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(71) Applicant: **Yamaha Hatsudoki Kabushiki Kaisha**
Iwata-shi, Shizuoka 438-8501 (JP)

(72) Inventor: **Iida, Kaichi**
Iwata-shi, Shizuoka 438-8501 (JP)

(74) Representative: **Grünecker, Kinkeldey,**
Stockmair & Schwanhäusser
Leopoldstrasse 4
80802 München (DE)

(54) Engine

(57) The end portion of the cylinder head includes a first end portion, and a first depressed portion depressed in a circular arc shape from the first end portion. The end portion of the cylinder head cover includes a second end portion and a second depressed portion depressed in a circular arc shape from the second end portion. A first virtual plane through the first end portion and a second virtual plane through the second end portion overlap with the camshaft. A mounting member includes a gasket and a collar member. The gasket includes a ring portion and the main body. The ring portion, having a circular form, is arranged between the first depressed portion and the second depressed portion. The main body is arranged between the first end portion of the cylinder head and the second end portion of the cylinder head cover. The collar member, a tubular shaped member, is inserted in the opening of the ring portion. The water pump is installed in the collar member. The ring portion is integrated with the collar member.

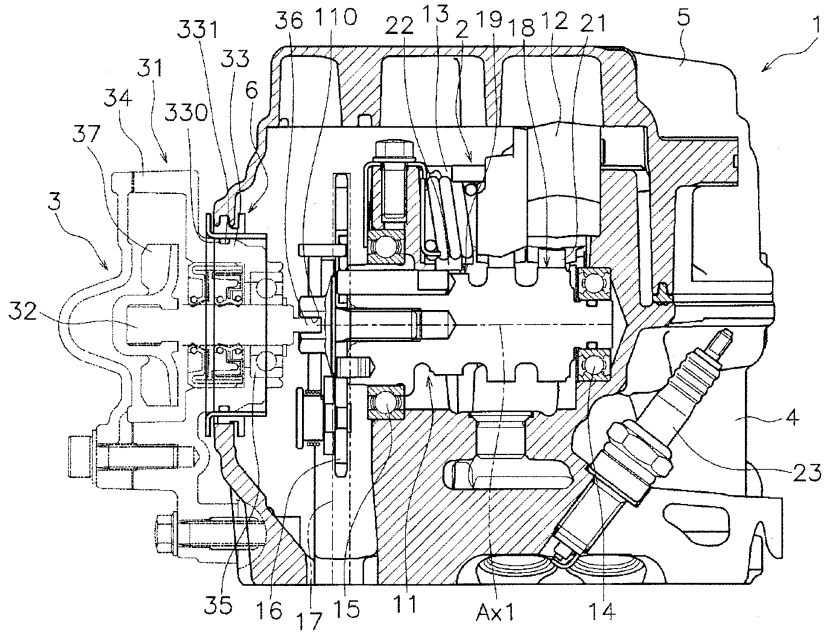

FIG. 1

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Description

[0001] The present invention relates to an engine.

[0002] Engines in which the mating surfaces of the cylinder head and the cylinder head cover are arranged at the same height as the cam axial center are known in the conventional art. For example in the engine disclosed in Japan Patent Laid-open Patent Publication JP-A-2010-138822, the collar member for installing a water pump is arranged between a semicircular notched face of the cylinder head and a semicircular notched face of the cylinder head cover. Further, a gasket is arranged between the end portion of the cylinder head and the cylinder head cover. The gasket is arranged so as to pass between the notched face of the cylinder head and the collar member, above the collar member.

[0003] In an engine in which the cam axial center is arranged at the same height as the mating surfaces of the cylinder head and the cylinder head cover as described above, the cylinder head cover can be removed in the condition in which the water pump is installed to the cylinder head. Further, the water pump is installed to the cylinder head by insertion in an opening in the collar member, and can be removed from the cylinder head by removal through the opening in the collar member. The water pump being able to be installed or removed in the condition in which the cylinder head cover is installed to the cylinder head enables improved serviceability.

[0004] As the collar member is arranged between the cylinder head and the cylinder head cover, in order that oil inside the cylinder head does not leak outside the engine it is necessary to provide sealing between the collar member and the cylinder head and between the collar member and the cylinder head cover. Accordingly, in the above-described engine, the problem arises that in order to provide effective sealing ability and serviceability the structure becomes complex.

[0005] An object of the present invention is to provide an engine that enables serviceability and sealing ability to be realized in a simple structure.

[0006] An engine according to a first aspect of the present invention, includes a camshaft, a water pump, a cylinder head, a cylinder head cover, and a mounting member. The camshaft includes an intake cam and an exhaust cam. The water pump is arranged along the direction of the axis of the camshaft. The cylinder head supports the camshaft. The cylinder head cover is installed on the cylinder head. The mounting member is arranged between the end portion of the cylinder head and the end portion of the cylinder head cover. The end portion of the cylinder head includes a first end portion, and a first depressed portion depressed in a circular arc shape from the first end portion. The end portion of the cylinder head cover includes a second end portion, and a second depressed portion depressed in a circular arc shape from the second end portion. A first virtual plane through the first end portion and a second virtual plane through the second end portion overlap with the camshaft. The mounting member includes a gasket and a collar member. The gasket includes a ring portion and the main body. The ring portion, having a circular form, is arranged between the first depressed portion and the second depressed portion. The main body is arranged between the first end portion of the cylinder head and the second end portion of the cylinder head cover. The collar member is a tubular shaped member and is inserted in an opening of the ring portion. The water pump is installed in the collar member. The ring portion is integrally formed with the collar member.

[0007] In this configuration, with the water pump in the condition of being installed to the cylinder head via the collar member, the cylinder head cover can be removed. Further, as the water pump can be installed to or removed from the collar member, the water pump can be installed or removed in the condition in which the cylinder head cover is installed on the cylinder head. This facilitates excellent serviceability. Again, the main body of the gasket provides sealing between the first end portion of the cylinder head and the second end portion of the cylinder head cover, while the ring portion of the gasket enables sealing between the first depressed portion and the collar member and between the second depressed portion and the collar member. Moreover, the ring portion being integrated with the collar member enables a reduction in the number of components. Accordingly, in a simple structure, serviceability and effective sealing can be provided.

[0008] It is preferable that the ring portion be integrated with the collar member by welding. In this case, the ring member and the collar member can be strongly integrated. This enables serviceability and effective sealing to be provided in a simple structure.

[0009] It is preferable for the collar member to include a tubular portion, and a flange portion projecting outward in the radial direction of the tubular portion. In this case, when the water pump is removed from the collar member, or when the water pump is installed in the collar member, positional displacement of the gasket is suppressed by the flange portion. This further improves the provision of serviceability and effective sealing in a simple structure.

[0010] It is preferable that the collar member be, in the cross-sectional form thereof, a letter L shape formed by the tubular portion and the flange portion. In this configuration, in comparison to the case in which a flange portion is disposed at both ends of the tubular portion, the gap formed between the cylinder head or the cylinder head cover and the flange portion can be reduced. This enables a reduction in the accumulation of oil or foreign substances in that gap, further improving the provision of sealing ability in a simple structure.

[0011] It is preferable that the collar member includes a tubular portion, a first flange portion projecting outward in the radial direction of the tubular portion, and a second flange portion projecting outward in the radial direction of the tubular portion. The ring portion is, in the axial direction of the collar member, arranged between the first

flange portion and the second flange portion. In this case, positional displacement of the gasket can be further suppressed, further improving the provision of sealing ability in a simple structure.

[0012] It is preferable that an extension of the center axis of the camshaft be positioned between the first virtual plane and the first depressed portion. The cylinder head further includes a fixed portion. The fixed portion is arranged adjacent to the first end portion of the cylinder head. The water pump is attached to the fixed portion. In this case, the fixed portion attaching the water pump can be arranged closer to the center axis of the camshaft. Accordingly, even though the fixed portion is provided only on the cylinder head, the water pump can be stably installed. Further, providing the fixed portion only on the cylinder head enables the water pump to be easily installed or removed, further improving serviceability. This further improves the realization of sealing ability in a simple structure

Advantageous Effects of the Invention

[0013] An engine according to an aspect of the present invention enables serviceability and effective sealing ability to be realized in a simple structure.

FIG. 1 is a cross-sectional drawing of part of an engine;
FIG. 2 is an exploded view of part of the engine;
FIG. 3 is a side view of part of the engine;
FIG. 4 is a plan view of the mounting member;
FIG. 5 is a drawing showing the mounting member viewed along the direction of the center axis of the collar member;
FIG. 6 provides a cross-sectional view along VI-VI in FIG. 5;
FIG. 7 provides a cross-sectional view along VII-VII FIG. 4;
FIG. 8 is a cross-sectional drawing showing a variant of the mounting member; and
FIG. 9 is a cross-sectional drawing showing another variant of the mounting member.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0014] An engine 1 related to an embodiment of the present invention will now be described with reference to the drawings. The engine 1 related to the embodiment of the present invention is a water cooled, single cylinder engine.

[0015] FIG. 1 is a cross-sectional drawing of part of the engine 1. FIG. 2 is an exploded view of the part of the engine 1. FIG. 3 is a side view of the part of the engine 1. As shown in FIG. 1, the engine 1 is provided with a valve mechanism 2, a water pump 3 a cylinder head 4, a cylinder head cover 5, and a mounting member 6. Note that in FIG. 1, to facilitate ease of understanding, the water pump 3 is indicated with broken lines. Further, in this embodiment, the direction toward the cylinder head cover 5 from the cylinder head 4 is referred to as "upward", while the opposite direction is referred to as "downward".

[0016] The valve mechanism 2 is a mechanism for driving an intake valve and an exhaust valve, not shown in the drawing. The valve mechanism 2 employs a Single OverHead Camshaft (SOHC) mechanism. The valve mechanism 2 is accommodated in the cylinder head 4 and the cylinder head cover 5. The valve mechanism 2 includes a camshaft 11, an intake rocker arm 12 and an exhaust rocker arm 13.

[0017] The camshaft 11 rotatably supports the cylinder head 4 via bearings 14 and 15. The center axis Ax1 of the camshaft 11 is perpendicular in relation to the upward-downward direction. A sprocket 16 is attached to one end of the camshaft 11. A cam chain 17 winds around the sprocket 16 of the camshaft 11, and a crankshaft sprocket not shown in the drawing, such that the rotations of the crankshaft are conveyed to the camshaft 11 via the cam chain 17.

[0018] The camshaft 11 includes an intake cam 18 and an exhaust cam 19. A roller 21 of the intake rocker arm 12 is in contact with the intake cam 18. A roller 22 of the exhaust rocker arm 13 is in contact with the exhaust cam 19. As the camshaft 11 rotates, the intake cam 18 causes the intake rocker arm 12 to drive, thereby opening/closing the intake valve. Further, as the camshaft 11 rotates, the exhaust cam 19 causes the exhaust rocker arm 13 to drive, thereby opening/closing the exhaust valve.

[0019] The cylinder head 4 supports the camshaft 11. A spark plug 23 is installed to the cylinder head 4. As shown in FIG. 2 and FIG. 3, the cylinder head cover 5 is installed on the cylinder head 4. As shown in FIG. 2, the cylinder head cover 5 is secured to the cylinder head 4 via a plurality of bolts 24a, 24b, 24c, and 24d. The end portion of the cylinder head 4 includes a first end portion 25 and a first depressed portion 26 depressed downward in the first end portion 25. The first depressed portion 26 has a circular arc shape. The first end portion 25 is arranged surrounding the periphery of the internal space of the cylinder head 4, and connects to both ends of the first depressed portion 26.

[0020] The end portion of the cylinder head cover 5 includes a second end portion 27 and a second depressed portion 28, depressed upward in the second end portion 27. The second depressed portion 28 has a circular arc shape. The second end portion 27 is arranged surrounding the periphery of the internal space of the cylinder head cover 5, and connects to both ends of the second depressed portion 28. The second end portion 27 is arranged upward of the first end portion 25. The second end portion 27 is arranged so as to face the first end portion 25.

[0021] As shown in FIG. 3, a first virtual plane P1 passing through the first end portion 25 and a second virtual plane P2 passing through the second end portion 27 overlap with the camshaft 11. The first virtual plane P1

is parallel to the center axis Ax1. The extension of the center axis Ax1 of the camshaft 11 is positioned between the first virtual plane P1 and the first depressed portion 26. In other words, the first virtual plane P1 is positioned upward from the center axis Ax1. That is to say, the first end portion 25 is arranged upward from the center axis Ax1. The second virtual plane P2 is parallel to the center axis Ax1. The second virtual plane P2 is positioned upward from the center axis Ax1. That is to say, the second end portion 27 is positioned upward from the center axis Ax1. Note that FIG. 3 shows the condition in which the water pump 3 is removed, and to facilitate ease of understanding the mounting member 6 is partially omitted.

[0022] As shown in FIG. 1, the water pump 3 is arranged along the direction of the center axis Ax1 of the camshaft 11. The water pump 3 is driven by the rotations of the camshaft 11, causing the cooling liquid of the engine 1 to circulate. The water pump 3 includes a water pump housing 31 and a water pump drive shaft 32.

[0023] The water pump housing 31 accommodates the water pump drive shaft 32. The water pump housing 31 includes a first cylindrical portion 33 and a second cylindrical portion 34. The outer diameter of the second cylindrical portion 34 is greater than the outer diameter of the first cylindrical portion 33.

[0024] The water pump drive shaft 32 is arranged coaxially with the camshaft 11. The water pump drive shaft 32 is rotatably supported in the first cylindrical portion 33 via a bearing 35. A locking projection 36 is disposed at one end of the water pump drive shaft 32. With the water pump 3 in the condition of being installed to the cylinder head 4, the locking projection 36 engages with a groove portion 110 at the tip of the camshaft 11. In this way, the rotations of the camshaft 11 are conveyed to the water pump drive shaft 32. An impeller 37 is installed at the other end of the water pump drive shaft 32. The impeller 37 is accommodated in the second cylindrical portion 34.

[0025] As shown in FIG. 2, the water pump housing 31 includes an intake port 38 and a discharge port 39. The intake port 38 and the discharge port 39 are connected to the second cylindrical portion 34 and link to the internal space of the second cylindrical portion 34. The intake port 38 is connected to a radiator via a cooling liquid hose not shown in the drawing. The discharge port 39 is connected to an intake opening 40 of a cooling liquid passage disposed in the cylinder head 4. The discharge port 39 is connected to the intake opening 40 via an O-ring 41.

[0026] The water pump 3 is attached to a side wall 42 of the cylinder head 4. The water pump housing 31 includes a plurality of fixed portions for installing the water pump 3 to the cylinder head 4. In this embodiment, the water pump housing 31 includes a first pump side fixed portion 43 and a second pump side fixed portion 44. As shown in FIG. 3, the side wall 42 of the cylinder head 4 includes a first cylinder side fixed portion 45 and a second cylinder side fixed portion 46. The first pump side fixed portion 43 and the second pump side fixed portion 44 are arranged in positions corresponding, respectively, to the first cylinder side fixed portion 45 and the second cylinder side fixed portion 46.

[0027] The first cylinder side fixed portion 45 and the second cylinder side fixed portion 46 are arranged proximal to the first end portion 25. More specifically, the first cylinder side fixed portion 45 and the second cylinder side fixed portion 46 are, in the upward-downward direction, positioned between the bottom of the first depressed portion 26 and the first end portion 25. At least a part of the first cylinder side fixed portion 45 is arranged at a height overlapping the camshaft 11. At least a part of the second cylinder side fixed portion 46 is arranged at a height overlapping the camshaft 11.

[0028] The side wall 42 of the cylinder head 4 includes a third cylinder side fixed portion 47. The third cylinder side fixed portion 47 is arranged proximal to the above-mentioned intake opening 40 of the cooling liquid passage. As shown in FIG. 2, the water pump housing 31 includes a third pump side fixed portion 48. The third cylinder side fixed portion 47 is arranged in position corresponding to the third pump side fixed portion 48.

[0029] As shown in FIG. 2, the first pump side fixed portion 43, the second pump side fixed portion 44, and the third pump side fixed portion 48 are secured, respectively, by the bolts 49a, the 49b and the 49c to, respectively, the first cylinder side fixed portion 45, the second cylinder side fixed portion 46, and the third cylinder side fixed portion 47.

[0030] A fixed portion for attaching the water pump 3 is not provided in the cylinder head cover 5. That is to say, the water pump 3 is secured to the cylinder head 4 but is not secured to the cylinder head cover 5. For this reason, with the water pump 3 in the condition of being secured to the cylinder head 4, the cylinder head cover 5 can be detached from the cylinder head 4. Further, with the water pump 3 in the condition of being secured to the cylinder head 4, the cylinder head cover 5 can be installed on the cylinder head 4.

[0031] As shown in FIG. 2 and FIG. 3, the mounting member 6 is arranged between the end portion of the cylinder head 4 and the end portion of the cylinder head cover 5. With the cylinder head cover 5 secured to the cylinder head 4, the mounting member 6 is held sandwiched between the end portion of the cylinder head 4 and the end portion of the cylinder head cover 5.

[0032] The mounting member 6 includes a gasket 51 and a collar member 52. The gasket 51 is a member for sealing between the cylinder head 4 and the cylinder head cover 5. The gasket 51, can be made for example, of rubber, however it is also suitable for the gasket 51 to be formed of a sealing material other than rubber. The collar member 52 has a tubular form, and is a member for supporting the water pump 3. The first cylindrical portion 33 of the water pump 3 is inserted into an opening in the collar member 52. A groove 330 is formed in the circumferential direction in the outer peripheral surface of the first cylindrical portion 33, an O-ring 331 fitted neatly therein. Between the inner peripheral surface of the

collar member 52 and the outer peripheral surface of the first cylindrical portion 33 is sealed by the O-ring 331. The collar member 52 is formed of a metal such as for example, iron or aluminum, however it is also suitable for the collar member 52 to be formed of another material such as a resin.

[0033] The gasket 51 includes a ring portion 53 and a main body 54. The ring portion 53 is of circular form, and is arranged between the first depressed portion 26 and the second depressed portion 28. The main body 54 is arranged between the first end portion 25 of the cylinder head 4 and the second end portion 27 of the cylinder head cover 5. The collar member 52 is inserted into the opening of the ring portion 53. The ring portion 53 is integrated with the collar member 52. In this embodiment, the ring portion 53 is integrated with the collar member 52 by welding, however it is also suitable for the ring portion 53 to be integrated with the collar member 52 by a securing means such as adhesion or the like.

[0034] FIG. 4 is a plan view of the mounting member 6. FIG. 5 is a drawing showing the mounting member 6 viewed along the direction of the center axis of the collar member 52. As shown in FIG. 4 and FIG. 5, the gasket 51 has an endless form corresponding to the end portion of the cylinder head cover 5 and the end portion of the cylinder head 4. FIG. 6 provides a cross-sectional view along VI-VI in FIG. 5. FIG. 7 provides a cross-sectional view along VII-VII in FIG. 4. Note that in FIG. 6 and FIG. 7 the cross-sections of the cylinder head 4 and the cylinder head cover 5 are shown in two-dot chain lines.

[0035] As shown in FIG. 6, the collar member 52 includes a tubular portion 55, and a flange portion 56 projecting outward in the radial direction of the tubular portion 55. The collar member 52 has an L shape cross-sectional form, formed by the tubular portion 55 and the flange portion 56. The outer diameter of the flange portion 56 is greater than the inside diameter of the first depressed portion 26 and the second depressed portion 28. The outer diameter of the tubular portion 55 is smaller than the inside diameter of the first depressed portion 26 and the second depressed portion 28. The tubular portion 55 is positioned between the first depressed portion 26 and the second depressed portion 28.

[0036] The tubular portion 55, being inserted in the opening of the ring portion 53, is supported by the first depressed portion 26 and the second depressed portion 28 via the ring portion 53. The tubular portion 55 extends linearly along the direction of the center axis Ax2 of the collar member 52. The length of the tubular portion 55 in the direction of the center axis Ax2 of the collar member 52 is greater than the length of the ring portion 53 in the direction of the center axis Ax2 of the collar member 52. For this reason, the end portion 550 of the tubular portion 55 projects beyond the ring portion 53. Note that the collar member 52 is arranged coaxially with the camshaft 11. Accordingly, the direction of the collar member 52 along the center axis Ax2 matches the direction of the camshaft 11 along the center axis Ax1.

[0037] The ring portion 53 includes a first ring portion 57 supported by the first depressed portion 26, and a second ring portion 58 supported by the second depressed portion 28. The ring portion 53 has an annular shape integratedly formed by the first ring portion 57 and the second ring portion 58.

[0038] The first ring portion 57 includes a first external projection 571, a first internal projection 572, and a first ring groove 573. The first ring groove 573 is arranged between the first external projection 571 and the first internal projection 572. The first depressed portion 26 includes a first outer wall portion 261 and a first inner wall portion 262. The first ring portion 57 is installed in the first depressed portion 26, the shape of the first external projection 571 of the first ring portion 57 adapting to fit when pressed into the first depressed portion 26, thereby sealing between the first ring portion 57 and the first depressed portion 26. The first outer wall portion 261 is arranged between the flange portion 56 and the first external projection 571. The first inner wall portion 262 is positioned inside the first ring groove 573.

[0039] The second ring portion 58 includes a second external projection 581, a second internal projection 582, and a second ring groove 583. The second ring groove 583 is arranged between the second external projection 581 and the second internal projection 582. The second depressed portion 28 includes a second outer wall portion 281, a second inner wall portion 282, and a second groove portion 283. The second groove portion 283 is arranged between the second outer wall portion 281 and the second inner wall portion 282. The second external projection 581 of the second ring portion 58 being fitted into the second groove portion 283 installs the second ring portion 58 in the second depressed portion 28. The second outer wall portion 281 is arranged between the flange portion 56 and the second external projection 581. The second inner wall portion 282 is arranged in the second ring groove 583. Note that the thickness t1 in the radial direction of the first external projection 571 is less than the thickness t2 in the radial direction of the second external projection 581.

[0040] As shown in FIG. 7, the main body 54 of the gasket 51 includes a third external projection 541, a third internal projection 542, and a third groove portion 543. The third external projection 541, the third internal projection 542, and the third groove portion 543 are provided on the surface (lower surface) in the cylinder head 4 side of the main body 54. The third groove portion 543 is arranged between the third external projection 541 and the third internal projection 542. The first end portion 25 being fitted into the third groove portion 543 installs the main body 54 at the first end portion 25.

[0041] The main body 54 of the gasket 51 includes a fourth external projection 544. The fourth external projection 544 is provided on the surface (upper surface) of the cylinder head cover 5 side of the main body 54. The fourth external projection 544 being fitted into a groove portion 271 of the second end portion 27, installs the

main body 54 at the second end portion 27.

[0042] With the engine 1 according to this embodiment of the present invention, in the condition in which the water pump 3 is installed to the cylinder head 4 via the collar member 52, the cylinder head cover 5 can be detached. Further, installing the water pump 3 to or removing the water pump 3 from the collar member 52, enables the water pump 3 to be installed or removed in the condition in which the cylinder head cover 5 is installed on the cylinder head 4. This facilitates superior serviceability.

[0043] The space between the first end portion 25 of the cylinder head 4 and the second end portion 27 of the cylinder head cover 5 is sealed by the main body 54 of the gasket 51. Further, the space between the collar member 52 and the first depressed portion 26 and the space between the collar member 52 and the second depressed portion 28 are sealed by the ring portion 53 of the gasket 51. Moreover, the ring portion 53 forming an integrated body with the collar member 52 enables the number of parts to be reduced. Accordingly sealing ability can be improved in a simple structure.

[0044] The ring portion 53 is integrated with the collar member 52 by welding. For this reason, the ring portion 53 and the collar member 52 are able to form a strong integrated body.

[0045] The flange portion 56 is installed at one end of the tubular portion 55 of the collar member 52. For this reason, when removing the water pump 3 from the collar member 52, or, when installing the water pump 3 in the collar member 52, positional displacement of the gasket 51 can be suppressed by the flange portion 56. No flange is provided at the other end of the tubular portion 55 of the collar member 52. For this reason in comparison to the case in which a flange is provided at both ends of the tubular portion 55, formation of a gap can be eliminated between the flange and the cylinder head 4 or the cylinder head cover 5. This enables a reduction in the accumulation of oil or foreign substances in that gap.

[0046] The first virtual plane P1 through the first end portion 25 of the cylinder head 4 is positioned further upward than the center axis Ax1 of the camshaft 11. For this reason, as the first cylinder side fixed portion 45 and the second cylinder side fixed portion 46 are arranged proximal to the first end portion 25 of the cylinder head 4, the first cylinder side fixed portion 45 and the second cylinder side fixed portion 46 can be arranged more toward the center axis Ax1 of the camshaft 11. Accordingly, with fixed portions provided on the cylinder head 4 only, the water pump 3 can be stably installed. Further, providing fixed portions on the cylinder head 4 only enables the water pump 3 to be installed and removed with ease, realizing further improved serviceability.

[0047] Although the invention has been described above by reference to an embodiment thereof, the invention is not limited to the embodiment described above. It is therefore understood that numerous modifications and variations can be devised without departing from the scope of the invention.

[0048] The cross-section of the collar member 52 is not restricted to the above-described letter L-shape form. For example, as shown in FIG. 8, it is suitable for the collar member 52 to include the tubular portion 55, a first flange portion 56a projecting outward in the radial direction of the tubular portion 55, and a second flange portion 56b projecting outward in the radial direction of the tubular portion 55. The outer diameters of the first flange portion 56a and the second flange portion 56b are the same. In this case, the ring portion 53 is arranged, in the center axis direction of the collar member 52, between the first flange portion 56a and the second flange portion 56b.

[0049] Again, as shown in FIG. 9, it is suitable for the outer diameter of the second flange portion 56b to be smaller than the outer diameter of the first flange portion 56a. It is suitable for the length of the tubular portion 55 in the center axis direction of the collar member 52 to be shorter than the length, in the center axis direction of the collar member 52, of the first cylindrical portion 33. In this case, it is suitable for the ring portion 53 to be arranged overlapping with the second flange portion 56b.

[0050] Moreover, as shown by the broken line in FIG. 9, it is suitable for the length of the tubular portion 55 in the center axis direction of the collar member 52 to be longer than the length, in the center axis direction of the collar member 52, of the first cylindrical portion 33. Further, it is suitable for the ring portion 53 to be arranged between the first flange portion 56a and the second flange portion 56b.

[0051] The fixed portions for installing the water pump 3 to the cylinder head 4 are not limited to the first-third cylinder side fixed portions 45 to 47 as in the above-described embodiment. It is suitable for the number of fixed portions to be two or less, again, it is suitable for the number of fixed portions to be four or more.

Claims

1. An engine (1) comprising:

a camshaft (11) including an intake cam (18) and an exhaust cam (19);
a water pump (3) arranged along the axial direction of the camshaft (11);
a cylinder head (4) supporting the camshaft (11);
a cylinder head cover (5) installed on the cylinder head (4); and
a mounting member (6) arranged between an end portion of the cylinder head (4) and an end portion of the cylinder head cover (5);
wherein the end portion of the cylinder head (4) includes a first end portion (25) and a first depressed portion (26) depressed in a circular arc shape from the first end portion (25),
the end portion of the cylinder head cover (5) includes a second end portion (27) and a second

depressed portion (28) depressed in a circular arc shape from the second end portion (27),
a first virtual plane (P1) passing through the first end portion (25) and a second virtual plane (P2) passing through the second end portion (27) overlap with the camshaft (11), and
the mounting member (6) includes:

a gasket (51) including a ring portion (53) of circular form arranged between the first depressed portion (26) and the second depressed portion (28) and a main body (54) arranged between the first end portion (25) and the second end portion (27); and
a collar member (52) in which the water pump (3) is installed, the collar member (52) having a tubular shape, the collar member (52) being inserted in an opening of the ring portion (53), and
the ring portion (53) is integrated with the collar member (52).

2. The engine (1) according to claim 1, wherein the ring portion (53) is integrated with the collar member (52) by welding.

3. The engine (1) according to either of claim 1 or claim 2, wherein the collar member (52) includes a tubular portion (55), and a flange portion (56) projecting outward in the radial direction of the tubular portion (55).

4. The engine (1) according to any of the claims 1 to 3, wherein the collar member (52) has, in the cross-sectional form thereof, a letter L shape formed by the tubular portion (55) and the flange portion (56).

5. The engine (I) according to any of the claims 1 to claim 3,
wherein the collar member (52) includes a tubular portion (55), a first flange portion (56a) projecting outward in the radial direction of the tubular portion (55), and a second flange portion (56b) projecting outward in the radial direction of the tubular portion (55), and
the ring portion (53) is arranged between the first flange portion (56a) and the second flange portion (56b), in the direction of the axis of the collar member (52).

6. The engine (1) according to any of the claims 1 to 5, wherein an extension of the center axis of the camshaft (11) is positioned between the first virtual plane (P1) and the first depressed portion (26), and
the cylinder head (4) further includes a fixed portion (45) to which the water pump (3) is attached, the fixed portion (45) being arranged adjacent to the first end portion (25).

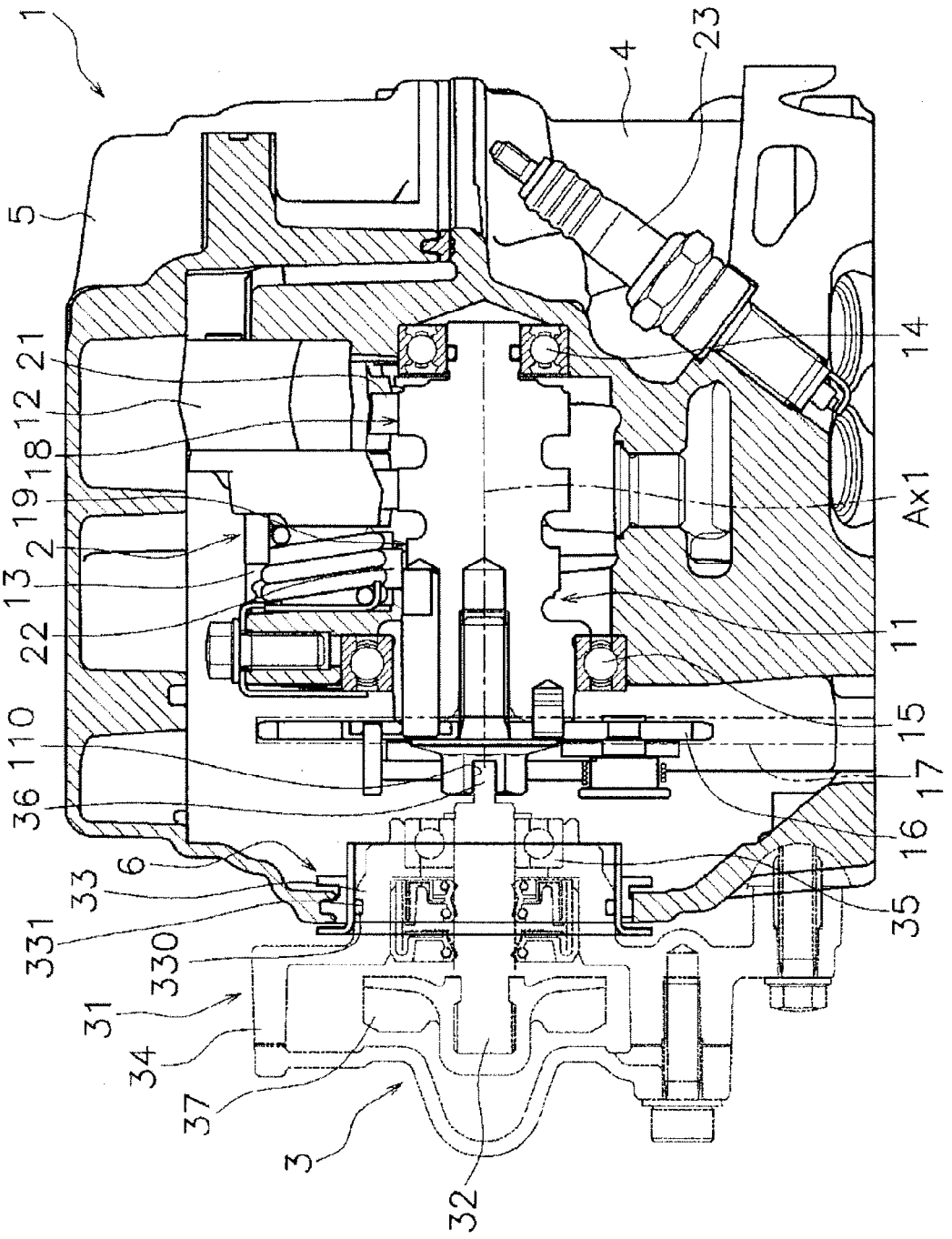
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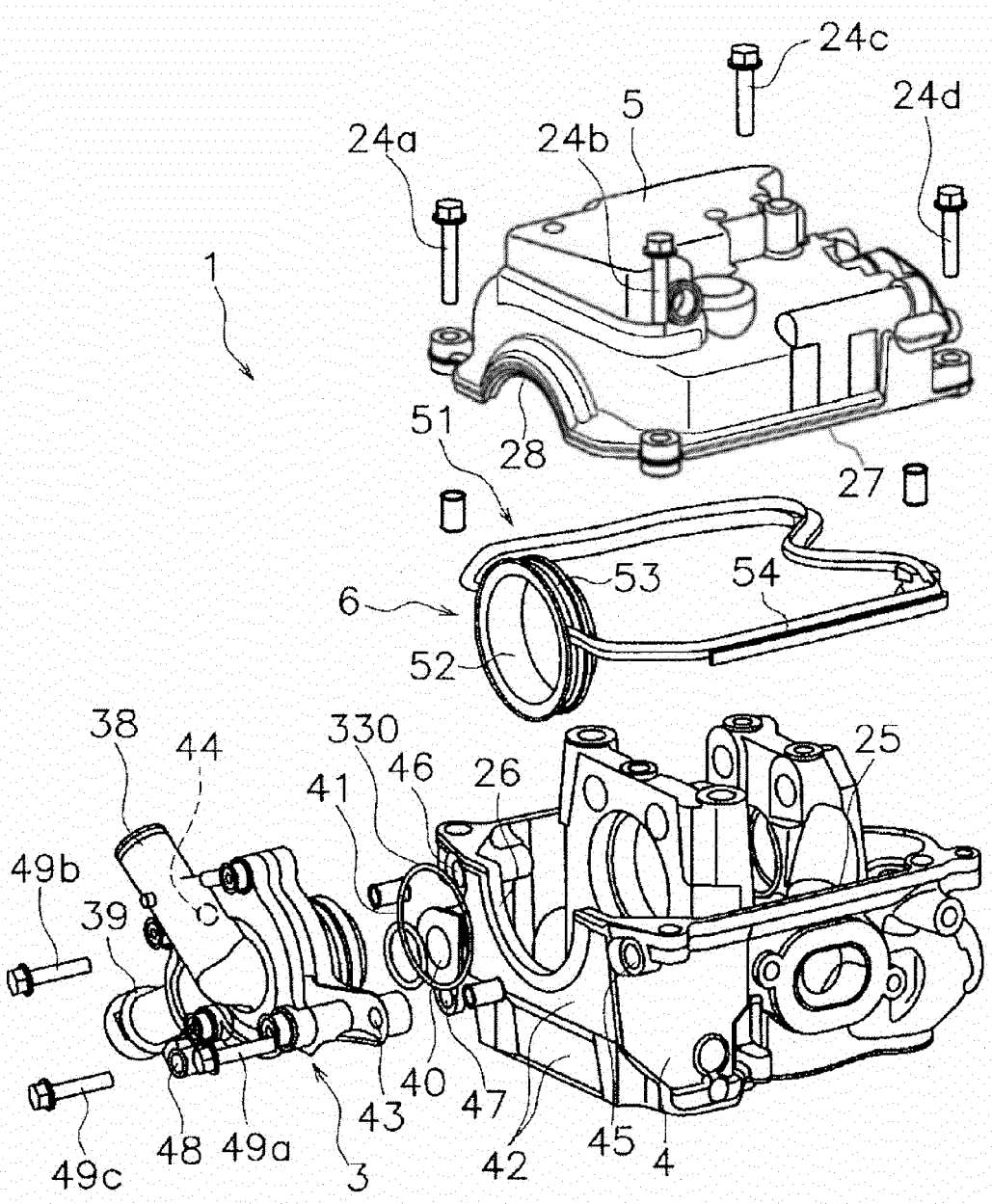
FIG. 1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49c

FIG. 2

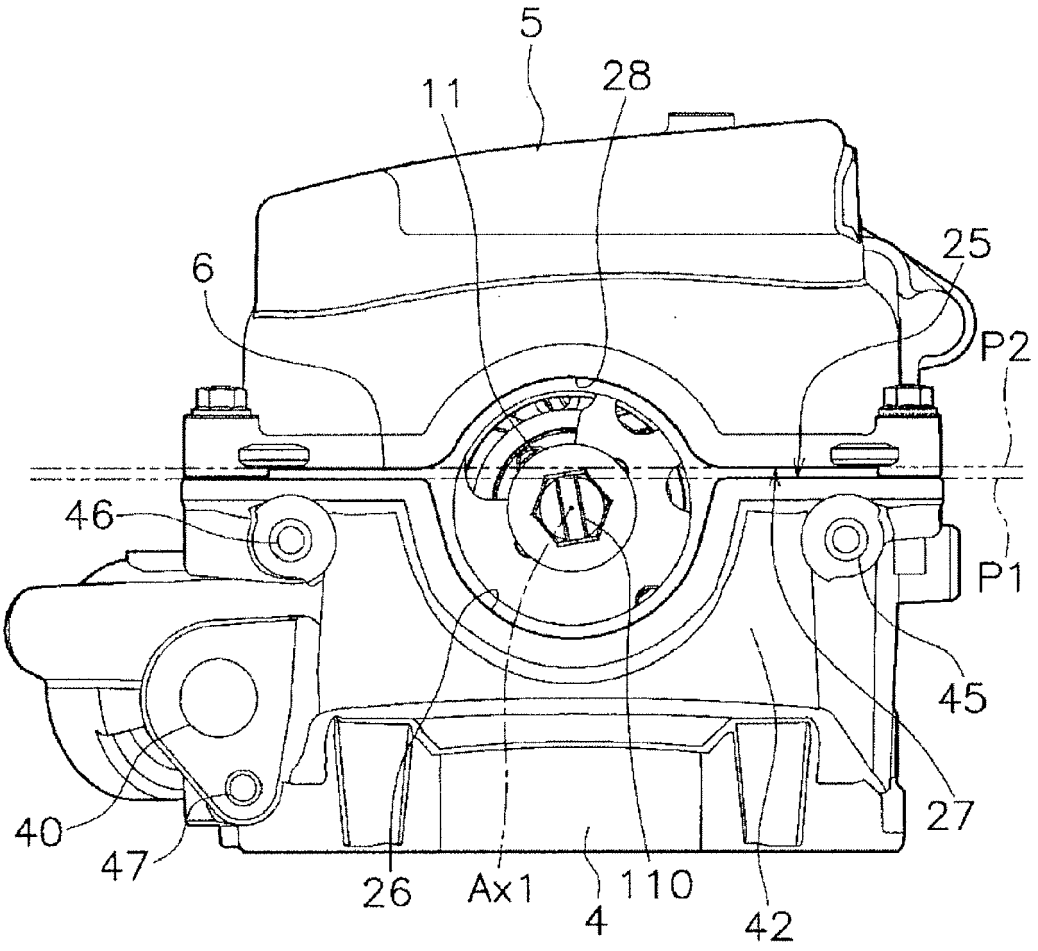


FIG. 3

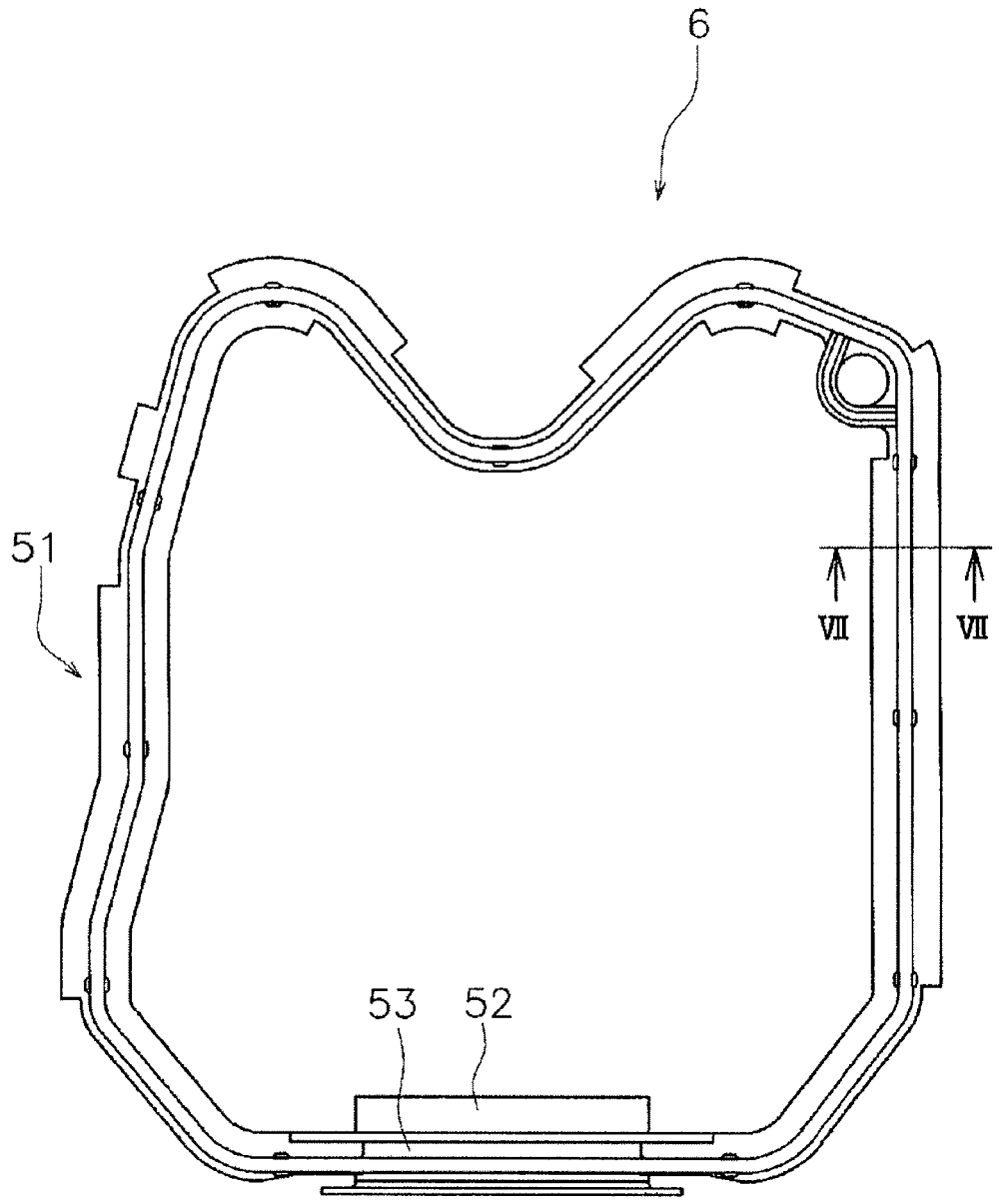


FIG. 4

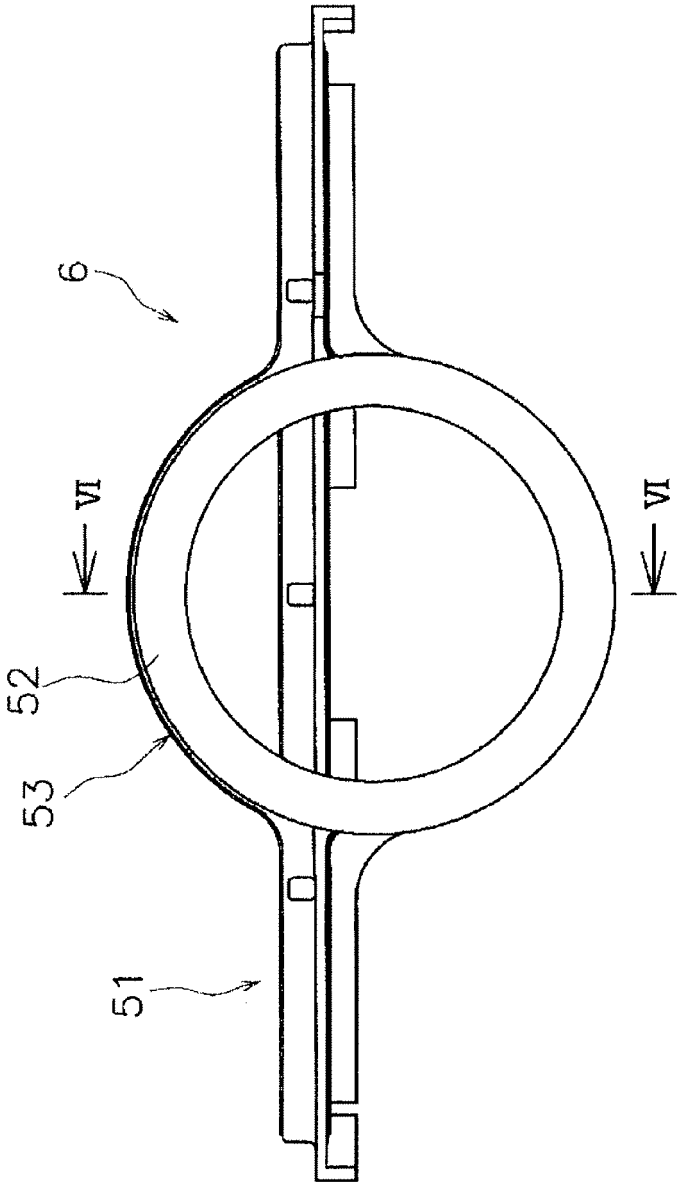
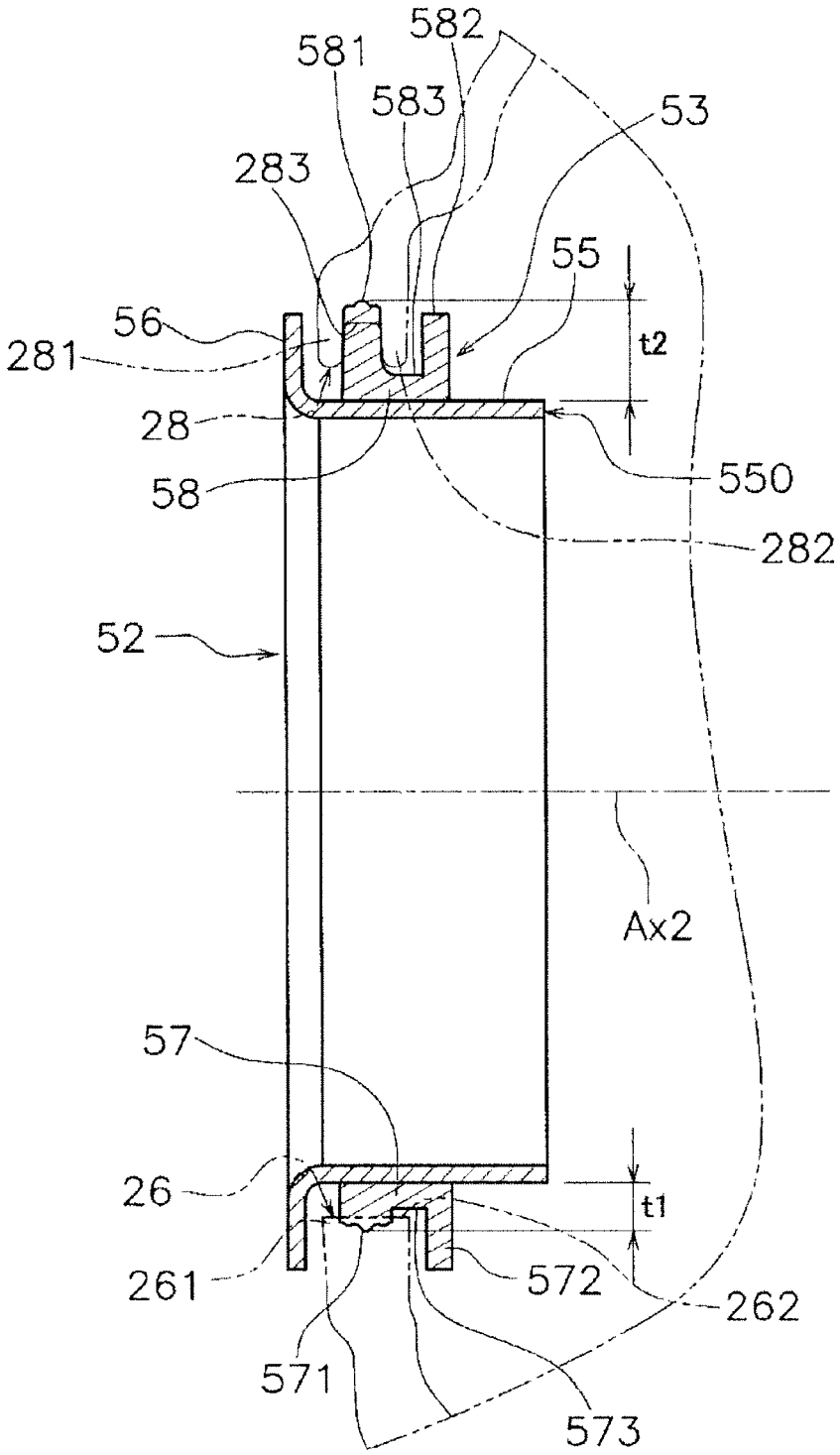


FIG. 5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262
571
573

FIG. 6

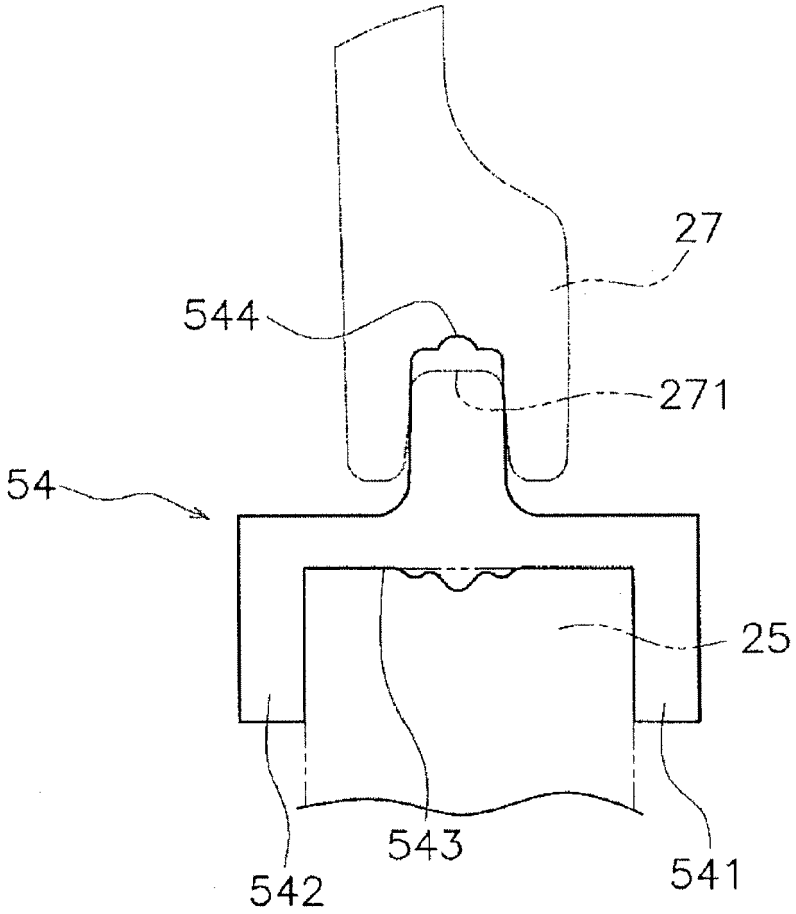

FIG. 7

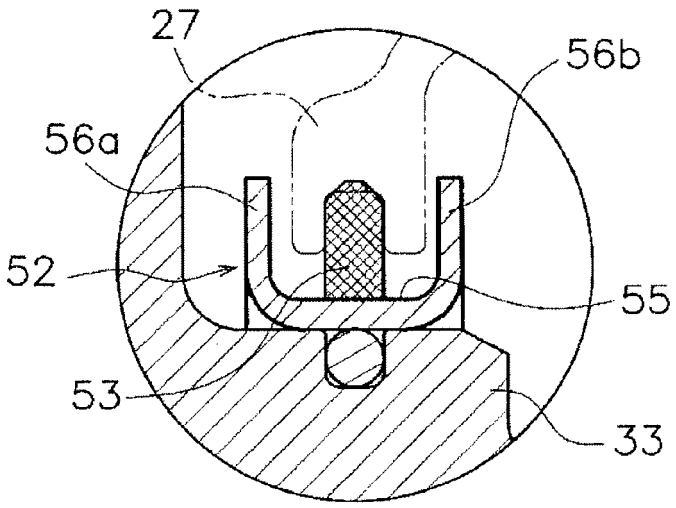

FIG. 8

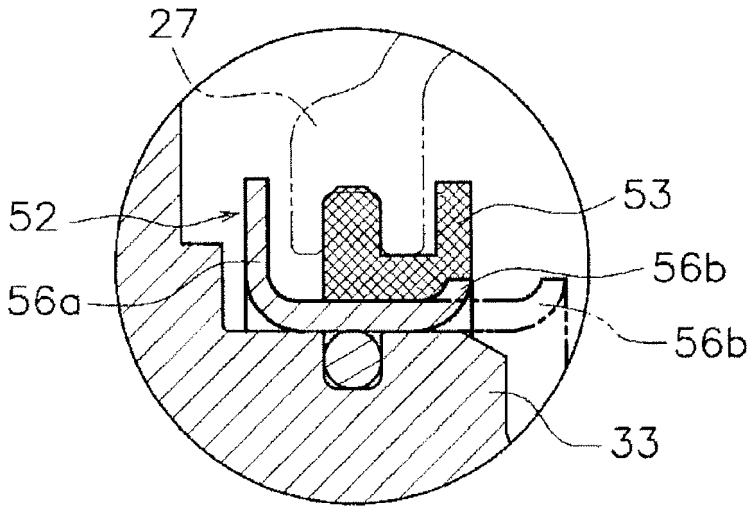

FIG. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 13 19 1018

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F01P
F02F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 November 2013	Luta, Dragos

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