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(54) **Compressor**

(57) The object of the present invention is to enhance the stiffness of the attachment part and the entire housing of the compressor with a simple configuration. A compressor (100), includes: an attachment part (211) protruded from an outer peripheral surface (210) of a housing (102) and including a first end surface (215) abutting on an attached member, a second surface (216) opposed to the first end surface, and a bolt hole (211a) opened to both the first end surface and the second end surface; and a reinforcement part (220) integrally formed with the attachment part and the housing and extending from a side surface (211b) of the attachment part formed along the bolt hole to the outer peripheral surface of the housing. The reinforcement part includes a hollow portion (218) that is formed by closing the first end surface side and opening the second end surface side.

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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 a housing and an attachment part integrally formed with the housing. For example, the attachment part is intended to fix the compressor to a vehicle engine or a frame disposed at the engine side (attached member). Specifically, for example, the attachment part has a bolt hole. A bolt inserted into the bolt hole is used to fix the compressor to the attached member. Design Registration No. 1066435 discloses a structure in which an attachment part is enhanced in stiffness (refer to Fig. 4). In this structure, the attachment part is reinforced with a plurality of rib-shaped reinforcement parts.

[0003] In the case of the compressor described in registered Design No. 1066435 A, a power transmission device is attached to one end of a housing. A belt is wound around the pulley of the power transmission device. Power transmission is performed between the compressor and the vehicle engine via the belt. The attachment part formed to the housing especially on the side where a power transmission device is disposed is reinforced by the plurality of reinforcement parts. Accordingly, the stiffness of the entire housing can be effectively enhanced.

[0004] Meanwhile, there has been increasing demand for lightweight compressors in recent years. One important issue is to facilitate weight reduction of the compressor while assuring stiffness of the housing member. Thus, in many cases, the housing member is formed by molding a relatively lightweight material, for example, an aluminum die-casting material.

[0005] However, if a large number of reinforcement parts as described above are formed at the attachment part to provide stiffness of the housing, the mold for use in the above-mentioned molding becomes complicated in structure. This leads to increase in mold cost. Further, it is necessary to remake an expensive mold with each change in shape of the housing. As a result, productivity of the housing and the compressor may be deteriorated.

SUMMARY

[0006] The present invention has been made in consideration of the above problems. One object of the present invention is to provide a compressor having a simple structure by which stiffness of both an attachment part and an entire housing can be enhanced.

[0007] To achieve the object, a compressor of a first embodiment of the present invention, includes: an attachment part protruded from an outer peripheral surface of a housing and including a first end surface abutting on an attached member, a second surface opposed to the first end surface, and a bolt hole opened to both the first end surface and the second end surface; and a reinforcement part integrally formed with the attachment part and the housing and extending from a side surface of the attachment part formed along the bolt hole to the outer peripheral surface of the housing, The reinforcement part includes a hollow portion that is formed by closing the first end surface side and opening the second end surface side.

[0008] In the compressor of a second embodiment according to the first embodiment, the reinforcement part includes: a bottom wall extending from the side surface of the attachment part to the outer peripheral surface of the housing in parallel to the first end surface of the attachment part; and a side wall standing from the bottom wall toward the second end surface of the attachment part and extending from the side surface of the attachment part to the outer peripheral surface of the housing.

[0009] In the compressor of a third embodiment according to the second embodiment, the bottom wall of the reinforcement part extends from the vicinity of the first end surface of the side surface of the attachment part to the outer peripheral surface of the housing in parallel to the first end surface of the attachment part.

[0010] In the compressor of a fourth embodiment according to the second or third embodiment, the side wall of the reinforcement part extends from the vicinity of the first end surface of the side surface of the attachment part to the side surface of the attachment part to at least an intermediate between the first end surface and the second end surface of the side surface of the attachment part.

[0011] In the compressor of a fifth embodiment according to any of the second to fourth embodiments, the side wall of the reinforcement part extends to the side surface of the attachment part in a projected region (Wp) of the bolt hole in the side surface of the attachment part.

[0012] In the compressor of a sixth embodiment according to any of the second to fifth embodiments, the side wall of the reinforcement part is inclined to be closer to the outer peripheral surface of the housing with distance from the attachment part.

[0013] In the compressor of a seventh embodiment according to any of the second to sixth embodiments, the housing further includes at one end thereof a power transmission device that transmits power of an external drive source to the compressor, a plurality of the attachment parts is provided, and the reinforcement part is disposed at, out of the plurality of attachment parts, the attachment part on a side near the power transmission device.

[0014] In the compressor of an eighth embodiment, the side wall of the reinforcement part includes a pedestal surface to which a bracket for fitting a power-distribution connector of the compressor is fixed via a fixing member, the bracket includes: a fitting part to which the power-

distribution connector is fitted; and a fixation part fixed to the pedestal surface; a rotation stopper part that bends from the fixation part and abuts on the bottom wall of the reinforcement part to stop rotation of the bracket.

[0015] The attachment part having the bolt hole receives high load due to vehicle vibrations and the like in the direction of the center line of the bolt hole and the direction orthogonal to the former direction. According to the compressor in the first embodiment of the present invention, the reinforcement part can effectively reinforce the attachment part having the bolt hole. Specifically, the reinforcement part is integrally formed with the housing, extending from the side surface of the attachment part formed along the bolt hole to the outer peripheral surface of the housing. Further, the reinforcement part includes the hollow portion. The hollow portion is formed by closing the first end surface side of the reinforcement part that abuts on the attached member and opening the second end surface side of the reinforcement part. Thus, the reinforcement part is provided with a casing structure with one opened end. As a result, the reinforcement part can effectively reinforce the attachment part, and further enhance the stiffness of the housing. In addition, an increase in stiffness of the housing can shift the natural vibration frequency of the compressor to a higher side, resulting in suppression of resonance between the compressor and the attached member.

[0016] In addition, the hollow portion allows weight reduction of the reinforcement part and the housing. The hollow portion can also be used as a cast part when the reinforcement part is integrally formed with the housing and the attachment part. Therefore, the stiffness of the attachment part and the entire housing of the compressor can be effectively enhanced by the simple structure while realizing weight reduction of the compressor.

[0017] According to the second embodiment, specifically, the reinforcement part has the bottom wall extending from the side surface of the attachment part to the outer peripheral surface of the housing in parallel to the first end surface of the attachment part, and the side wall standing from the bottom wall toward the second end surface of the attachment part and extending from the side surface of the attachment part to the outer peripheral surface of the housing.

[0018] According to the third embodiment, the bottom wall of the reinforcement part extends from the vicinity of the first end surface of the side surface of the attachment part to the outer peripheral surface of the housing in parallel to the first end surface of the attachment part. The thus-configured bottom wall can further effectively enhance the stiffness of the attachment part and the entire housing of the compressor on the first end surface side near the attached member as a vibration source at the attachment part.

[0019] According to the fourth embodiment, the side wall of the reinforcement part extends from the vicinity of the first end surface of the side surface of the attachment part at least to the intermediate between the first end surface and the second end surface of the side surfaces of the attachment part extending to the side surface of the attachment part. Specifically, the side wall of the reinforcement part is formed at 1/2 or more of the attachment part in the direction of the center line of the bolt hole. Therefore, the stiffness of the attachment part and the entire housing of the compressor can be further enhanced.

[0020] According to the fifth embodiment, the side wall of the reinforcement part extends to the side surface of the attachment part in the projected region of the bolt hole in the side surface of the attachment part. Accordingly, the side wall of the reinforcement part can reliably support and reinforce the bolt hole in the attachment part to which a high load is applied. Therefore, the stiffness of the attachment part and the entire housing of the compressor can be further enhanced.

[0021] According to the sixth embodiment, the side wall of the reinforcement part is inclined to be closer to the outer peripheral surface of the housing with distance from the attachment part. This allows the side wall to be smaller in size. Therefore, the weight of the reinforcement part can be further reduced.

[0022] According to the seventh embodiment, a plurality of the attachment parts is included. In addition, the reinforcement part is disposed at, out of the plurality of attachment parts, the attachment part on the side nearer the power transmission device. In the vicinity of the power transmission device with larger vibration, therefore, the stiffness of the attachment part and the entire housing of the compressor in the vicinity of the power transmission device with larger vibration can be effectively enhanced.

[0023] According to the eighth embodiment, the bracket includes the fitting part to which the power-distribution connector is fitted, the fixation part fixed to the pedestal surface, and the rotation stopper part bending from the fixation part and abutting on the bottom wall of the reinforcement part to stop rotation of the bracket. Therefore, the rotation of the bracket around the fixing member can be restricted by the bottom wall.

[0024] In addition, the pedestal surface is formed by a partial region of the side wall of the reinforcement part. Therefore, the pedestal surface can be concurrently formed with integral formation of the housing, the attachment part, and the reinforcement part by molding. Such integral formation allows the reinforcement part to be further reduced in weight as compared to the case where the pedestal part for fixing the bracket is separately machined and provided to the housing. Further, the further simple configuration can enhance the stiffness of the attachment part and the entire housing of the compressor.

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 (first example);

FIG. 2 is a partial enlarged view of the compressor as seen from a direction of arrow A in FIG. 1, illustrating an attachment part;

FIG. 3 is a partial enlarged view of the variable capacity compressor in FIG. 1, illustrating the attachment part and a reinforcement part;

FIG. 4 is a partial enlarged view of the variable capacity compressor in FIG. 1 as seen from the direction opposite to the direction of arrow A, illustrating the attachment part and the reinforcement part;

FIG. 5 is a diagram as seen from back side of FIG. 3, illustrating the attachment part and the reinforcement part;

FIG. 6 is a partial enlarged view of a variable capacity compressor according to one embodiment of the present invention (second example) as seen from the same direction as that in FIG. 4, illustrating the attachment part and the reinforcement part; and

FIG. 7 is a partial enlarged view of a variable capacity compressor according to one embodiment of the present invention (second example) as seen from the same direction as that in FIG. 5, illustrating the attachment part and the reinforcement part.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[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 (hereinafter, referred to simply as compressor). The compressor 100 includes a cylinder block 101, a front housing (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 can be changed along the drive shaft 110.

[0030] The link mechanism 120 includes a first arm 112a projected from the rotor 112, a second arm 111a obliquely 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 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 has an inclination angle of substantially 0°. The maximum inclination angle of the swash plate 111 is restricted by the swash plate 111 abutting on the rotor 112.

[0033] An inclination angle decreasing spring 114 is fitted between the rotor 112 and the swash plate 111. The inclination angle decreasing spring 114 is formed from 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 is formed from 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.

[0034] Biasing force of the inclination angle increasing spring 115 is set larger than 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.

[0035] 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 (not shown). 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.

[0036] The drive shaft 110 is supported by the front housing 102 via a bearing 131 in a radial direction, and is supported by the cylinder block 101 via a bearing 132 in a radial direction. In addition, the drive shaft 110 is integrally coupled to the rotor 112. Therefore, the drive shaft 110 is supported together with the rotor 112 by the

front housing 102 via a bearing 133 in a thrust direction. Further, the drive shaft 110 is supported by the cylinder block 101 via a thrust plate 134 in the thrust direction. Therefore, when power from an external drive source is transmitted to the power transmission device, the drive shaft 110 can rotate in synchronization with rotation of the power transmission device. A clearance between the drive shaft 110 and the thrust plate 134 is adjusted to a predetermined clearance by an adjustment screw 135.

[0037] A piston 136 is disposed in the cylinder bores 101a. The outer peripheral part of the swash plate 111 is stored 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.

[0038] 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.

[0039] 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.

[0040] A muffler chamber 143 is provided on the outer peripheral surface of the cylinder block 101. A protrusion wall 101b is protruded from the outer peripheral surface of the cylinder block 101 in a cylindrical shape. The muffler chamber 143 is formed by tightening a cover member 106 by a bolt to an open end surface of the protrusion wall 101b via a seal member (not shown).

[0041] A discharge port 106a is formed at the cover member 106. The discharge port 106a is connected to a piping of a discharge-side refrigerant circuit (not shown) in the air-conditioner system. In addition, the discharge port 106a is opened to the muffler chamber 143. A check valve 200 is disposed in the muffler chamber 143. The muffler chamber 143 and the discharge chamber 142 communicate with each other by a communication path 144. The check valve 200 is disposed at a connection between the communication path 144 and the muffler chamber 143. The check valve 200 operates in response to a pressure difference between the communication path 144 and the muffler chamber 143. If the pressure difference is smaller than a predetermined value, the communication path 144 is closed. If the pressure difference is larger than the predetermined value, the communication path 144 is opened. Therefore, the discharge chamber 142 is connected to the discharge-side refrigerant circuit in the air-conditioner system via a refrigerant discharge path formed by the communication path 144, the check valve 200, the muffler chamber 143, and the discharge port 106a.

[0042] A suction port 104a and a communication path 104b are formed at the cylinder head 104 to provide a suction path. The suction chamber 141 is connected to the suction-side refrigerant circuit in the air-conditioner system via the suction path.

[0043] A control valve 300 is disposed at the cylinder head 104. The control valve 300 controls the amount of discharge gas introduced to the crank chamber 140 by adjusting the opening of a pressure supply path 145 providing communication between the discharge chamber 142 and the crank chamber 140.

[0044] Refrigerant in the crank chamber 140 flows into the suction chamber 141 via a release pressure path 146. The release pressure path 146 includes a communication path 101c, a space 101d, and an orifice 103c formed on the valve plate 103 in this order.

[0045] Therefore, the control valve 300 changes the pressure in the crank chamber 140 to alter the inclination angle of the swash plate 111 (that is, the stroke of the piston 136). As a result, the discharge capacity of the compressor 100 is variably controlled.

[0046] The control valve 300 can optimally control the suction pressure of the suction chamber 141 according to external environment. That is, the control valve 300 contains a solenoid (not illustrated). The amount of power distribution to the solenoid is adjusted according to an external signal. For example, during operation of the air-conditioner (that is, during operation of the compressor 100), the amount of power distribution to the solenoid is adjusted such that the suction pressure of the suction chamber 141 reaches a predetermined value. As a result, the discharge capacity of the compressor 100 can be variably controlled. Meanwhile, during non-operation of the air-conditioner (that is, non-operation of the compressor 100), the pressure supply path 145 is forcedly opened by turning off the power distribution to the solenoid of the control valve 300. As a result, the discharge capacity of the compressor 100 is controlled to the minimum.

<Example 1>

[0047] Referring to FIG. 1, one example of a variable capacity compressor according to one embodiment of the present invention will be described. In this variable capacity compressor (hereinafter, also referred to as compressor) 100, the front housing 102 has an outer peripheral surface 210. Attachment parts 211 and 212 are integrally disposed on the outer peripheral surface 210. The attachment parts 211 and 212 protrude to the radial outside of the front housing 102. Meanwhile, an attachment part 214 is integrally provided on an outer end surface 213 of the cylinder head 104. The attachment part 214 protrudes outward in the axial direction of the drive shaft 110. Therefore, the compressor 100 is attached to

a vehicle engine (not shown) or an attached member such as a frame as a member of the engine, by the attachment parts 211, 212, and 214.

[0048] The attachment parts 211, 212, and 214 have bolt holes 211a, 212a, and 214a, respectively. Bolts (not shown) are inserted into the respective bolt holes 211a, 212a, and 214a. Therefore, the compressor 100 is firmly fixed to the attached member by the bolts.

[0049] Of the attachment parts 211, 212, and 214, the attachment parts 211 and 212 are positioned on a side near the power transmission device (boss part 102a side).

[0050] The attachment part 211 has a surface on the side of the boss part 102a and a surface on the opposite side thereof (side surface 211b formed along the bolt hole 211a). A reinforcement part 220 is integrally formed with the attachment part 211 and the front housing 102 extending from the side surface 211b to the outer peripheral surface 210 of the front housing 102.

[0051] The attachment part 212 is formed in the same manner as the attachment part 211. Specifically, the attachment part 212 on the side of the power transmission device has a surface on the side of the boss part 102a and a surface on the opposite side thereof (side surface 212b). A reinforcement part 221 having the same shape as that of the reinforcement part 220 is integrally formed with the attachment part 212 and the front housing 102 extending from the side surface 212b to the outer peripheral surface 210 of the front housing 102.

[0052] FIG. 2 illustrates the attachment part 211 of the compressor 100 as seen from the direction of arrow A in FIG. 1. The attachment part 211 has a first end surface 215 abutting the attached member, and a second end surface 216 opposed to the first end surface 215. In FIG. 2, the bolt hole 211a is indicated by a broken line. The bolt hole 211a is opened to the first end surface 215 and the second end surface 216. A center line of the bolt hole 211a is approximately orthogonal to the axial line of the drive shaft 110, the first end surface 215, and the second end surface 216. A bolt (not shown) is inserted from the second end surface 216 into the bolt hole 211a to screw into the attached member (not shown) abutting on the first end surface 215. At that time, the head part of the bolt abuts on the second end surface 216. The attachment part 212 is used in the same manner as the attachment part 211.

[0053] The attachment part 211 has a side surface 211 c. The side surface 211 c faces the boss part 102a. The side surface 211c has an opening 217 in an almost central area between the first end surface 215 and the second end surface 216. The opening 217 is formed between the first end surface 215 and the second end surface 216, and is communicated with a part of the bolt hole 211 a. Specifically, the opening 217 is communicated with the bolt hole 211a over about 2/3 of the length of the bolt hole 211a. As a result, the opening 217 allows weight reduction of the attachment part 211. Each of the attachment parts 212 and 214 has at least a first end surface (not shown) and a second end surface (not shown) similar to those of the attachment part 211.

[0054] The first end surfaces and the second end surfaces of the attachment parts 212 and 214 are approximately orthogonal to center lines of the bolt holes 212a and 214a, and are formed on a plane almost parallel to the first end surface 215 and the second end surface 216. These first end surfaces including the first end surface 215 are formed on almost the same plane. In addition, these first end surfaces form the front housing 102 with respect to the attached member, or an attachment surface 230 of the compressor 100.

[0055] Next, the reinforcement part 220 of the attachment part 211 will be described in detail. The reinforcement part 221 of the attachment part 212 has the same shape as that of the reinforcement part 220 of the attachment part 211, and thus descriptions thereof will be omitted.

[0056] As illustrated in FIGS. 3 to 5, the reinforcement part 220 has an end surface that abuts on the side surface 211b of the attachment part 211 formed along the bolt hole 211a, and an end surface that abuts on the outer peripheral surface 210 of the front housing 102. The reinforcement part 220 is integrally formed with the attachment part 211 and the front housing 102 by molding an aluminum die-casting material or the like. Further, the reinforcement part 220 has a bottom wall 220a, a first side wall (side wall) 220b, and a second side wall (side wall) 220c.

[0057] The bottom wall 220a is formed to extend from the vicinity of the first end surface 215 of the side surface 211b to the outer peripheral surface 210 in parallel to the first end surface 215. In addition, as illustrated in FIG. 5, the bottom wall 220a has the shape of an almost right-angled trapezoid in a planar view. The bottom wall 220a protrudes outward in the radial direction of the front housing 102 in a direction orthogonal to the center line of the bolt hole 211a.

[0058] As illustrated in FIG. 4, the first side wall 220b and the second side wall 220c constitute side walls of the reinforcement part 220. The first side wall 220b and the second side wall 220c vertically stands from the bottom wall 220a toward the second end surface 216 almost along the side surface 211 b and the center line of the bolt hole 211a. That is, each of the first side wall 220b and the second side wall 220c extends from the side surface 211b to the outer peripheral surface 210. The first side wall 220b and the second side wall 220c may extend from the side surface 211b across the outer peripheral surface 210.

[0059] As illustrated in FIGS. 3 and 5, the first side wall 220b extends from the side surface 211b so as to be opposed to the outer peripheral surface 210. The first side wall 220b is inclined to be closer to the outer peripheral surface 210 with distance from the attachment part 211.

[0060] As illustrated in FIG. 4, the first side wall 220b is formed to extend to the side surface 211b from the

vicinity of the first end surface 215 of the side surface 211b. Specifically, the first side wall 220b extends to the intermediate between the first end surface 215 and the second end surface 216 of the side surface 211b extending to the side surface 211b (in FIG. 4, about 2/3 of the distance from the first end surface 215 to the second end surface 216).

[0061] As illustrated in FIG. 3, the first side wall 220b is formed to extend to the side surface 211b in a projected region Wp of the bolt hole 211a in the side surface 211b. The first side wall 220b may extend to a portion of the side surface 211b corresponding to the bolt hole 211 a.

[0062] Meanwhile, as illustrated in FIG. 4, the second side wall 220c is the same height as the first side wall 220b. The second side wall 220c is formed to extend from the first side wall 220b to the outer peripheral surface 210, and is opposed to the side surface 211b in parallel. The second side wall 220c is also connected to the outer peripheral surface 210 in the vicinity of a joint end surface between the front housing 102 and the cylinder block 101.

[0063] In this manner, the reinforcement part 220 has the bottom wall 220a, the first side wall 220b, and the second side wall 220c of the attachment part 211. The reinforcement part 220 also has a casing structure with one end opened, which is formed in the shape of an almost right-angled trapezoid in cross-sectional view. Specifically, the reinforcement part 220 has a portion on the first end surface 215 side (attachment surface 230 side) closed by the bottom wall 220a and an opened (aperture) portion on the second end surface 216 side (opposite of the attachment surface 230). In other words, the reinforcement part 220 has a casing structure that has a hollow portion 218 as a space in the shape of an almost right-angled trapezoid in a cross-sectional view.

[0064] As stated above, in the compressor 100 of the embodiment, the reinforcement part 220 having the foregoing casting structure produces an advantage as described below. That is, it is possible to effectively reinforce the attachment part 211 having the bolt hole 211a to which a high load is applied due to vibrations of the vehicle or the like in the direction of the center line of the bolt hole 211a and the direction orthogonal to the former direction (in other words, in the axial direction and the radial direction of the drive shaft 110). The reinforcement of the attachment part 211 makes higher the stiffness of the front housing 102. In addition, the front housing 102 with higher stiffness can shift the natural vibration frequency of the compressor 100 to a higher side. Thus, the higher natural vibration frequency can lead to suppress resonance between the compressor 100 and the attached member.

[0065] The hollow portion 218 allows weight reduction of the reinforcement part 220 and the front housing 102. The hollow portion 218 can also be used as a cast part for forming by molding the reinforcement part 220 integrally with the front housing 102 and the attachment part 211. Therefore, the stiffness of the attachment part 211 and the front housing 102 can be effectively enhanced by the simple structure while realizing weight reduction. As a result, the stiffness of the entire housing of the compressor 100 can be effectively enhanced.

[0066] As stated above, the bottom wall 220a is disposed in the vicinity of the first end surface 215 (at the attached surface 230 side). The first end surface 215 is an end surface on the attached member side where the vehicle engine and the like as a vibration source are disposed. Therefore, the stiffness of the attachment part 211 and the entire housing of the compressor 100 on the first end surface 215 side can be effectively enhanced.

[0067] In addition, the first side wall 220b is formed to extend from the vicinity of the first end surface 215 of the side surface 211b at least to the intermediate between the first end surface 215 and the second end surface 216 of the side surface 211b extending to the side surface 211b. Therefore, the first side wall 220b is formed at 1/2 or more of the attachment part 211 in the direction of the center line of the bolt hole 211a. Therefore, the stiffness of the attachment part 211 and the entire housing of the compressor 100 can be further enhanced.

[0068] The first side wall 220b is formed to extend to the side surface 211b in the projected region Wp of the bolt hole 211a in the side surface 211b. Therefore, the first side wall 220b can reliably support and reinforce the bolt hole 211a of the attachment part 211 to which a high load is applied due to vehicle vibrations and the like. Therefore, the stiffness of the attachment part 211 and the entire housing of the compressor 100 can be further enhanced.

[0069] The first side wall 220b is inclined to be closer to the outer peripheral surface 210 with distance from the attachment part 211. This makes the second side wall 220c smaller. As a result, weight reduction of the reinforcement part 220 can be further facilitated.

[0070] In addition, as stated above, the reinforcement parts 220 and 221 are disposed at the attachment parts 211 and 212, respectively, of the three attachment parts 211, 212 and 214, which are located nearer the power transmission device in the front housing 102. Therefore, in the vicinity of the power transmission device with larger vibration, the stiffness of the attachment parts 211 and 212 and the entire housing of the compressor 100 can be efficiently enhanced.

<Second example>

[0071] Referring to FIGS. 6 and 7, a second example of a variable capacity compressor according to one embodiment of the present invention will be described. The variable capacity compressor of the example has almost the same configuration as the compressor 100 illustrated in FIG. 1 except for some respects described below. Therefore, the same components of the second example as those of the first example are given the same reference numerals as those of the first example, and thus descriptions thereof will be omitted.

[0072] FIGS. 6 and 7 are partial enlarged views of the

variable capacity compressor as seen from the same directions as those in FIGS. 4 and 5, illustrating the front housing 102, the attachment part 211, and the reinforcement part 220. As illustrated in these drawings, the first side wall 220b of the second example has a pedestal surface 240. Fixed on the pedestal surface 240 is a bracket 150 for attachment of a power-distribution connector. Attached to the bracket 150 is, for example, a power-distribution connector of an electromagnetic clutch as a power transmission device or a power-distribution connector of the control valve 300.

[0073] The pedestal surface 240 is formed almost orthogonal to the side surface 211 b in a predetermined region. The predetermined region here refers to a region that ranges from an almost intermediate part between the side surface 211b of the attachment part 211 of the first side wall 220b and the second side wall 220c to the second side wall 220c. In other words, the pedestal surface 240 is formed in almost parallel to the outer peripheral surface 210. The bracket 150 has a fitting part 150a, a fixed part 150b, and a rotation stopper part 150c. A power-distribution connector is fitted to the fitting part 150a. The fixation part 150b is fixed to the pedestal surface 250 by a fixing member 160 such as a screw. The rotation stopper part 150c bends at an almost right angle from the fixation part 150b, and abuts on the bottom wall 220a to stop rotation of the bracket 150.

[0074] As stated above, at the reinforcement part 220 of the second example, the rotation stopper part 150c abuts on the bottom wall 220a. Thus, the bottom wall 220a restricts the rotation of the bracket 150 around the fixing member 160. That is, the bottom wall 220a acts as a rotation stopper wall. The pedestal surface 240 is formed by a partial region of the first side wall 220b of the reinforcement part 220. Thus, the pedestal surface 240 can be formed concurrently with integral formation of the front housing 102, the attachment part 211, and the reinforcement part 220 by molding. This integral formation further facilitates weight reduction of the reinforcement part 220 as compared to the case where the pedestal part for fixation of the bracket 150 is separately machined and provided to the front housing 102 or the like. Further, the stiffness of the attachment part 211 and the entire housing of the compressor 100 can be enhanced by the further simple structure.

[0075] As in the foregoing, one embodiment of the present invention will be described. However, the present invention is not limited to the foregoing embodiment but can be modified in various manners without deviating from the essence of the present invention.

[0076] For example, in each of the foregoing examples, the reinforcement part 220 is formed at the two attachment parts 211 and 212 on the side of the power transmission device. However, the positions of the attachment parts are not limited to two but may be either one of them.

[0077] In addition, in each of the foregoing examples, the reinforcement part 220 is formed in regions across the attachment parts 211 and 212 on the side opposite to the power transmission device. However, if the positions of the attachment parts 211 and 212 are sufficiently separated from the power transmission device, the reinforcement part 220 may be formed in regions of the attachment parts 211 and 212 on the side of the power transmission device.

[0078] The side walls including the first side wall 220b and the second side wall 220c may have a curved wall surface. The shape of the bottom wall 220a is not limited to an almost right-angled trapezoid in a planar view but may be an almost triangle in a planar view or the like.

[0079] In each of the foregoing examples, the compressor 100 is a variable capacity compressor. The present invention is not limited to this but may be applied to other various compressors.

[0080] One object of the present invention may be to provide a compressor that enhances stiffness of the attachment parts with respect to the attached member, that is, the stiffness of the entire housing, by a simple structure.

[0081] The first side wall 220b may be inclined to be closer to the outer peripheral surface 210 with distance from the attachment part 211.

[0082] The attachment part 211 may have the first end surface 215 abutting on the attached member and the second end surface 216 opposed to the first end surface 215, the first end surface 215 and the second end surface 216 may each have the bolt hole 211a, and by tightening a bolt to the attachment part 211, the head of the bolt may abut on the second end surface 216.

[0083] The compressor according to the embodiment may be any of the following first to eighth compressors:

[0084] The first compressor includes: an attachment part that has a first end surface that is protruded from an outer peripheral surface of a housing and abuts on an attached member and a second end surface that is opposed to the first end surface, the first end surface and the second end surface having a bolt hole; and a reinforcement part that is integrally formed with the attachment part and the housing from a side surface of the attachment part formed along the bolt hole to the outer peripheral surface, wherein the reinforcement part has a hollow portion that is formed by closing the first end surface side and opening the second end surface side.

[0085] The second compressor is characterized in that, in the first compressor, the reinforcement part includes: a bottom wall that extends from the side surface to the outer peripheral surface in parallel to the first end surface; and a side wall standing from the bottom wall to the second end surface side and extending from the side surface to the outer peripheral surface.

[0086] The third compressor is characterized in that, in the second compressor, the bottom wall extends from vicinity of the first end surface of the side surface to the outer peripheral surface in parallel to the first end surface.

[0087] The fourth compressor is characterized in that, in the second compressor, the side wall extends from vicinity of the first end surface of the side surface at least

to an intermediate between the first end surface and the second end surface of the side surface extending to the side surface.

[0088] The fifth compressor is characterized in that, in the second compressor, the side wall extends to the side surface in a projected region of the bolt hole in the side surface.

[0089] The sixth compressor is characterized in that, in the second compressor, the side wall is inclined to be closer to the outer peripheral surface with distance from the attachment part.

[0090] The seventh compressor is characterized in that, in the second compressor, a power transmission device is disposed at one end of the housing to transmit power of an external drive source to the compressor, and the reinforcement part is disposed at, out of a plurality of the attachment parts, the attachment part on the side of the housing nearer the power transmission device.

[0091] The eighth compressor is characterized in that, in the second compressor, the side wall has a pedestal surface at a part thereof to which a bracket for fitting a power-distribution connector of the compressor is fixed via a fixing member, and the bracket has a fitting part to which the power-distribution connector is fitted, a fixation part fixed to the pedestal surface, and a rotation stopper part that bends from the fixation part and abuts on the bottom wall to stop rotation of the bracket.

[0092] 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:

an attachment part (211) protruded from an outer peripheral surface (210) of a housing (102) and including a first end surface (215) abutting on an attached member, a second surface (216) opposed to the first end surface, and a bolt hole (211a) opened to both the first end surface and the second end surface; and
a reinforcement part (220) integrally formed with the attachment part and the housing and extending from a side surface (211b) of the attachment part formed along the bolt hole on the outer peripheral surface of the housing, wherein
the reinforcement part includes a hollow portion (218) that is formed by closing the first end surface side and opening the second end surface side.

2. The compressor according to Claim 1, wherein the reinforcement part includes:

a bottom wall (220a) extending from the side surface of the attachment part to the outer peripheral surface of the housing in parallel to the first end surface of the attachment part; and
a side wall (220b, 220c) standing from the bottom wall toward the second end surface of the attachment part and extending from the side surface of the attachment part to the outer peripheral surface of the housing.

3. The compressor according to Claim 2, wherein the bottom wall of the reinforcement part extends from the vicinity of the first end surface (215) of the side surface of the attachment part to the outer peripheral surface of the housing in parallel to the first end surface of the attachment part.

4. The compressor according to Claim 2 or 3, wherein the side wall of the reinforcement part extends from the vicinity of the first end surface of the side surface of the attachment part at least to an intermediate between the first end surface and the second end surface of the side surface of the attachment part extending to the side surface of the attachment part.

5. The compressor according to any of Claims 2 to 4, wherein the side wall of the reinforcement part extends to the side surface of the attachment part in a projected region (Wp) of the bolt hole in the side surface of the attachment part.

6. The compressor according to any of Claims 2 to 5, wherein the side wall of the reinforcement part is inclined to be closer to the outer peripheral surface of the housing with distance from the attachment part.

7. The compressor according to any of Claims 2 to 6, wherein
the housing further includes at one end thereof a power transmission device that transmits power of an external drive source to the compressor,
a plurality of the attachment parts is provided, and
the reinforcement part is disposed at, out of the plurality of attachment parts, the attachment part on a side near the power transmission device.

8. The compressor (100) according to any of Claims 2 to 7, wherein
the side wall of the reinforcement part includes a

pedestal surface (240) to which a bracket (150) for fitting a power-distribution connector of the compressor is fixed via a fixing member (160),
the bracket includes:

a fitting part (150a) to which the power-distribution connector is fitted; and
a fixation part (150b) fixed to the pedestal surface;
a rotation stopper part (150c) that bends from the fixation part and abuts on the bottom wall of the reinforcement part to stop rotation of the bracket.

9. The compressor according to Claim 2, wherein the side wall of the reinforcement part includes:

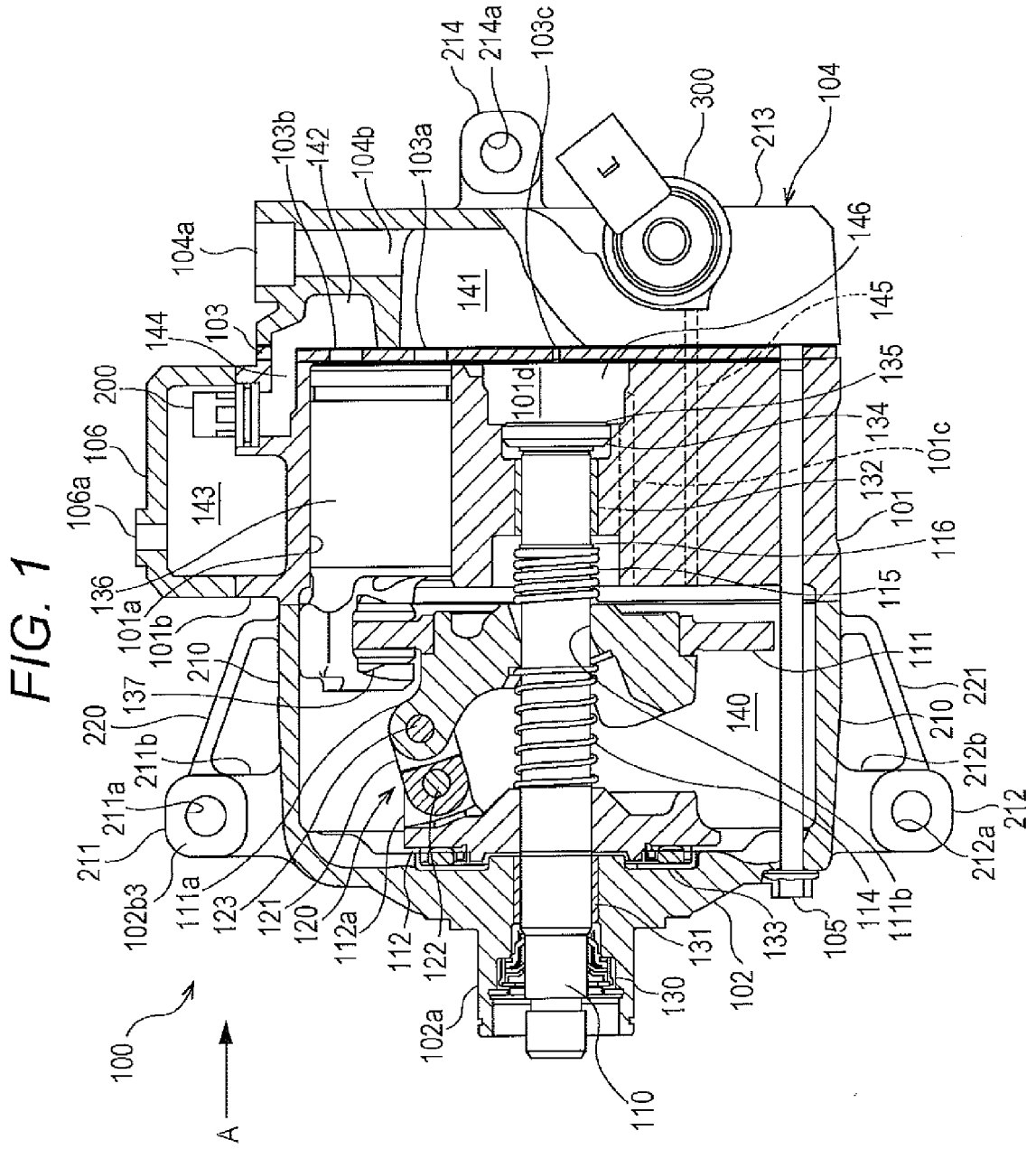
a first side wall (220b) that is opposed to the outer peripheral surface of the housing and extends from the side surface of the attachment part; and
a second side wall (220c) that is formed to extend from the first side wall to the outer peripheral surface of the housing and is opposed to the side surface of the attachment part in parallel.

10. The compressor according to Claim 9, wherein the first side wall is inclined to be closer to the outer peripheral surface of the housing with distance from the attachment part.

11. The compressor according to Claim 9 or 10, wherein the second side wall is the same height as the first side wall.

12. The compressor according to any of Claims 9 to 11, wherein the second side wall is connected to the outer peripheral surface of the housing in the vicinity of a joint end surface between the housing and a cylinder block (101) of the compressor.

FIG. 1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134
106a
143
132
101c
101
136
116
101a
101b
115
210
111
137
140
221
220
210
211b
212b
211a
212
211
212a
102b3
111a
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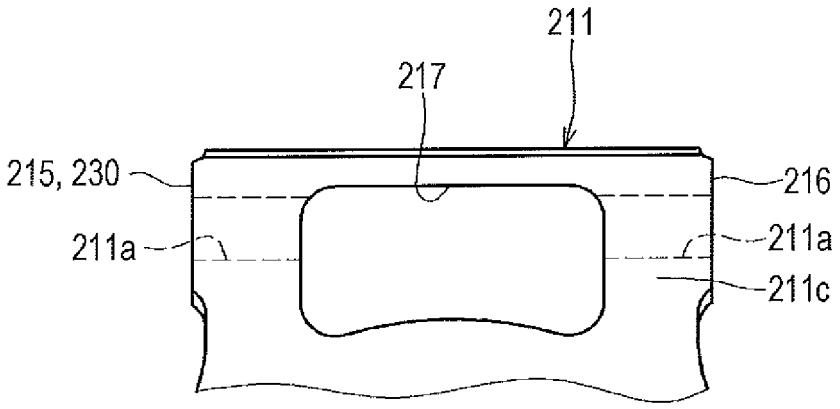
A

FIG. 2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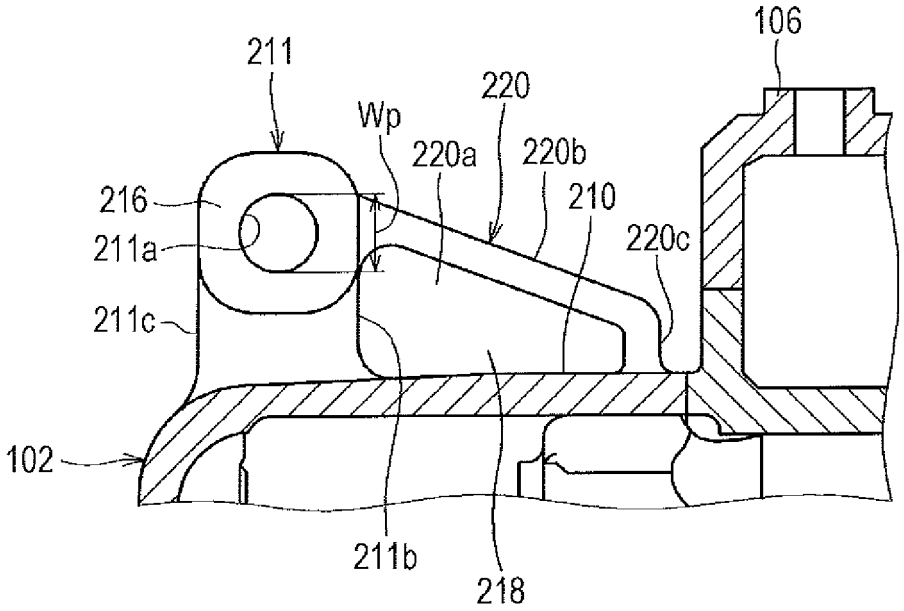
211c

FIG. 3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218

FIG. 4

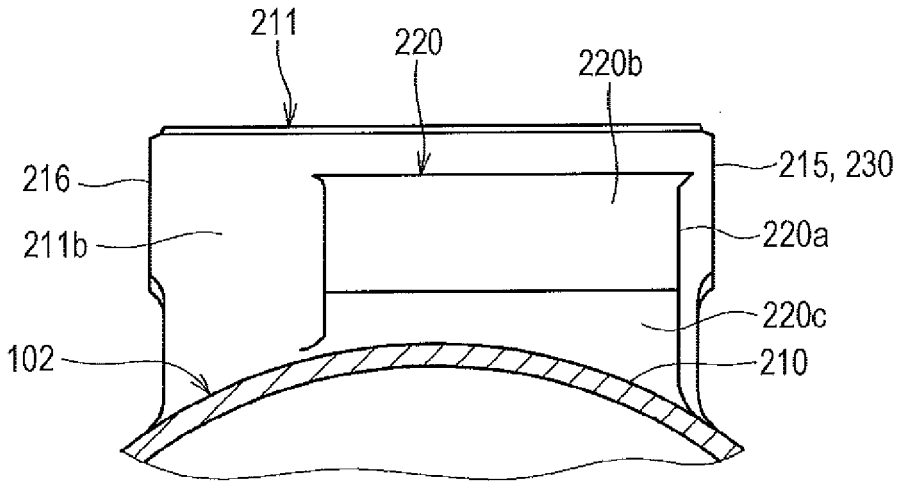
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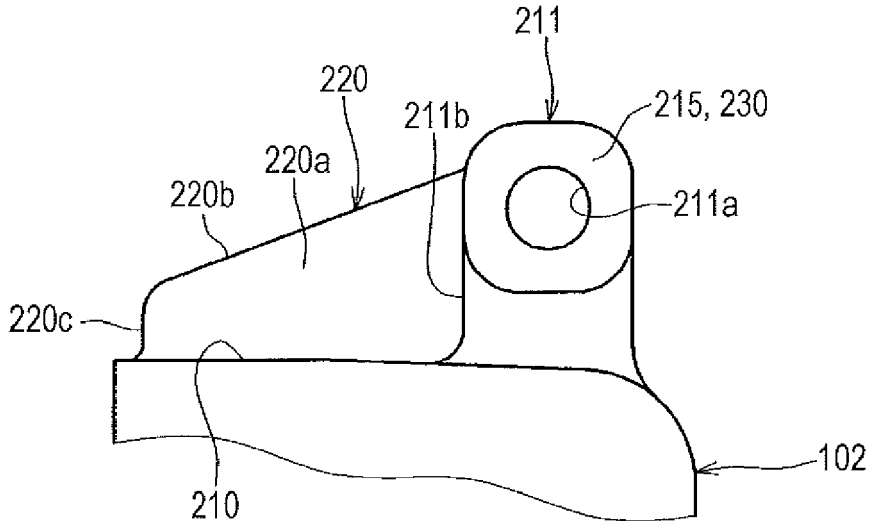
FIG. 5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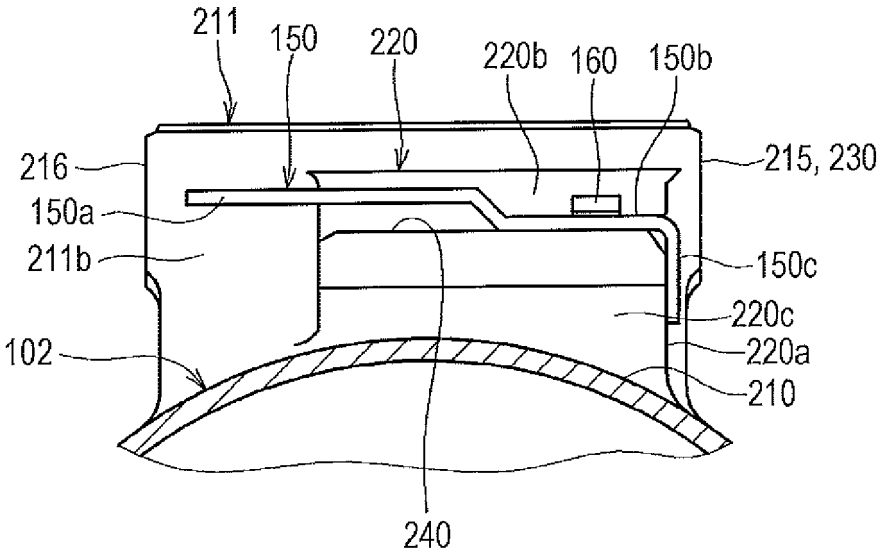
210

FIG. 6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102
220a
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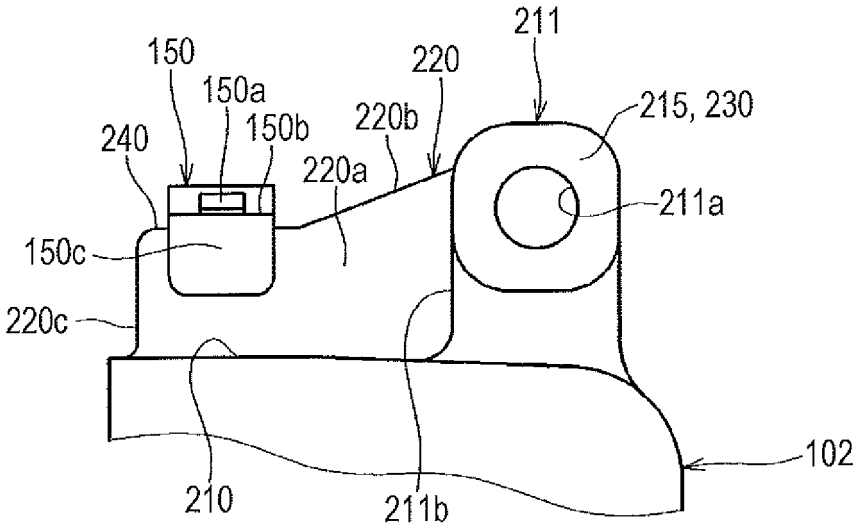
240

FIG. 7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EUROPEAN SEARCH REPORT

Application Number
EP 14 17 0210

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F04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 November 2014	Fistas, Nikolaos

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