f) of the housing and including a communication path (144) opened for a working fluid;
a cover member (106) including an abutment surface (106d) on which the protrusion wall abuts, a connection end surface (106c) to which piping of an external circuit for the working fluid is connected, and a connection port (106a) penetrating through the connection end surface; and
a muffler chamber (143) defined by the outer peripheral surface, the protrusion wall, and the cover member, wherein
an inner peripheral surface (211) of the connection port includes a predetermined inclination angle (β) with respect to the attachment surface, and is orthogonal to the abutment surface (106d) and the connection end surface (106c).

2. The compressor according to Claim 1, wherein the connection port is a discharge port for the working

fluid,
the communication path includes a discharge path for the working fluid ranging from the discharge chamber for the working fluid through the muffler chamber to the discharge port,
the muffler chamber includes a large region (143a) and a small region (143b) that are formed by providing the inner peripheral surface of the connection port with the inclination angle (β) with respect to the attachment surface, and
the communication path is opened to the large region side of the muffler chamber.

3. The compressor according to Claim 2, wherein the connection port communicates with the small region side of the muffler chamber.

4. The compressor according to Claim 3, wherein
the cover member includes a check valve (200) disposed in the discharge path between the discharge port and the muffler chamber and an accommodation chamber (106b) that accommodates the check valve in the discharge path, and
an inner peripheral surface of the accommodation chamber is parallel to the inner peripheral surface of the connection port.

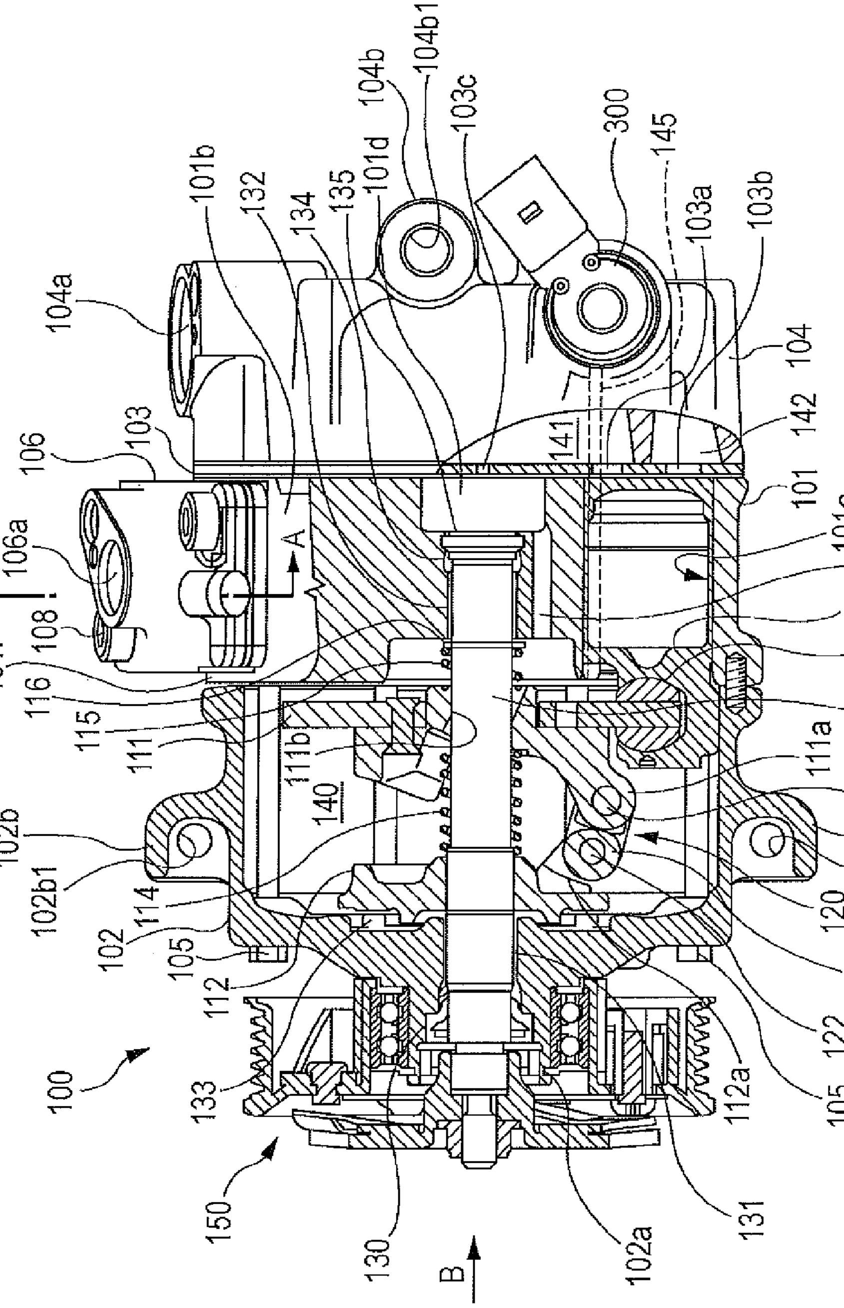
5. The compressor according to Claim 4, wherein
the cover member includes a relief valve (220) attached to the outer peripheral surface thereof and a pressure release path (106f) providing communication between the relief valve and a downstream side of the check valve in the discharge path, and
an inner peripheral surface of the pressure release path is parallel to the abutment surface and the connection end surface.

6. The compressor according to any one of Claims 1 to 5, wherein
the housing includes a plurality of housing members, and
the attachment surface and the protrusion wall are formed at different housing members.

7. The compressor according to Claim 5, wherein
the accommodation chamber for the check valve is disposed with displacement from the discharge port to the relief valve side.

8. The compressor according to Claim 5, wherein an outer end of the relief valve faces obliquely downward.

FIG. 1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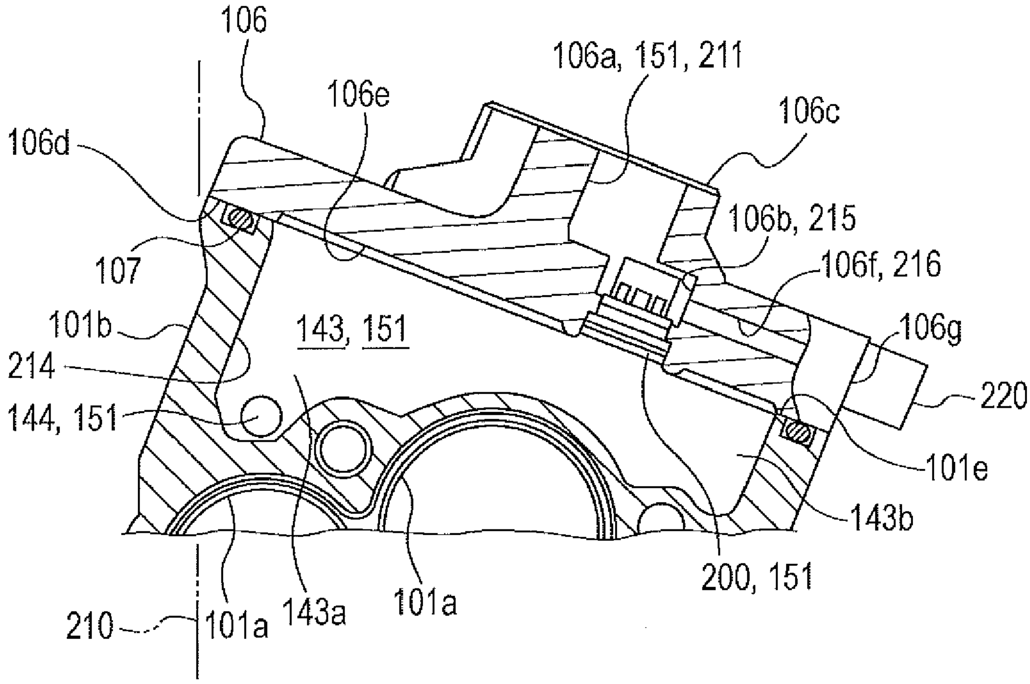
112a

FIG. 2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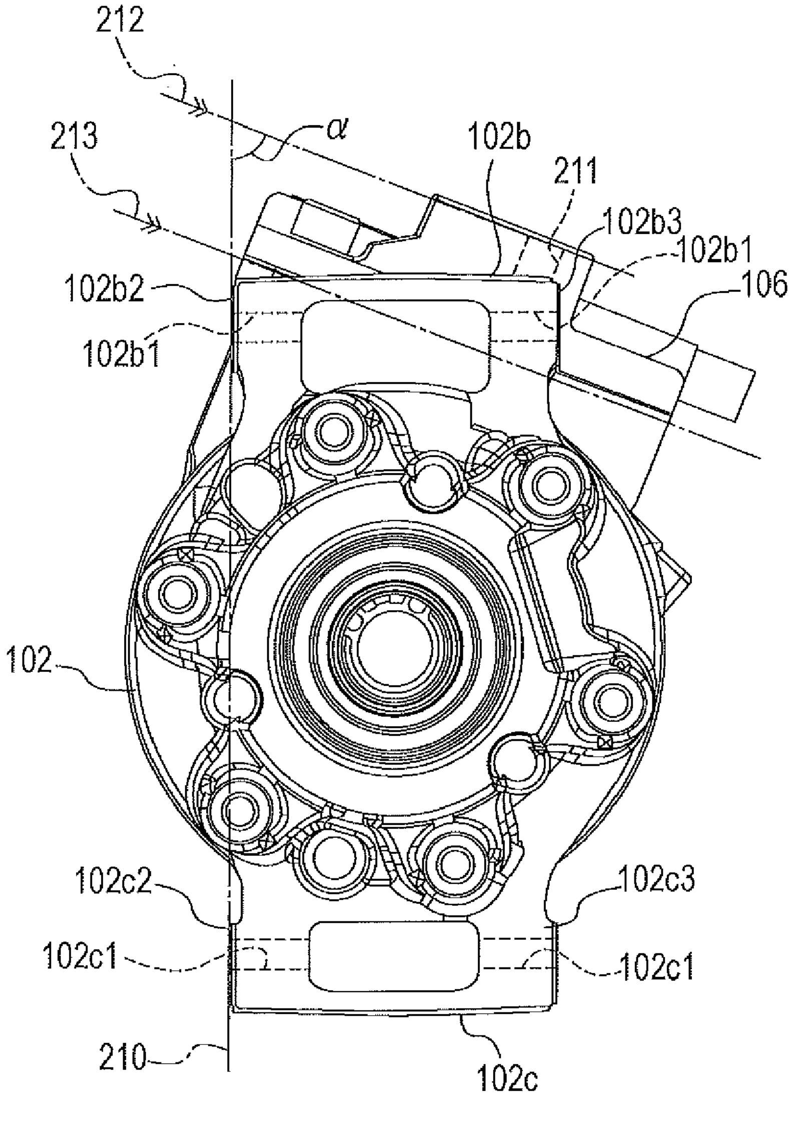
101a

FIG. 3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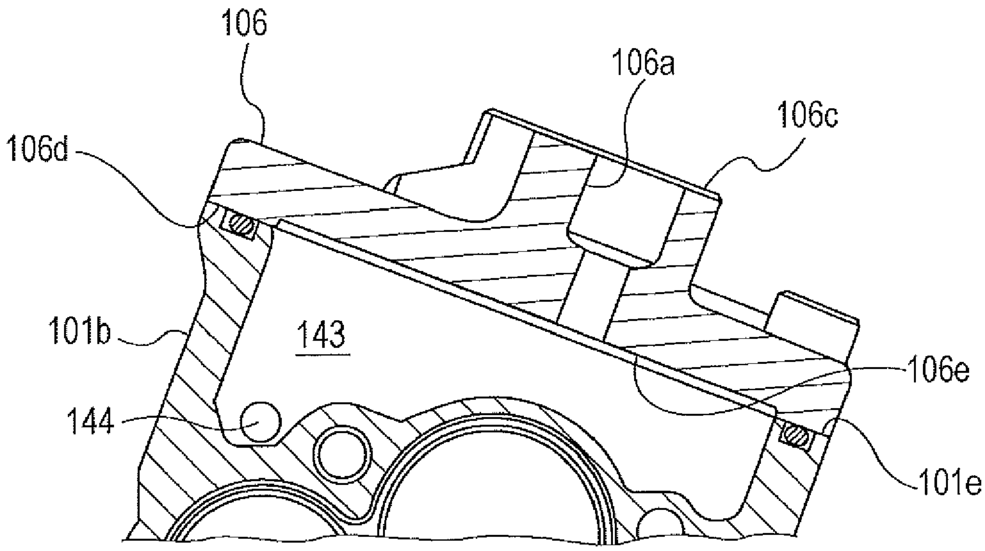
210
102c

FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 14 17 0212

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
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