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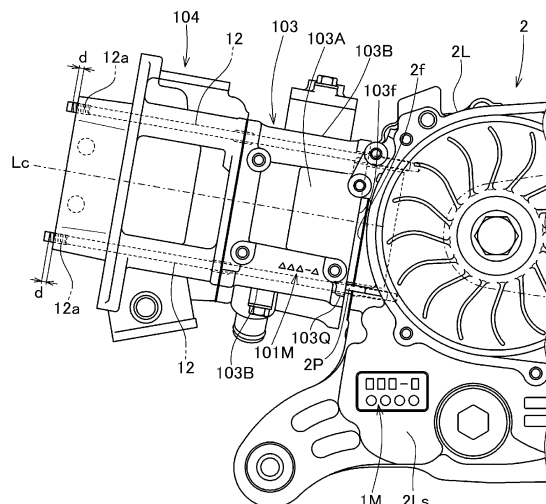
(54) **MISASSEMBLY PREVENTION STRUCTURES FOR INTERNAL COMBUSTION ENGINE**

(57) An misassembly prevention structure for an internal combustion engine that prevents misassembly of a part of a different internal combustion engine model is provided.

The present misassembly prevention structure for an internal combustion engine is a structure wherein a one part 2 of the parts contacting each other constituting a first internal combustion engine 1 has an abutting interference portion 2P formed by extending outwardly a part of a peripheral wall 2A having a mating surface 2f as an end face so as to project in a vertical direction from

the mating surface 2f while another part 3 does not have an abutted interference portion to be abutted formed at a portion opposite to the abutting interference portion 2P of the one part 2, and another part 103 of parts contacting each other constituting a second internal combustion engine 101 different from the first internal combustion engine 1 has an abutted interference portion 103Q to be abutted formed at a portion opposite to said abutting interference portion 2P of the one part 2 of the first internal combustion engine 1.

Fig.15



Description

[Technical Field]

[0001] The present invention relates to a structure for preventing misassembly of parts contacting each other at mating surfaces constituting an internal combustion engine.

[Background Art]

[0002] In order to enhance the ease of assembly between parts of such parts of the internal combustion engine, there is an example in which fitting portions of the parts have shapes different from each other to prevent misassembly. (see, for example, Patent Document 1).

[Prior Art Document]

[Patent Document]

[0003] [Patent Document 1]
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[0004] Patent Document 1 discloses a structure for an internal combustion engine in which a skirt portion projecting from a joining surface (mating surface) of a cylinder block is fitted into a skirt portion fitting hole of a crankcase to assemble the cylinder block to the crankcase with the joining surfaces of them joined to each other with a gasket interposed therebetween, the structure being such that, a pair of projection portions having shapes different from each other are provided on an outer periphery of the skirt portion of the cylinder block while a pair of recess portions having shapes different from each other and configured to individually engage with the projection portions are provided in the skirt portion insertion hole of the crankcase.

[0005] Since the projection portions having shapes different from each other are formed on the skirt portion of the cylinder block and the recess portions having shapes different from each other for individually engaging with the projection portions are formed in the skirt portion insertion hole, they can be assembled to each other in correct postures of them, and even if it is tried to join them in an erroneous postures rotated by 180 degrees from each other, the projection portions and the recess portions cannot be engaged with each other, and therefore, misassembly can be prevented.

[Summary of the Invention]

[Underlying Problem to be solved by the Invention]

[0006] An internal combustion engine is formed in a specific model from its structure, external form and so forth.

[0007] The misassembly prevention structure disclosed in Patent Document 1 prevents, only in an assem-

bly of a crankcase and a cylinder block of a same model of an internal combustion engine, that the crankcase and the cylinder block are assembled in wrong assembly postures to each other.

[0008] Parts of internal combustion engines of models different from each other cannot be prevented from being assembled to each other in error.

[0009] For example, if one of the internal combustion engines is the internal combustion engine according to Patent Document 1 and has a pair of recess portions of different shapes from each other in the skirt portion insertion hole of the crankcase and, a skirt portion of a cylinder head of the internal combustion engine of the other model has an outer diameter equal to the inner diameter of the skirt portion insertion hole of the crankcase described above, but the skirt portion does not have projection portions, then the cylinder block is fitted with and assembled in error to the crankcase.

[0010] Since the projection portions of the skirt portion of the cylinder block and the recess portions of the skirt portion insertion hole of the crankcase are all provided on the inner side of the mating surfaces of the cylinder block and the crankcase, they are inconspicuous, and therefore, there is the possibility that, without sufficient confirmation by visual inspection, the cylinder block of the internal combustion engine of the different model may be assembled in error to the crankcase.

[0011] The present invention has been made in view of such a point as described above, and it is an object of the present invention to provide a misassembly prevention structure for an internal combustion engine that prevents misassembly of parts of internal combustion engines of different models.

[Means to solve the Problem]

[0012] In order to attain the object described above, the misassembly prevention structure for an internal combustion engine according to the present invention is a misassembly prevention structure for an internal combustion engine, preventing misassembly of parts constituting an internal combustion engine contacting each other at mating surfaces opposite to each other. In the misassembly prevention structure, a one part of the parts contacting each other constituting a first internal combustion engine (1) has an abutting interference portion formed by extending outwardly a part of a peripheral wall having a mating surface as an end face so as to project in a vertical direction from the mating surface while another part does not have an abutted interference portion to be abutted formed at a portion opposite to the abutting interference portion of the one part, and another part of parts contacting each other constituting a second internal combustion engine different from the first internal combustion engine has an abutted interference portion to be abutted formed at a portion opposite to the abutting interference portion of the one part of the first internal combustion engine.

[0013] According to this structure, in an internal combustion engine of a same model, since the one part of parts contacting each other at mating surfaces has the abutting interference portion formed by extending outwardly the part of the peripheral wall having the mating surface as an end face so as to project in a vertical direction from the mating surface while the other part does not have the abutted interference portion to be abutted at a portion opposite to the abutting interference portion of the one part, the one part and the other part do not interfere with each other at the abutting interference portion and can be assembled to each other with the mating surfaces of them mated with each other.

[0014] However, since the one part of parts contacting each other at mating surfaces has the abutting interference portion formed by extending outwardly a part of the peripheral wall having the mating surface as an end face so as to project in a vertical direction from the mating surface, and the other part of parts contacting each other constituting the second internal combustion engine different from the first internal combustion engine has the abutted interference portion to be abutted formed at a portion opposite to the abutting interference portion of the one part of the first internal combustion engine, if it is tried to assemble the one part of the first internal combustion engine and the other part of the second internal combustion engine to each other, then the abutting interference portion projecting in the vertical direction from the mating surface of the one part abuts on and interferes with the abutted interference portion of the other part and the mating surfaces cannot be mated with each other with an air gap produced between therebetween, and therefore, it can be recognized that the assembly is misassembly and such misassembly is prevented.

[0015] Further, since the abutting interference portion of the one part of the first internal combustion engine is provided by extending outwardly a part of the peripheral wall having the mating surface as an end face so as to project in the vertical direction from the mating surface and the abutted interference portion of the other part of the second internal combustion engine is provided at the portion opposite to the abutting interference portion, both of the abutting interference portion and the abutted interference portion are formed projecting at opposite positions of the outer surfaces of the parts, and therefore, the abutting interference portion and the abutted interference portion are conspicuous. Consequently, it is easy to discriminate by visual inspection before assembly whether or not the assembly is misassembly, and such misassembly can be prevented.

[0016] In the configuration described above, the mating surface of the one part of the first internal combustion engine may be a milled surface while a surface of the abutting interference portion may be a material surface.

[0017] According to this configuration, since the mating surface of the one part of the first internal combustion engine is a milled surface while the surface of the abutting interference portion formed by extending outwardly a part

of the peripheral wall (2A) having the mating surface (2F) as an end face is a material surface, it is easier to recognize the abutting interference portion by visual inspection from the difference in surface from the mating surface, and misassembly can be prevented.

[0018] In the configuration described above, the parts contacting each other may be a crankcase and a cylinder block, the abutting interference portion may be provided on the crankcase of the first internal combustion engine, and the abutted interference portion may be provided on the cylinder block of the second internal combustion engine.

[0019] According to this configuration, since the abutting interference portion is provided on the crankcase of the first internal combustion engine and the abutted interference portion is provided on the cylinder block of the second internal combustion engine, the abutting interference portion projecting in the vertical direction from the mating surface of the crankcase of the first internal combustion engine abuts on and interferes with the abutted interference portion of the cylinder block of the second internal combustion engine and the mating surfaces cannot be mated with each other with an air gap produced therebetween, and consequently, it can be recognized readily that the assembly is misassembly and such misassembly is prevented.

[0020] Further, since the abutting interference portion of the crankcase is formed by extending outwardly a part of the peripheral wall having the mating surface as an end surface so as to project in the vertical direction from the mating surface, the abutting interference portion stands out well and it is easy to check by visual inspection before assembly whether or not the assembly may become misassembly, and such misassembly can be prevented.

[0021] In the configuration described above, the cylinder block and a cylinder head may be placed on and fastened to the crankcase by one or more than one fastening bolts, and the abutting interference portion may be formed so as to extend outwardly from a threaded hole boss portion of a threaded hole for the fastening bolt, the threaded hole being formed so as to have an opening at the mating surface of the crankcase.

[0022] According to this configuration, since the abutting interference portion is formed so as to extend outwardly from the threaded hole boss portion of the threaded hole of the fastening bolt, the threaded hole being formed so as to have an opening at the mating surface of the crankcase, the abutting interference portion is easy to be found, which enhances the discrimination, and the rigidity of the abutting interference portion can be enhanced.

[0023] In the configuration described above, the abutting interference portion may be formed continuously to a reinforcement wall formed on a side wall continuous to the peripheral wall having the mating surface of the crankcase as an end face.

[0024] According to this configuration, since the abut-

ting interference portion is formed continuously to the reinforcement wall formed on the side wall continuous to the peripheral wall having the mating surface of the crankcase as an end face, the rigidity of the abutting interference portion can be enhanced further.

[0025] In the configuration described above, the abutted interference portion may be formed so as to extend outwardly from an insertion hole boss portion of a bolt insertion hole for the fastening bolt, the bolt insertion hole being formed so as to have an opening at a mating surface of the cylinder block.

[0026] According to this configuration, since the abutted interference portion is formed so as to extend outwardly from the insertion hole boss portion of the bolt insertion hole for the fastening bolt, the bolt insertion hole being formed so as to have the opening at the mating surface of the cylinder block, it is easy to find the abutted interference portion, which enhances the discrimination, and the rigidity of the abutted interference portion can be enhanced.

[0027] In the configuration described above, an identification mark of the second internal combustion engine is provided in a vicinity of the abutted interference portion on the peripheral wall having the mating surface of the cylinder block as an end face.

[0028] According to this configuration, since the identification mark of the second internal combustion engine is provided in the vicinity of the abutted interference portion on the peripheral wall having the mating surface of the cylinder block as an end face, the abutted interference portion can be found easily by using the identification mark as a clue, and the discrimination is enhanced and misassembly can be prevented.

[0029] In addition, it is possible to confirm that the cylinder block is the cylinder block of the second internal combustion engine by the identification mark itself, and misassembly can be prevented.

[0030] In the configuration described above, the fastening bolt may be a stud bolt, and when the cylinder block and the cylinder head of the second internal combustion engine are placed on the crankcase of the first internal combustion engine, the abutting interference portion of the crankcase may abut on and interfere with the abutted interference portion of the cylinder block and a length of a male threaded end portion of the stud bolt projecting from the cylinder head may be shorter than a length of a female threaded portion of a nut.

[0031] According to this configuration, since the fastening bolt is the stud bolt and, when the cylinder block and the cylinder head of the second internal combustion engine are placed on the crankcase of the first internal combustion engine, the abutting interference portion of the crankcase abuts on and interferes with the abutted interference portion of the cylinder block and the length of the male threaded end portion of the stud bolt projecting from the cylinder head is shorter than and insufficient with respect to the length of the female threaded portion of the nut, it can be recognized readily that the assembly

is misassembly, and even if the nut is screwed, since it cannot be fastened with certainty, it can be recognized apparently that the assembly is misassembly.

5 [Effects of the Invention]

[0032] In the present invention, since the one part of parts contacting each other at mating surfaces has the abutting interference portion formed by extending outwardly a part of the peripheral wall having the mating surface as an end face so as to project in a vertical direction from the mating surface, and the other part of parts contacting each other constituting the second internal combustion engine different from the first internal combustion engine has the abutted interference portion to be abutted formed at a portion opposite to the abutting interference portion of the one part of the first internal combustion engine, if it is tried to assemble the one part of the first internal combustion engine and the other part of the second internal combustion engine to each other, then the abutting interference portion projecting in the vertical direction from the mating surface of the one part abuts on and interferes with the abutted interference portion of the other part and the mating surfaces cannot be mated with each other with an air gap produced between therebetween, and therefore, it can be recognized that the assembly is misassembly and such misassembly is prevented.

[0033] Further, since the abutting interference portion of the one part of the first internal combustion engine is provided by extending outwardly a part of the peripheral wall having the mating surface as an end face so as to project in the vertical direction from the mating surface and the abutted interference portion of the other part of the second internal combustion engine is provided at the portion opposite to the abutting interference portion, both of the abutting interference portion and the abutted interference portion are formed projecting at opposite positions of the outer surfaces of the parts, and therefore, the abutting interference portion and the abutted interference portion are conspicuous. Consequently, it is easy to discriminate by visual inspection before assembly whether or not the assembly is misassembly, and such misassembly can be prevented.

45 [Brief Description of Drawings]

[0034]

FIG. 1 is a left side elevational view of a first internal combustion engine according to an embodiment of the present invention;

FIG. 2 is a sectional view of the first internal combustion engine 1 (sectional view taken along line II-II of FIG. 1);

FIG. 3 is a left side elevational view depicting a state in which a cylinder block and a cylinder head are sequentially placed on and assembled to a crank-

case;

FIG. 4 is an exploded left side elevational view depicting a state in which the cylinder block and the cylinder head are sequentially removed and disassembled from the crankcase;

FIG. 5 is a view as viewed in an arrow mark V of the cylinder block (view as viewed in the arrow mark V of FIG. 4);

FIG. 6 is a view as viewed in an arrow mark VI of the crankcase (view as viewed in the arrow mark VI of FIG. 4);

FIG. 7 is a sectional view of the crankcase (sectional view taken along line VII-VII of FIG. 5);

FIG. 8 is a partial perspective view of the crankcase;

FIG. 9 is a partial sectional view in a state in which the cylinder block is assembled to the crankcase (sectional view taken along line IX-IX of FIGS. 5 and 6);

FIG. 10 is a left side elevational view depicting a state in which a cylinder block and a cylinder head are sequentially placed on and assembled to a crankcase of a second internal combustion engine;

FIG. 11 is an exploded left side elevational view depicting a state in which the cylinder block and the cylinder head are sequentially removed and disassembled from the crankcase;

FIG. 12 is a view as viewed in an arrow mark XII of the cylinder block (view as viewed in the arrow mark XII of FIG. 11);

FIG. 13 is a view as viewed in an arrow mark XIII of the crankcase (view as viewed in the arrow mark XIII of FIG. 11);

FIG. 14 is a partial sectional view in a state in which the cylinder block is assembled to the crankcase (sectional view taken along line XIV-XIV of FIGS. 12 and 13);

FIG. 15 is a left side elevational view in a state in which it is tried to assemble the cylinder block and the cylinder head of the second internal combustion engine but erroneously to the crankcase of the first internal combustion engine; and

FIG. 16 is a partial sectional view in a state in which such misassembly is tried.

[Modes for carrying out the Invention]

[0035] In the following, an embodiment of the present invention is described with reference to FIGS. 1 to 16.

[0036] FIG. 1 is a side elevational view of a first internal combustion engine 1 according to one embodiment to which the present invention is applied.

[0037] The present first internal combustion engine 1 is mounted on a small-sized vehicle such as a motorcycle.

[0038] In FIG. 1, the present first internal combustion engine 1 is in a posture in a state in which it is mounted on a vehicle not depicted.

[0039] It is to be noted that, in the description of the

present specification, the forward, rearward, leftward and rightward directions are in accordance with the usual standard in which the straight ahead direction of the vehicle is the forward direction, and in the drawings, reference character FR indicates the forward direction, RR the rearward direction, LH the leftward direction, and RH the rightward direction.

[0040] The present first internal combustion engine 1 is a single-cylinder 4-stroke water-cooled overhead camshaft (OHC) type internal combustion engine, and a crankcase 2 of the first internal combustion engine 1 is configured by integrating a left crankcase 2L and a right crankcase 2R of the left and right split type. The right crankcase 2R forms a half of a crankcase unit and the left crankcase 2L forms, at a front portion thereof, a half of the crankcase unit but is swollen rearwardly such that it serves also as a transmission case in which a belt type continuously variable transmission 30 elongated forwardly and rearwardly is accommodated.

[0041] Substantially forwardly from the crankcase 2, the cylinder block 3, a cylinder head 4 and a head cover 5 are placed in order so as to be inclined forwardly by a great amount.

[0042] FIG. 2 is a sectional view of the first internal combustion engine 1 (sectional view taken along line II-II of FIG. 1), and referring to FIG. 2, the first internal combustion engine 1 includes a connecting rod 22 that connects a piston 21 that moves back and forth in a cylinder bore 3b on the inner side of a cylinder liner 3a of the cylinder block 3 and a crank pin 20a of a crankshaft 20 to each other.

[0043] A forwardly and rearwardly elongated left side open face of the left crankcase (transmission case) 2L is covered by a transmission case cover 8, and a belt type continuously variable transmission 30 is accommodated in the inside thereof.

[0044] In the crankcase 2 formed by integration of the front portion of the left crankcase 2L and the right crankcase 2R, the crankshaft 20 is supported by left and right main bearings 20b, 20b for rotation, and on a left extension out of extensions of the crankshaft 20 extending leftward and rightward in the horizontal direction, a centrifugal weight 32 and a driving pulley 31a of the belt type continuously variable transmission 30 are mounted.

[0045] Referring to FIG. 1, the belt type continuously variable transmission 30 is a power transmission mechanism in which a V belt 31c is stretched over the driving pulley 31a and a driven pulley 31b mounted on an input power shaft 35a of a reduction mechanism 35 arranged in a rear portion of the left crankcase (transmission case) 2L, and the transmission ratio is automatically changed by changing the wrapping diameter of the V belt 31c on the driving pulley 31a by movement of the centrifugal weight 32 in response to the engine speed, and simultaneously by changing the wrapping diameter of the driven pulley 31b, and thereby performs continuously variable speed change

[0046] Referring to FIG. 2, on a right extension of the

crankshaft 20, a driving cam chain sprocket wheel 20s and so forth are mounted, and an AC generator 25 is mounted at a right end portion.

[0047] A plurality of radiator fans 26 is formed on a right side face of an outer rotor 25r of the AC generator 25.

[0048] An outer periphery of the radiator fans 26 is generally surrounded by a shroud 27, and a radiator 28 is provided on the right side of the radiator fans 26 and is supported by the shroud 27. The radiator 28 is covered by a radiator cover 9 with louvers.

[0049] The present first internal combustion engine 1 adopts a single overhead camshaft (SOHC) type 4-valve system, and the cylinder block 3 and the cylinder head 4 are fastened to the crankcase 2 by four stud bolts 12 extending in a cylinder axial line (center axial line of the cylinder liner 3a) Lc direction and nuts 13. A valve train mechanism 40 is provided on the cylinder head 4 (FIG. 2).

[0050] A cam chain 42 transmitting power to the valve train mechanism 40 extends between a camshaft 41 and the crankshaft 20. For this, cam chain chambers 2c, 3c and 4c are provided in a communicating relationship with the right crankcase 2R, the cylinder block 3 and the cylinder head 4 (refer to FIG. 2).

[0051] That is, the cam chain 42 extends between a driven cam chain sprocket wheel 41s fitted at a right end of the camshaft 41 extending leftward and rightward in the horizontal direction and the driving cam chain sprocket wheel 20s fitted on the crankshaft 20 through the inside of the cam chain chambers 2c, 3c and 4c.

[0052] FIG. 3 is a left side elevational view depicting a state in which the cylinder block 3 and the cylinder head 4 are stacked sequentially on the crankcase 2 and fastened by the stud bolts 12. FIG. 4 is an exploded left side elevational view depicting a state in which the cylinder block 3 and the cylinder head 4 are sequentially disassembled and moved in the cylinder axial line Lc direction from the crankcase 2.

[0053] A gasket 10 is sandwiched between mating surfaces 2f and 3f of the crankcase 2 and the cylinder block 3.

[0054] It is to be noted that a gasket 11 is sandwiched also between mating surfaces 3g and 4g of the cylinder block 3 and the cylinder head 4.

[0055] FIG. 5 is a view of the cylinder block 3 as viewed in an arrow mark V in FIG. 4 and is a view of the cylinder block 3 as viewed from the mating surface 3f with the crankcase 2.

[0056] It is to be noted that, in the drawings, a dotted pattern is given to the mating surface 3f.

[0057] Referring to FIGS. 5 and 4, the cylinder block 3 projects, at a cylindrical portion thereof to which the cylinder liner 3a is lined up, from the mating surface 3f with the crankcase 2 to form a skirt portion 3S.

[0058] Referring to FIG. 5, the cam chain chamber 3c of a rectangular shape is formed on the right side (RH) of the cylinder bore 3b of the cylinder block 3.

[0059] A perimeter of the skirt portion 3S and a perimeter of an opening of the cam chain chamber 3c serve as the mating surface 3f with the crankcase 2, and the

mating surface 3f is an end face of a peripheral wall 3A of the cylinder block 3.

[0060] The periphery of the cylinder bore 3b of the cylinder block 3 is swollen outwardly at four locations of an outer periphery thereof to form insertion hole boss portions 3B through which bolt insertion holes 3h extend.

[0061] As depicted in FIG. 5, the bolt insertion holes 3h are opened at two upper and lower locations of the left side of the cylinder bore 3b and at two upper and lower locations of the right side cam chain chamber 3c of the cylinder bore 3b on the mating surface 3f of the cylinder block 3.

[0062] The four bolt insertion holes 3h extend in parallel to the cylinder axial line Lc from the mating surface 3f on the crankcase 2 side to the mating surface 3g of the cylinder head 4 side and have the stud bolts 12 inserted therein.

[0063] On the other hand, referring to FIG. 6 that is a view as viewed in an arrow mark VI of the crankcase 2 (view as viewed in the arrow mark VI of FIG. 4), the crankcase 2 of the left and right split type formed by integration of the left crankcase 2L and the right crankcase 2R has, on the mating surface 2f with the cylinder block 3, a skirt portion fitting hole 2S into which the skirt portion 3S of the cylinder block 3 is fitted and has the cam chain chamber 2c formed on the right side (RH) of the skirt portion fitting hole 2S.

[0064] It is to be noted that a dotted pattern is given to the mating surface 2f in the drawings.

[0065] The perimeter of the opening of the skirt portion fitting hole 2S and the perimeter of the opening of the cam chain chamber 2c form the mating surface 2f with the cylinder block 3, and the mating surface 2f is an end face of the peripheral wall 2A projecting a little to the cylinder block 3 side from the side wall 2W of the crankcase 2 (refer to FIG. 8).

[0066] The periphery of the skirt portion fitting hole 2S of the peripheral wall 2A of the crankcase 2 is swollen at four locations thereof to the outer side to form threaded hole boss portions 2B in which threaded holes 2h are provided.

[0067] The four threaded holes 2h are respectively opposite to the four bolt insertion holes 3h of the cylinder block 3, and the stud bolts 12 are screwed into the threaded holes 2h and implanted.

[0068] Referring to FIGS. 6 to 8, an abutting interference portion 2P is formed on the surface of the side wall 2W continuous to the peripheral wall 2A such that it extends leftward (LH) (rightward in FIG. 6) from the left side lower threaded hole boss portion 2B out of the four threaded hole boss portions 2B of the peripheral wall 2A projecting from the side wall 2W of the present crankcase 2.

[0069] The abutting interference portion 2P projects in the vertical direction from the mating surface 2f (refer to FIG. 7).

[0070] Since the abutting interference portion 2P of the crankcase 2 is formed extending outwardly from the

threaded hole boss portion 2B, the abutting interference portion 2P is easy to be found, which enhances the discrimination, and the rigidity of the abutting interference portion 2P can be enhanced.

[0071] While the mating surface 2f of the crankcase 2 is a milled surface formed by milling, the surface of the abutting interference portion 2P is a material surface that is not processed.

[0072] Accordingly, from the difference in the surface from the mating surface 2f, the abutting interference portion 2P can be identified and found out easily by visual inspection.

[0073] On the side wall 2W of the left crankcase 2L on which the abutting interference portion 2P is formed, a reinforcement rib 2r extends leftward (LH) from a root portion of the abutting interference portion 2P, and the reinforcement rib 2r is formed as a ridge on the surface of the side wall 2W.

[0074] In particular, the abutting interference portion 2P is formed continuously to the reinforcement rib 2r which is formed on the side wall 2W continuous to the peripheral wall 2A whose end face is the mating surface 2f of the crankcase 2.

[0075] Accordingly, the rigidity of the abutting interference portion 2P can be enhanced further.

[0076] Further, referring to FIGS. 1, 3 and so forth, an identification mark 1M of the first internal combustion engine 1 is provided on a left side surface 2Ls of the side wall that extends downwardly from the driving pulley 31a of the belt type continuously variable transmission 30 at a front portion of the left crankcase 2L from where the abutting interference portion 2P can be seen.

[0077] It is to be noted that also a serial number or the like of the first internal combustion engine 1 is inscribed on the identification mark 1M.

[0078] As depicted in FIG. 3, the identification mark 1M is provided to a portion of the left side surface 2Ls of the crankcase 2 from where the abutting interference portion 2P can be seen, the portion being in the proximity of the abutting interference portion 2P.

[0079] The abutting interference portion 2P can be found easily by using the identification mark 1M as a clue, which enhances the discrimination, and misassembly can be prevented.

[0080] Further, by the identification mark 1M itself, it can be confirmed that the crankcase in question is the crankcase 2 of the first internal combustion engine 1, and misassembly can be prevented.

[0081] When the cylinder block 3 is to be assembled to the crankcase 2, the portion of the cylinder block 3 opposite to which the abutting interference portion 2P of the crankcase 2 has no abutted interference portion on which the abutting interference portion 2P is to be abutted.

[0082] Accordingly, when the four stud bolts 12 implanted on the mating surface 2f of the crankcase 2 are inserted through the four bolt insertion holes 3h of the cylinder block 3 (refer to FIG. 4) and the skirt portion 3S

of the cylinder block 3 is fitted into the skirt portion fitting hole 2S of the crankcase 2 to assemble the cylinder block 3 to the crankcase 2, since an abutted interference portion on which the abutting interference portion 2P on the crankcase 2 side is to be abutted does not exist on the cylinder block 3 side as depicted in FIG. 9, the mating surface 3f of the cylinder block 3 can be mated with and assembled to the mating surface 2f of the crankcase 2 with the gasket 10 sandwiched therebetween.

[0083] After the cylinder block 3 is assembled to the crankcase 2 in this manner, the cylinder head 4 is further assembled to the cylinder block 3 and nuts 13 are screwed with and tightened to male threaded end portions 12a of the stud bolts 12 projecting from the opening end face of the bolt insertion holes, which is an end face of a bearing wall 4d for a rocker arm shaft or the like of the cylinder head 4 with a washers 14 interposed respectively therebetween as depicted in FIG. 3.

[0084] The first internal combustion engine 1 can be manufactured in this manner.

[0085] It is to be noted that the length of the male threaded end portion 12a of each of the present stud bolts 12 projecting from the cylinder head 4 in a state in which the cylinder block 3 and the cylinder head 4 are placed on the crankcase 2 is equal to or a little longer than the length of a female threaded portion of the nut 13.

[0086] A left side elevational view depicting a state in which, in a second internal combustion engine 100 of a model different from that of the first internal combustion engine 1, a cylinder block 103 and a cylinder head 104 are sequentially placed on a crankcase 102 and fastened to the crankcase 102 by stud bolts 112 is depicted in FIG. 10, and an exploded left side elevational view depicting a state in which the cylinder block 103 and the cylinder head 104 are sequentially disassembled and moved from the crankcase 102 in the direction of the cylinder axial line Lc is depicted in FIG. 11.

[0087] The crankcase 102, cylinder block 103 and cylinder head 104 of the second internal combustion engine 100 have shapes similar to those of the crankcase 2, cylinder block 3 and cylinder head 4 of the first internal combustion engine 1, respectively, and mating surfaces 102f and 103f of the crankcase 102 and the cylinder block 103 of the second internal combustion engine 100 are substantially same as the mating surfaces 2f and 3f of the crankcase 2 and the cylinder block 3 of the first internal combustion engine 1, respectively.

[0088] Further, the inner diameter of a skirt portion fitting hole 102S of the crankcase 102 into which the skirt portion 103S of the cylinder block 103 is fitted is also substantially equal to the inner diameter of the skirt portion fitting hole 2S of the crankcase 2 of the first internal combustion engine 1.

[0089] However, an abutting interference portion, that is equivalent to the abutting interference portion 2P that is formed on the side wall 2W continuous to the peripheral wall 2A whose end face is given as the mating surface 2f of the crankcase 2 of the first internal combustion en-

gine 1, does not exist at the same position on the crankcase 102 of the second internal combustion engine 100.

[0090] Further, on the cylinder block 103 of the second internal combustion engine 100, an abutted interference portion 103Q that is to be abutted is formed at a portion of the cylinder block 103 opposite to the abutting interference portion 2P of the crankcase 2 of the first internal combustion engine 1.

[0091] Referring to FIGS. 12 and 14, the abutted interference portion 103Q is formed on the surface of a peripheral wall 103A so as to extend leftward substantially along the mating surface 103f from a left side lower insertion hole boss portion 103B among four insertion hole boss portions 103B of the peripheral wall 103A having the mating surface 103f of the present cylinder block 103 as an end face.

[0092] The abutted surface of the abutted interference portion 103Q has a plane same with that of the mating surface 103f and is formed by milling as well as the mating surface 103f.

[0093] Since the abutted interference portion 103Q of the cylinder block 103 is formed so as to extend outwardly from the insertion hole boss portion 103B to the outer side, the abutted interference portion 103Q is easy to be found, which enhances the discrimination and can enhance the rigidity of the abutted interference portion 103Q.

[0094] Referring to FIGS. 13 and 14, the crankcase 102 of a second internal combustion engine 101 has, at a portion to which the abutted interference portion 103Q of the cylinder block 103 is opposite when assembling the cylinder block 103, no abutting interference portion that may abut on the abutted interference portion 103Q.

[0095] Accordingly, when the four stud bolts 112 implanted on the mating surface 102f of the crankcase 102 are inserted through the four bolt insertion holes 103h of the cylinder block 103 and the skirt portion 103S of the cylinder block 103 is fitted into the skirt portion fitting hole 102S of the crankcase 102 to assemble the cylinder block 103 to the crankcase 102, since such an abutting interference portion that may abut on the abutted interference portion 103Q of the cylinder block 103 does not exist on the crankcase 102 side as depicted in FIG. 14, the mating surface 103f of the cylinder block 103 can be mated with the mating surface 102f of the crankcase 102 to assemble them to each other with a gasket sandwiched therebetween (refer to FIG. 10).

[0096] After the cylinder block 103 is assembled to the crankcase 102 in this manner, the cylinder head 104 is further assembled to the cylinder block 103 and nuts 113 are screwed with and tightened to male threaded end portions of the stud bolts 112 projecting from the opening end face of the bolt insertion holes of the cylinder head 104, with a washer 114 interposed respectively therebetween.

[0097] The second internal combustion engine 101 can be manufactured in this manner.

[0098] If it is tried to assemble the cylinder block 103

of the second internal combustion engine 101 of a different model to the crankcase 2 of the first internal combustion engine 1, then at a location of the cylinder block 103 opposite to the abutting interference portion 2P of the crankcase 2, the abutted interference portion 103Q on which the abutting interference portion 2P is to abut exists.

[0099] Accordingly, if it is tried to insert the four stud bolts 12 implanted on the mating surface 2f of the crankcase 2 through the four bolt insertion holes 103h of the cylinder block 103 and fit the skirt portion 103S of the cylinder block 103 into the skirt portion fitting hole 2S of the crankcase 2 to assemble the cylinder block 103 to the crankcase 2, then since the abutting interference portion 2P projecting from the mating surface 2f on the crankcase 2 side abuts on and interfere with the abutted interference portion 103Q that forms a plane same with that of the mating surface 103f on the cylinder block 103 side, the mating surfaces 2f and 103f cannot mate with each other with an air gap formed therebetween as depicted in Fig. 15 and Fig. 16. Therefore, it can be recognized readily that the assembly is misassembly, and such misassembly is prevented.

[0100] Further, in an misassembly state depicted in FIG. 15, a length d of the male threaded end portion 12a of each stud bolt 12 projecting outwardly from the cylinder head 104 is shorter than and insufficient with respect to a length of the female threaded portion of the nut 13 as shown in Fig. 15, the misassembly can be easily recognized. Further, even if the nuts 13 are screwed, since the nuts 13 cannot be screwed and tightened with certainty, it can be recognized readily that the assembly is misassembly.

[0101] It is to be noted that, if the projection length of the abutting interference portion 2P on the crankcase 2 side from the mating surface 2f further increases, then in the case where the cylinder block 103 and the cylinder head 104 are placed on the crankcase 2 as depicted in FIG. 15, the air gap between the mating surfaces 2f and 103f of the crankcase 2 and the cylinder block 103 further increases, the male threaded end portions 12a of the stud bolts 12 may not project from the cylinder head 104 by movement of the cylinder head 104, and therefore, the nuts 13 cannot be screwed, from which it can be discriminated apparently that the assembly is misassembly.

[0102] Further, when it is tried to assemble the cylinder block 103 of the second internal combustion engine 101 of a different model to the crankcase 2 of the first internal combustion engine 1, the abutting interference portion 2P of the crankcase 2 has a material surface different from the mating surface 2f and is formed extending to the outside of the peripheral wall 2A (threaded hole boss portions 2B), which facilitates identification of the abutting interference portion 2P. Further, the abutted interference portion 103Q of the cylinder block 103 is formed extending to the outside of the peripheral wall 103A (insertion hole boss portion 103B) and can be identified readily.

Therefore, it is possible to easily find the abutting interference portion 2P and the abutted interference portion 103Q being opposite to each other and make them correspond to each other, and consequently, the misassembly can be prevented.

[0103] Referring to FIGS. 10 and 11, on the left side surface of the peripheral wall 103A of the cylinder block 103 of the second internal combustion engine 101, an identification mark 101M of the second internal combustion engine 101 is provided in the proximity of the abutted interference portion 103Q.

[0104] By using the identification mark 101M as a clue, the abutted interference portion 103Q can be found easily, which enhances the discrimination and can prevent misassembly.

[0105] Further, it can be checked from the identification mark 101M itself that the cylinder block concerned is the cylinder block 103 of the second internal combustion engine 101, and this is useful to prevent misassembly.

[0106] As depicted in FIG. 15 showing a misassembly state, since the identification mark 1M is provided on the left side surface of the crankcase 2 of the first internal combustion engine 1 and the identification mark 101M is provided on the left side surface of the cylinder block 103 of the second internal combustion engine 101 such that both of the identification marks 1M and 101M can be visually observed from the left side, the identification marks 1M and 101M can be confirmed relative to each other and the abutting interference portion 2P and the abutted interference portion 103Q in the proximity of the identification marks 1M and 101M can be visually observed relative to each other, and misassembly can be checked easily.

[0107] Also, when it is tried to assemble the cylinder block 103 of the second internal combustion engine 101 of a different model to the crankcase 2 of the first internal combustion engine 1, the identification marks 1M and 101M and the abutting interference portion 2P and abutted interference portion 103Q can be visually observed relative to each other, and misassembly can be prevented.

[0108] Although the misassembly prevention structure for an internal combustion engine according to the embodiment of the present invention has been described, the mode of the present invention is not limited to the embodiment described above and includes those carried out in various modes within the scope of the present invention.

[Reference Signs List]

[0109]

1 ... First internal combustion engine, 1M ... Identification mark,
2 ... Crankcase, 2L ... Left crankcase, 2R ... Right crankcase, 2c ... Cam chain chamber, 2f ... Mating surface, 2W ... Side wall, 2r ... Reinforcement rib,

2A ... Peripheral wall, 2S ... Skirt portion fitting hole, 2B ... Threaded hole boss portion, 2h ... Threaded hole, 2P ... Abutting interference portion, 2Pf ... Abutting surface,

3 ... Cylinder block, 3a ... Cylinder liner, 3b ... Cylinder bore, 3c ... Cam chain chamber, 3f, 3g ... Mating surface, 3A ... Peripheral wall, 3S ... Skirt portion, 3B ... Insertion hole boss portion, 3h ... Bolt insertion hole,

4 ... Cylinder head, 4c ... Cam chain chamber, 4d ... Bearing wall,

5 ... Head cover, 8 ... Transmission case cover, 9 ... Radiator cover, 10, 11 ... Gasket, 12 ... Stud bolt, 13 ... Nut, 14 ... Washer,

20 ... Crankshaft, 21 ... Piston, 22 ... Connecting rod, 25 ... AC generator, 26 ... Radiator fan, 27 ... Shroud, 28 ... Radiator,

30 ... Belt type continuously variable transmission, 31a ... Driving pulley, 31b ... Driven pulley, 31c ... V belt, 32 ... Centrifugal weight, 35 ... Reduction mechanism, 35a ... Input power shaft,

40 ... Valve train mechanism, 41 ... Camshaft, 42 ... Cam chain, 43 ... Cam chain chamber,

101 ... Second internal combustion engine, 101M ... Identification mark,

102 ... Crankcase, 102f ... Mating surface, 102S ... Skirt portion fitting hole,

103 ... Cylinder block, 103f ... Mating surface, 103Q ... Abutted interference portion, 103Qf ... Abutted surface, 103A ... Peripheral wall, 103B ... Insertion hole boss portion, 103h ... Bolt insertion hole, 103S ... Skirt portion,

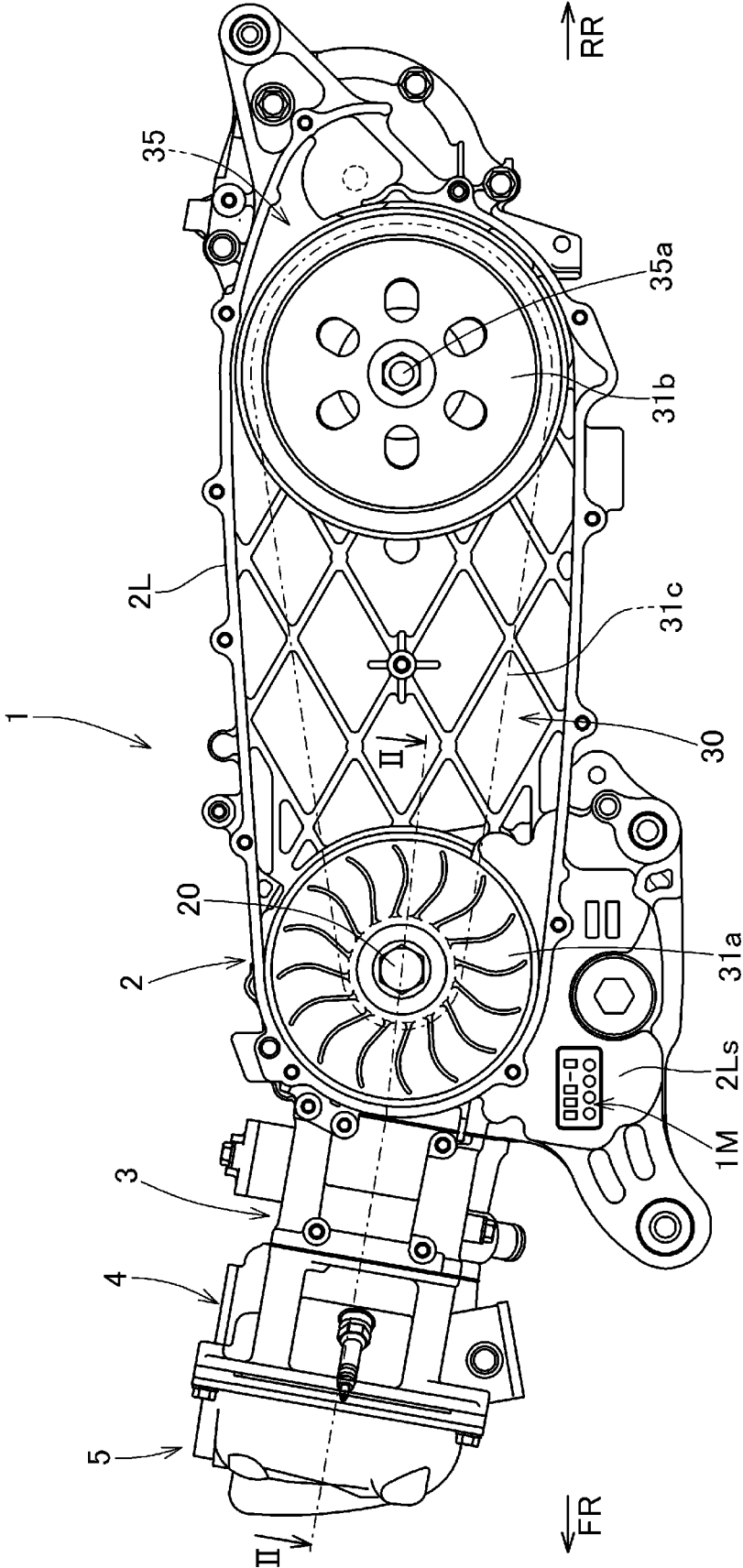
104 ... Cylinder head, 112 ... Stud bolt, 113 ... Nut, 114 ... Washer

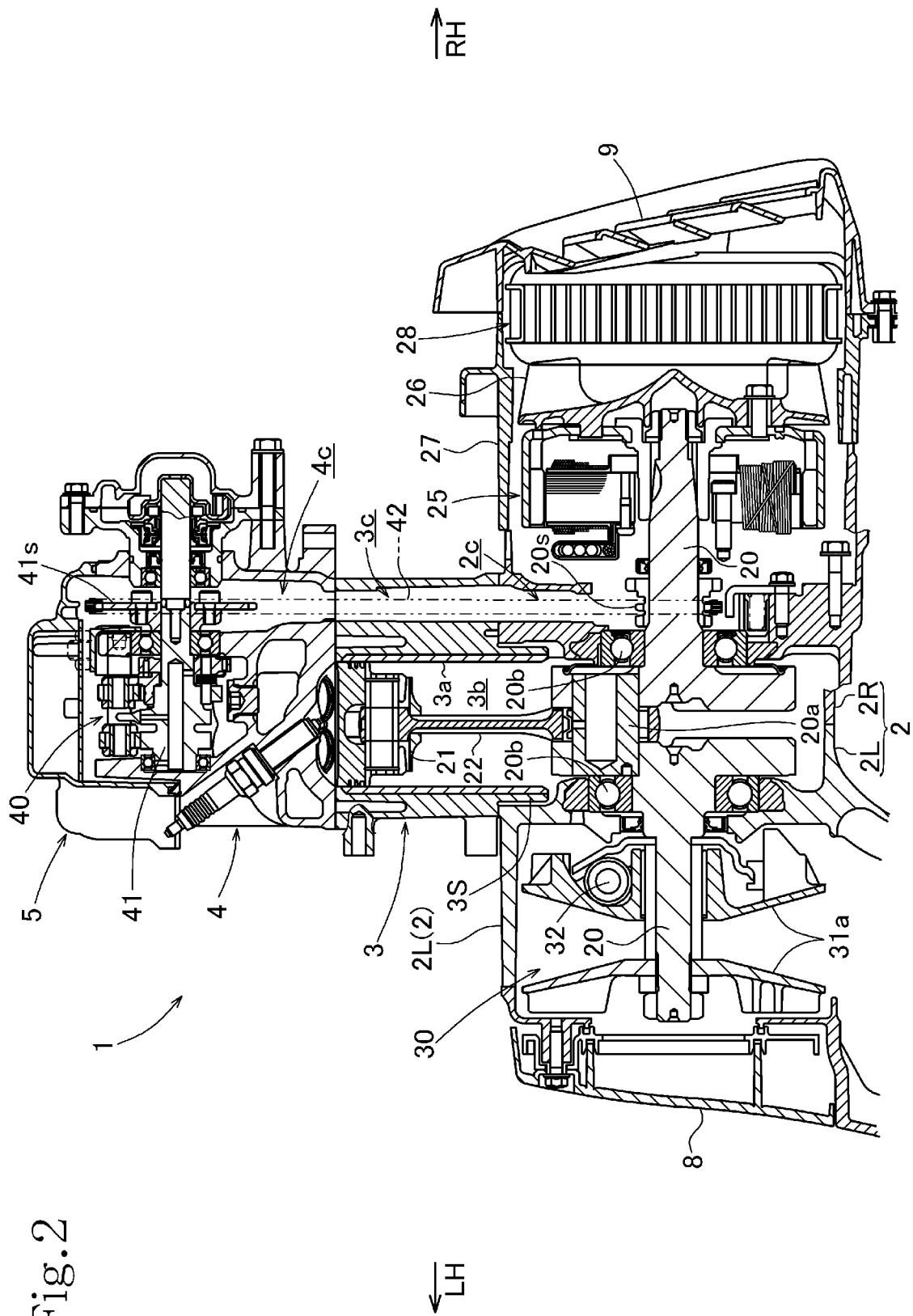
Claims

1. An misassembly prevention structure for an internal combustion engine, preventing misassembly of parts constituting an internal combustion engine contacting each other at mating surfaces opposite to each other, wherein
a one part (2) of the parts contacting each other constituting a first internal combustion engine (1) has an abutting interference portion (2P) formed by extending outwardly a part of a peripheral wall (2A) having a mating surface (2f) as an end face so as to project in a vertical direction from the mating surface (2f) while an other part (3) does not have an abutted interference portion to be abutted formed at a portion opposite to said abutting interference portion (2P) of said one part (2), and
another part (103) of parts contacting each other constituting a second internal combustion engine (101) different from said first internal combustion engine (1) has an abutted interference portion (103Q) to be abutted formed at a portion opposite to said abutting

- interference portion (2P) of said one part (2) of said first internal combustion engine (1).
2. The misassembly prevention structure for an internal combustion engine according to claim 1, wherein the mating surface (2f) of the one part (2) of said first internal combustion engine (1) has a milled surface while a surface of said abutting interference portion (2P) has a material surface.
 3. The misassembly prevention structure for an internal combustion engine according to claim 1 or 2, wherein said parts contacting each other are a crankcase (2, 102) and a cylinder block (3, 103), said abutting interference portion (2P) is provided on the crankcase (2) of said first internal combustion engine (1), and said abutted interference portion (103Q) is provided on the cylinder block (103) of said second internal combustion engine (101).
 4. The misassembly prevention structure for an internal combustion engine according to claim 3, wherein said cylinder block (3, 103) and a cylinder head (4, 104) are placed on and fastened to said crankcase (2, 102) by one or more than one fastening bolts (12, 112), and said abutting interference portion (2P) is formed so as to extend from a threaded hole boss portion (2B) of a threaded hole (2h) for said fastening bolt (12), said threaded hole (2h) being formed so as to have an opening at the mating surface (2f) of said crankcase (2).
 5. The misassembly prevention structure for an internal combustion engine according to claim 4, wherein said abutting interference portion (2P) is formed continuously to a reinforcement wall (2r) formed on a side wall (2W) continuous to the peripheral wall (2A) having the mating surface (2f) of said crankcase (2) as an end face.
 6. The misassembly prevention structure for an internal combustion engine according to claim 4 or 5, wherein said abutted interference portion (103Q) is formed so as to extend from an insertion hole boss portion (103B) of a bolt insertion hole (103h) for said fastening bolt (112), the bolt insertion hole (103h) being formed so as to have an opening at a mating surface (103f) of said cylinder block (103).
 7. The misassembly prevention structure for an internal combustion engine according to claim 6, wherein an identification mark (101M) of said second internal combustion engine (101) is provided in a vicinity of said abutted interference portion (103Q) on a peripheral wall (103A) having said mating surface (103f) of the cylinder block (103) as an end face.
 8. The misassembly prevention structure for an internal combustion engine according to any one of claims 4 to 7, wherein said fastening bolt (12, 112) is a stud bolt, and when the cylinder block (103) and the cylinder head (104) of said second internal combustion engine (101) are placed on said crankcase (2) of the first internal combustion engine (1), said abutting interference portion (2P) of the crankcase (2) abut on and interfere with said abutted interference portion (103Q) of the cylinder block (103) and a length of a male threaded end portion (12a) of the stud bolt (12) projecting from the cylinder head (104) is shorter than a length of a female threaded portion of a nut (13).

Fig.1





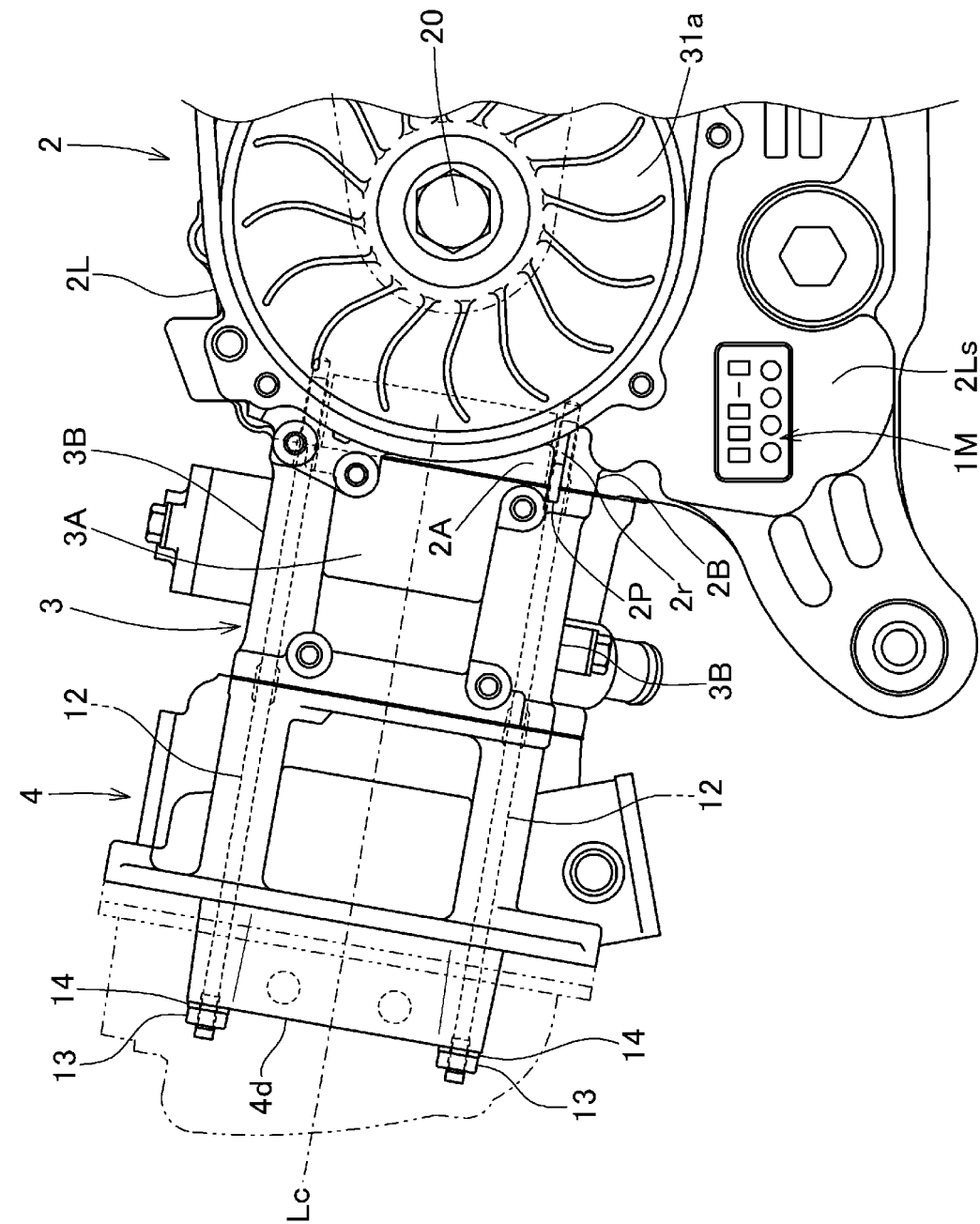


Fig.3

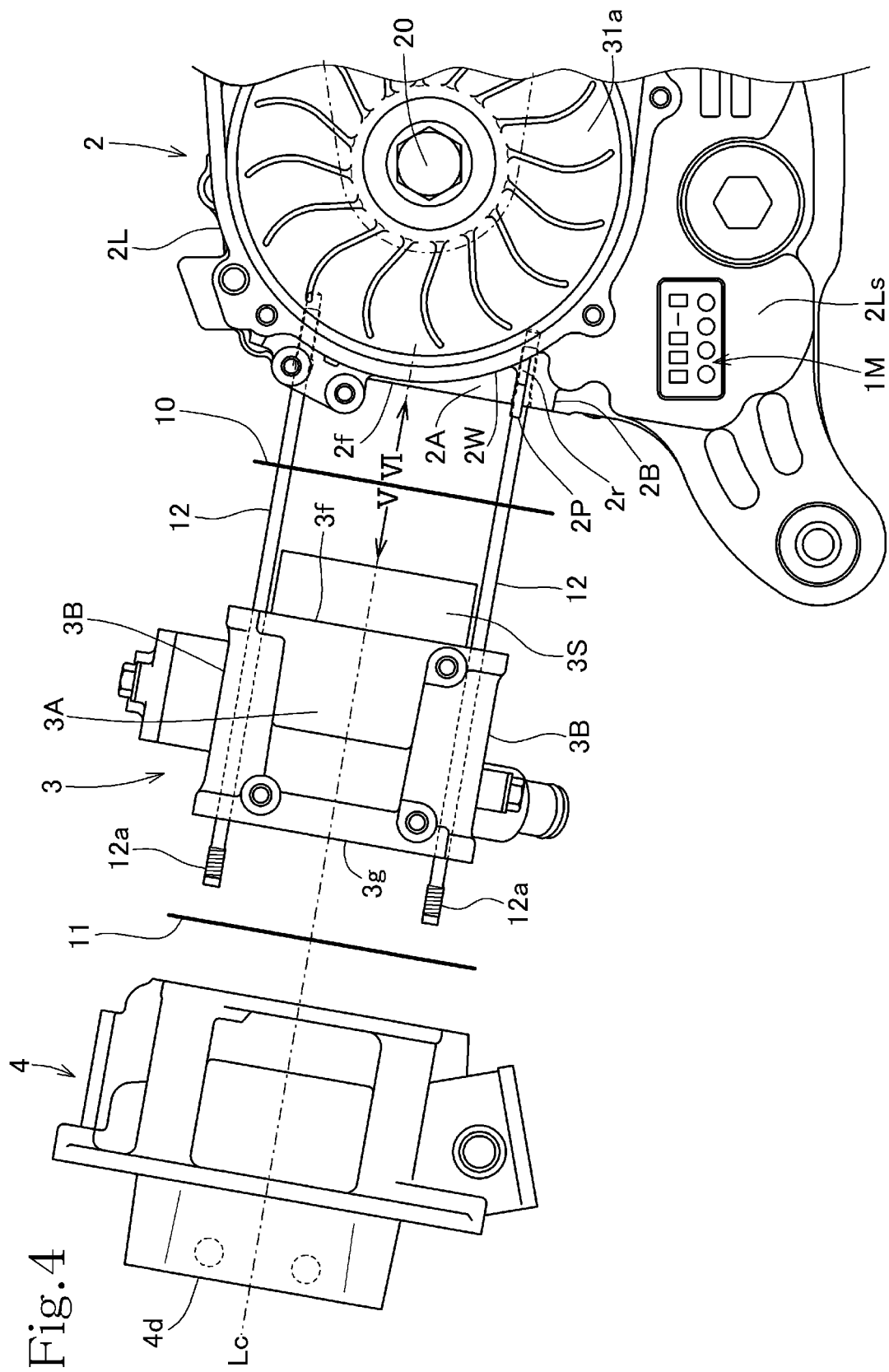
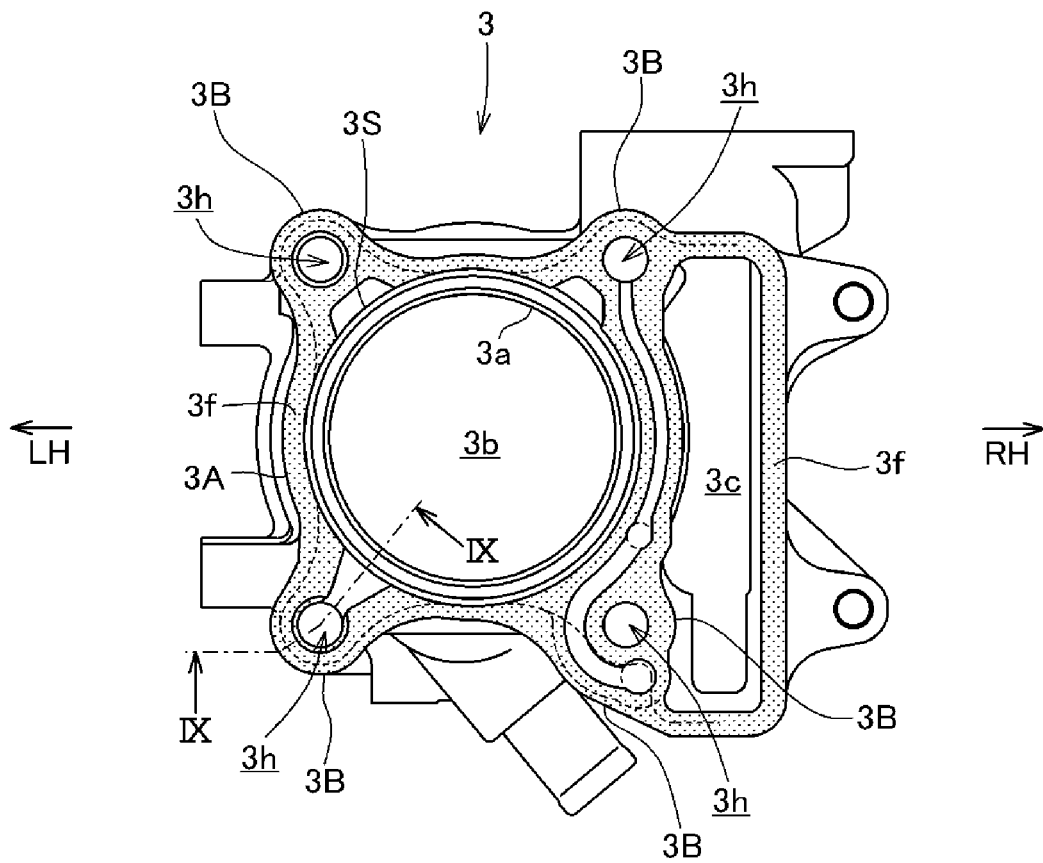


Fig.5



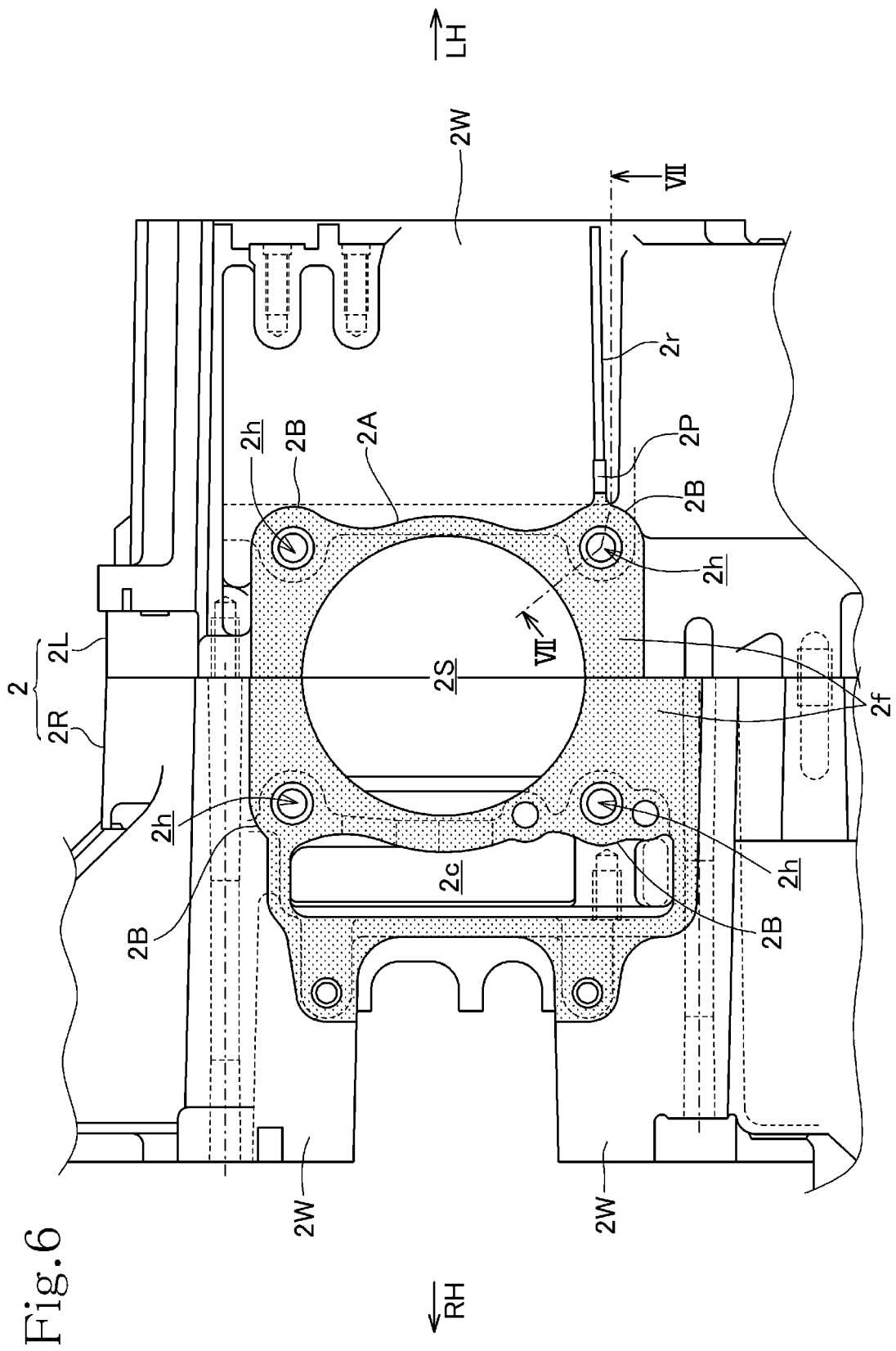


Fig.7

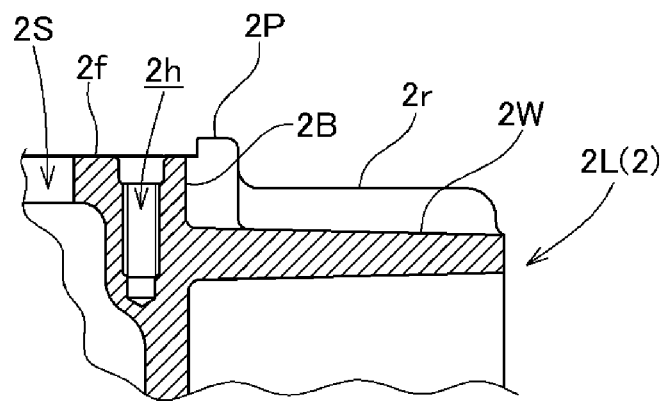


Fig.8

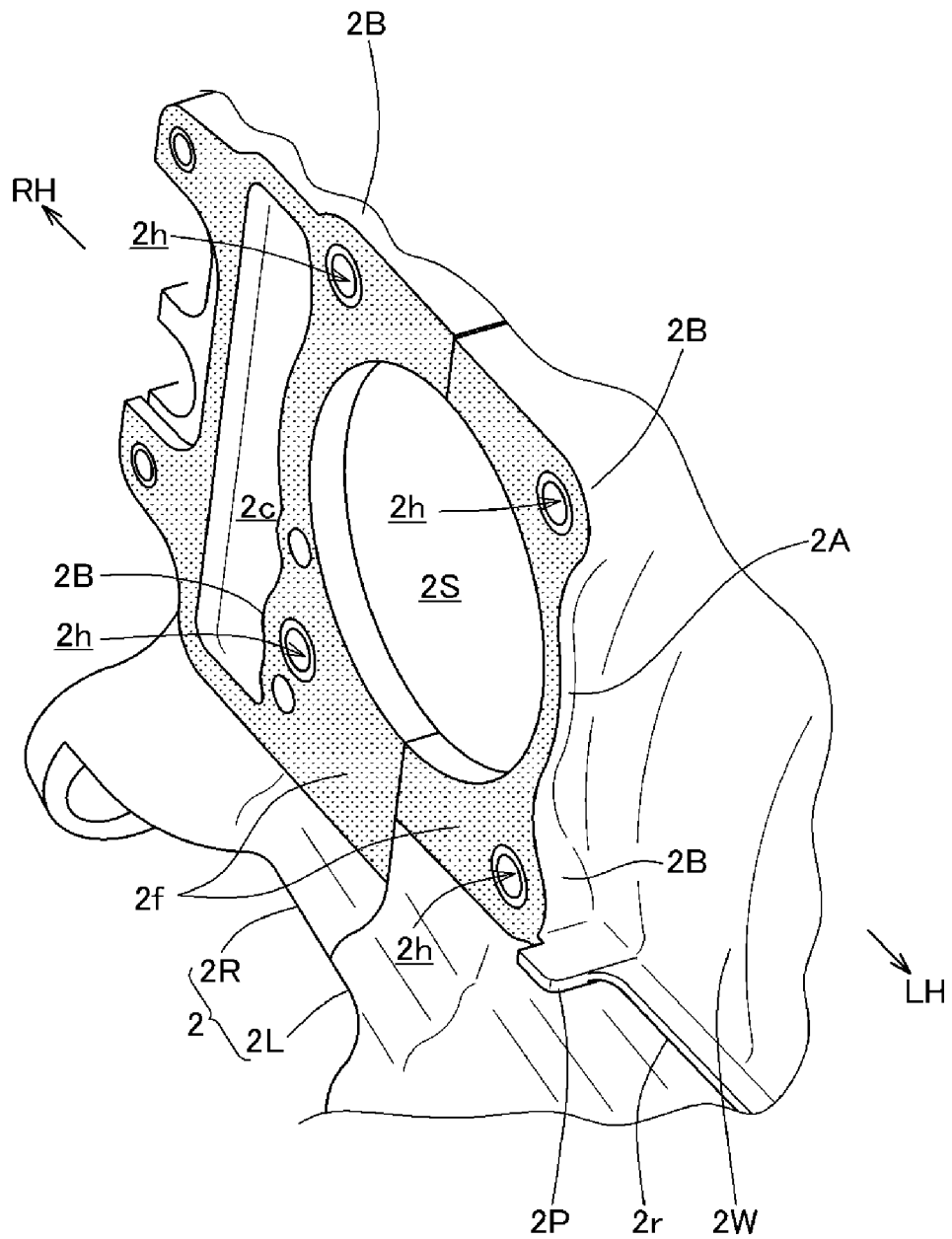
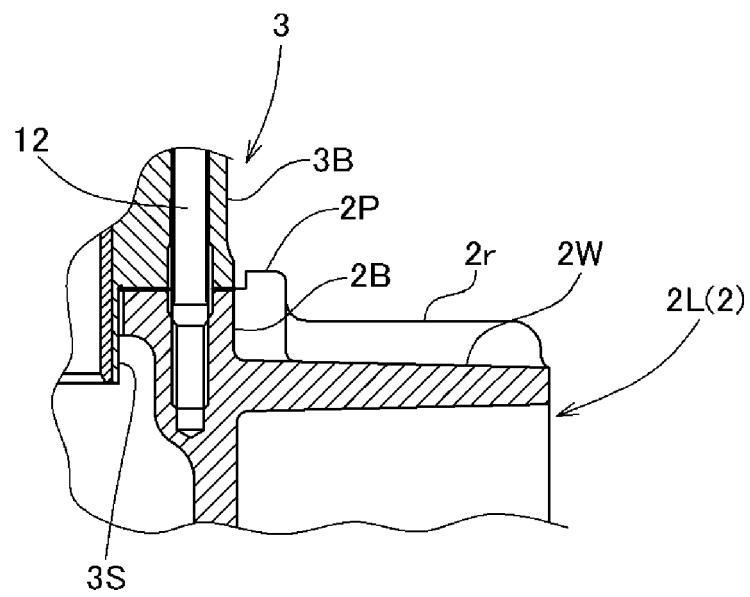


Fig.9



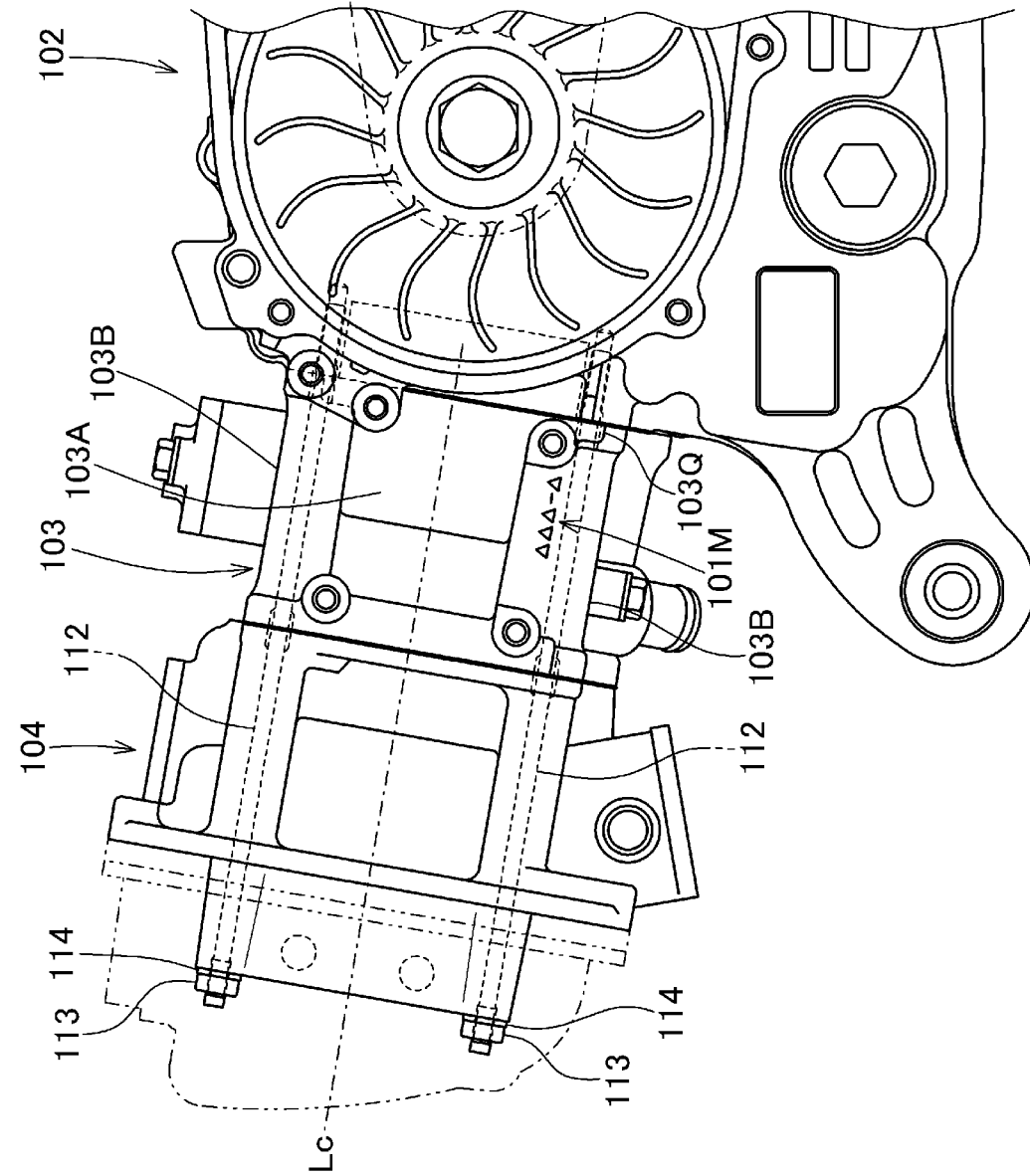


Fig.10

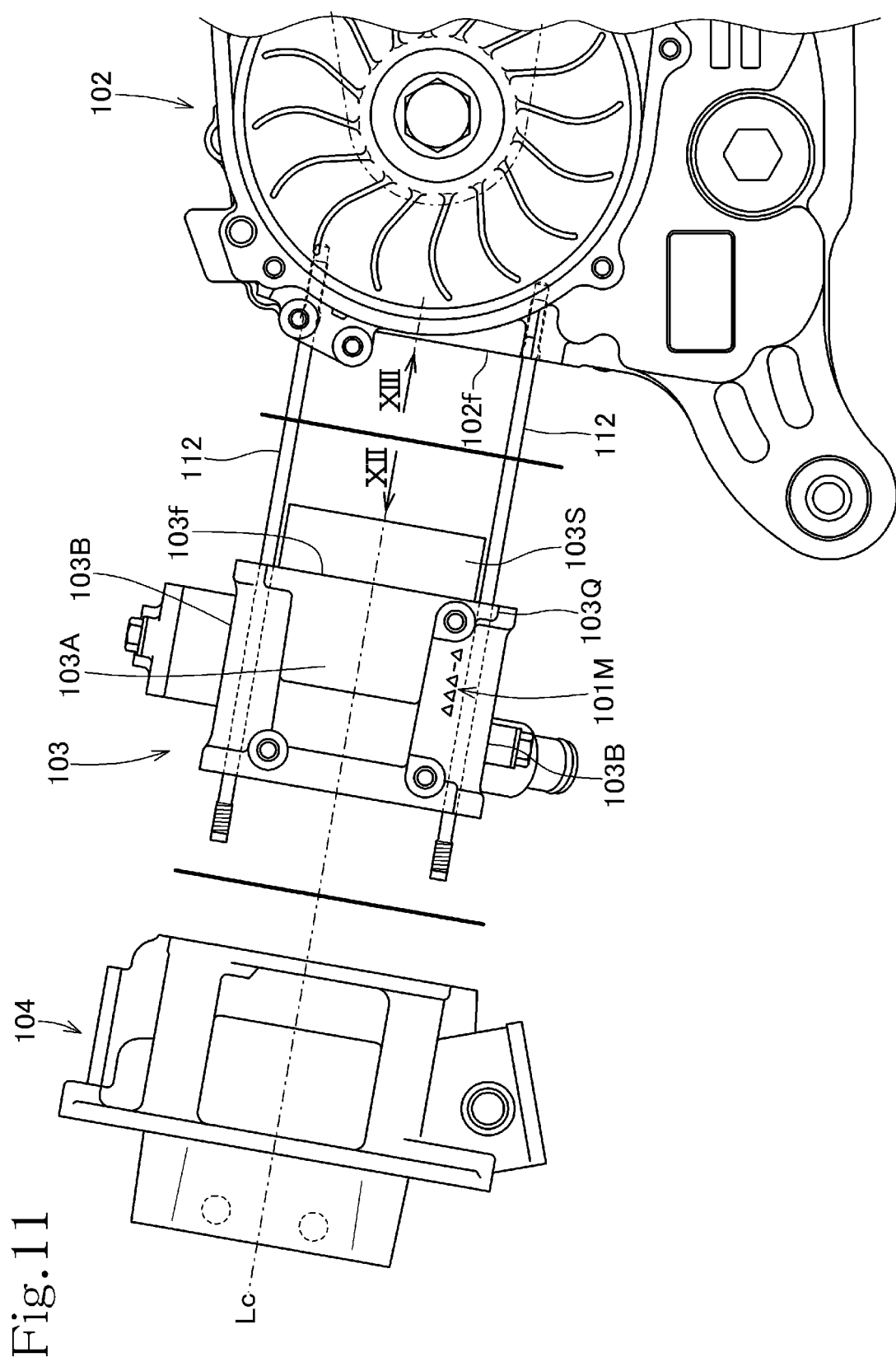


Fig.12

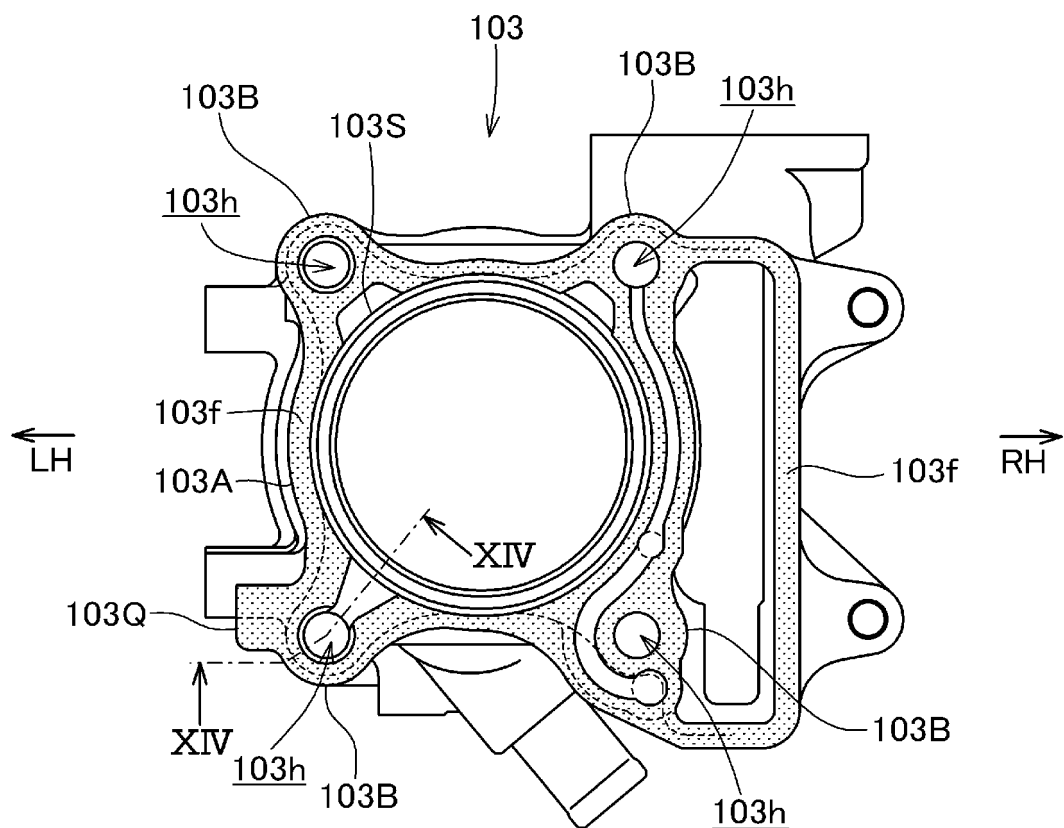


Fig.13

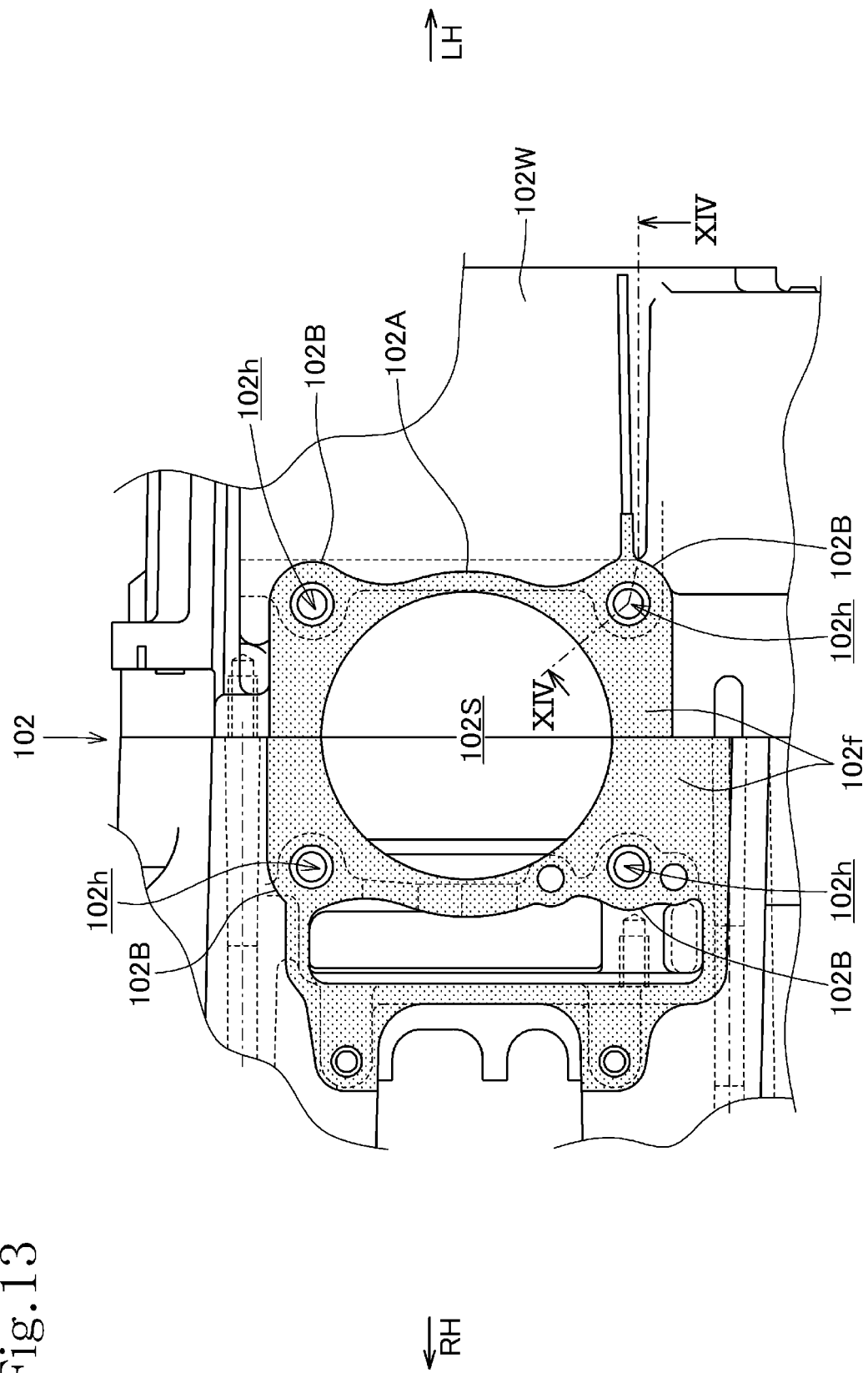
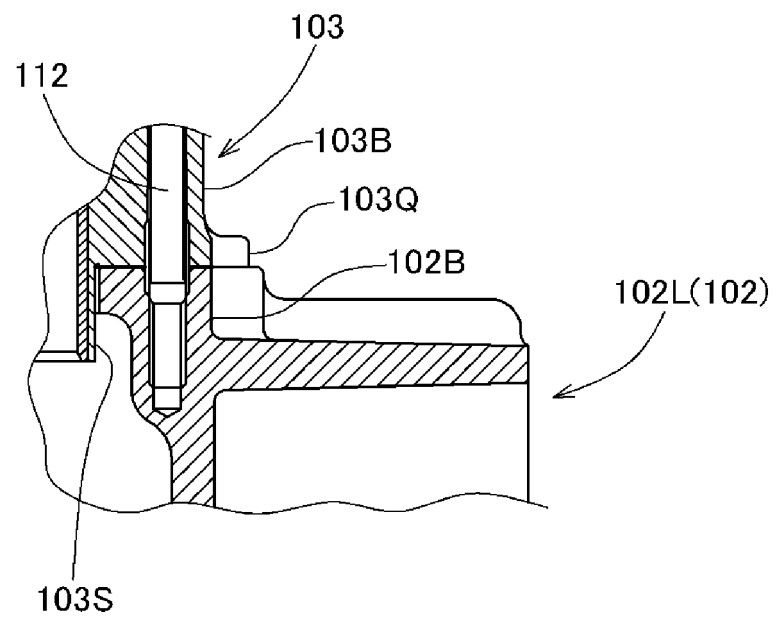


Fig.14



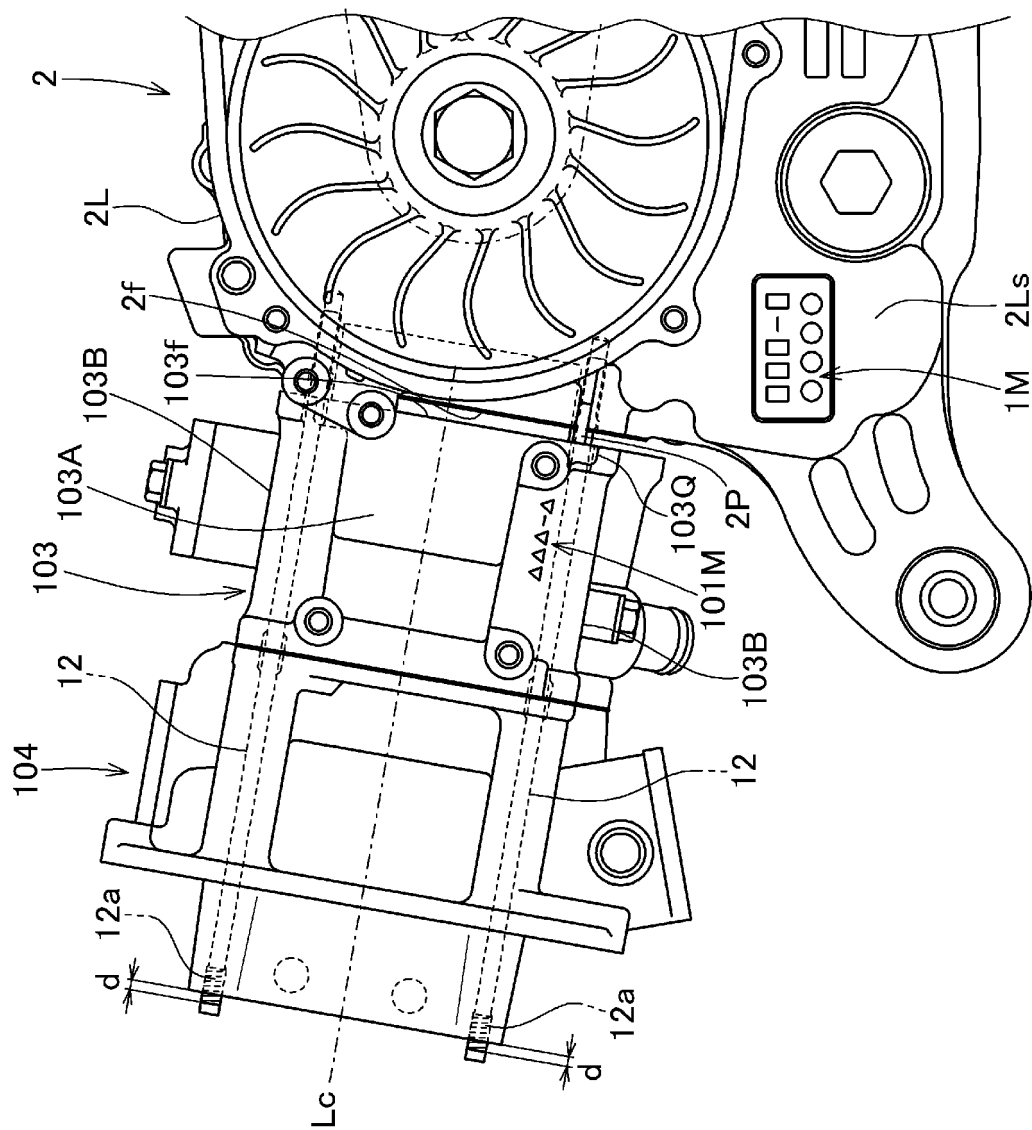
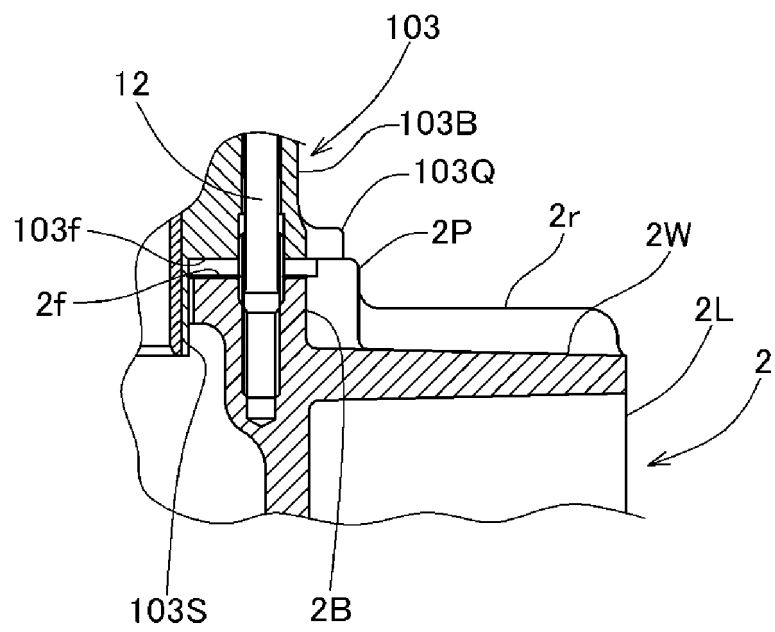


Fig. 15

Fig.16



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/078781

A. CLASSIFICATION OF SUBJECT MATTER

F02F7/00(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F02F7/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2016
Kokai Jitsuyo Shinan Koho	1971-2016	Toroku Jitsuyo Shinan Koho	1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 11-101155 A (Fuji Heavy Industries Ltd.), 13 April 1999 (13.04.1999), paragraphs [0013] to [0041]; fig. 1 to 4 (Family: none)	1-8
Y	JP 2004-19474 A (Toyota Motor Corp.), 22 January 2004 (22.01.2004), paragraphs [0028] to [0029]; fig. 13 (Family: none)	1-8

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

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"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search
27 October 2016 (27.10.16)Date of mailing of the international search report
08 November 2016 (08.11.16)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/078781

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 52717/1993 (Laid-open No. 22441/1995) (Ichikoh Industries Ltd.), 21 April 1995 (21.04.1995), paragraph [0006]; fig. 1 to 2 (Family: none)	1-8
Y	JP 2015-34466 A (Suzuki Motor Corp.), 19 February 2015 (19.02.2015), fig. 11 to 19 (Family: none)	1-8
Y	JP 2007-262930 A (Honda Motor Co., Ltd.), 11 October 2007 (11.10.2007), fig. 6 & US 2007/0221160 A1 fig. 6 & EP 1840353 A1	4-8
Y	JP 2005-41550 A (Kawasumi Laboratories, Inc.), 17 February 2005 (17.02.2005), paragraphs [0008] to [0009]; fig. 1 to 2 (Family: none)	7-8
A	JP 11-351116 A (Daihatsu Motor Co., Ltd.), 21 December 1999 (21.12.1999), fig. 1 to 5 (Family: none)	1-8
A	JP 2001-115892 A (Honda Motor Co., Ltd.), 24 April 2001 (24.04.2001), paragraphs [0038] to [0040]; fig. 7 & US 6343576 B1 column 8, lines 41 to 65; fig. 1 & EP 1092852 A2 & KR 10-2001-0040093 A & CN 1294256 A	1-8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3547816 B [0003]