(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 482 134 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.12.2004 Bulletin 2004/49

(51) Int Cl.[7]: **F01M 11/00**

(21) Application number: **04253169.9**

(22) Date of filing: **28.05.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(30) Priority: **28.05.2003 JP 2003150311**

(71) Applicant: **Petroliam Nasional Berhad**
50088 Kuala Lumpur (MY)

(72) Inventor: **Osman, Azmi**
c/o Yamaha Engine Developments Co.Ltd.
Iwata, Shizuoka 438-0026 (JP)

(74) Representative: **Murray, Elisabeth Anne et al**
Mathys & Squire,
100 Gray's Inn Road
London WC1X 8AL (GB)

(54) Oil pan structure for an engine

(57) In an example, an oil pan 8 comprises a bottom plate 26, a vertical wall 27 integrally protruded upwardly from outer edges of the bottom plate 26, an outwardly extending flange 28 formed integral with the vertical wall 27 at the protruded end and fixed to the lower end of a crankcase 2, a pair of bosses 21, 21 located below the outwardly extending flange 28 and integrally projecting laterally outwardly from the outside surface of the vertical wall 27 for supporting a component 14 of an engine 1, and a connecting piece 29 disposed between these two bosses 21, 21 for connecting the two bosses 21, 21 integrally. The bottom plate 26, vertical wall 27, outwardly extending flange 28, bosses 21, 21 and connecting piece 29 are formed by casting. The inner edge 29a of the connecting piece 29 on the side of the vertical wall 27 is formed integral with the outwardly extending flange 28.

Such an arrangement can prevent shrinkage cavities from being produced when a pair of bosses are provided on the outside surface of a vertical wall of an oil pan made by casting and these bosses are reinforced.

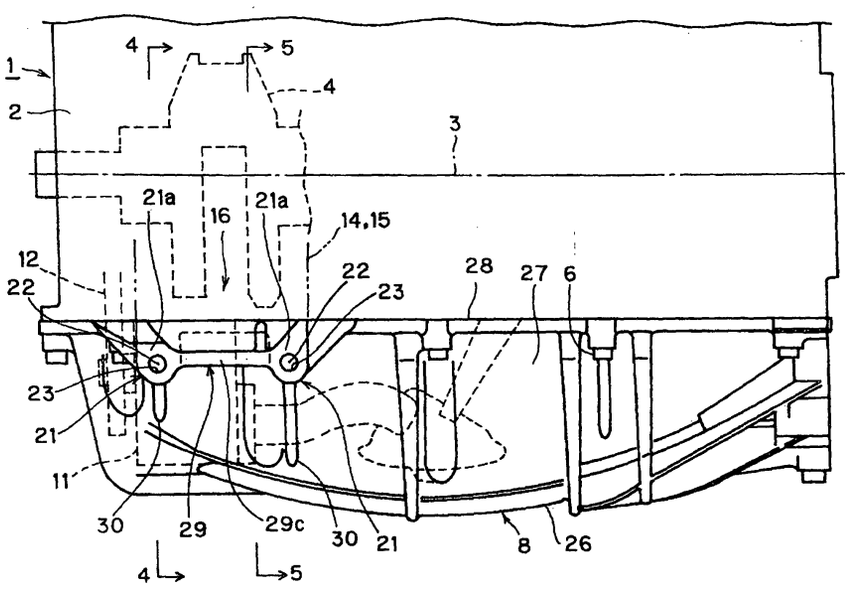

FIG. 1

EP 1 482 134 A2

Description

[0001] This invention relates to an oil pan structure in an engine. In preferred examples, bosses are formed integral with a vertical wall in an oil pan made by casting and an engine component is supported on the bosses.

[0002] The conventional oil pan structure in an engine described above includes a system shown in JP-A-H06-108919. According to the patent document, the oil pan comprises a bottom plate, a vertical wall integrally protruding upwardly from the outer edge of the bottom plate, an outwardly extending flange formed integral with the vertical wall at the protruding end and fixed to the lower end of the crankcase, a pair of bosses located below the outwardly extending flange and integrally projecting laterally outwardly from the outside surface of the vertical wall for supporting an engine component, and a connecting piece disposed between these two bosses and formed integral with the vertical wall in the vertical middle portion thereof for integrally connecting the two bosses; and the bottom plate, vertical wall, outwardly extending flange, bosses and connecting piece are formed by casting. Oil retained in the oil pan is supplied to engine portions, for lubrication.

[0003] In this case, the two bosses are reinforced by the connecting piece, thereby improving supporting strength of the two bosses to support the engine component.

[0004] In the prior art described above, a connecting piece is formed integral with the vertical wall, together with a pair of bosses, so that the overall volume of these bosses and connecting piece is fairly large compared with the middle portion of the vertical wall to be integrated with these parts. Therefore, shrinkage cavities are apt to be produced during casting of the oil pan on the inside surface of the middle portion of the vertical wall to be integrated with the bosses and the connecting piece. This is unfavorable to the strength of the vertical wall.

[0005] Also, since in the prior art, the projecting end faces of bosses are provided separately, machining work is required individually for each projecting end face when these projecting end faces are machined flat. This machining work is therefore apt to be troublesome.

[0006] In view of the foregoing, an object of examples of this invention is to prevent shrinkage cavities from being produced when a pair of bosses are provided on the outside surface of a vertical wall of an oil pan made by casting and these bosses are reinforced.

[0007] In addition, another object of examples of this invention is to facilitate machining work when the projecting ends of the bosses are machined flat.

[0008] To seek to achieve the foregoing object, an oil pan structure in an engine of aspects of this invention is as follows. Symbols attached to the technical terms in this section should not be construed as limiting the technical scope of this invention to the contents of the described embodiment of the invention to be described later, or limiting in any other way.

[0009] According to an aspect of the invention there is provided an oil pan structure in an engine comprising a bottom plate 26, a vertical wall 27 integrally protruding upwardly from outer edges of the bottom plate 26, an outwardly extending flange 28 formed integral with the vertical wall 27 at the protruding end and fixed to the lower end of a crankcase 2, a pair of bosses 21, 21 located below the outwardly extending flange 28 and integrally projecting laterally outwardly from the outside surface of the vertical wall 27 for supporting a component 14 of an engine 1, and a connecting piece 29 disposed between these two bosses 21, 21 for connecting the two bosses 21, 21 integrally, and said bottom plate 26, vertical wall 27, outwardly extending flange 28, bosses 21, 21 and connecting piece 29 being formed by casting, wherein;

[0010] The inner edge 29a of said connecting piece 29 on the side of said vertical wall 27 is formed integral with said outwardly extending flange 28.

Preferably said inner edge 29a of said connecting piece 29 is thinner than the outer edge 29b of said connecting piece 29 in the projecting direction of said bosses 21, 21.

[0011] Preferably projecting end faces 21a, 21a of said bosses 21, 21, and the end face 29c of said connecting piece 29 at the outside edge 29b are formed flush with each other.

[0012] A broad aspect of the invention provides an oil pan structure for an engine comprising a bottom plate, a wall protruding upwardly from the bottom plate, an outwardly extending flange extending from the wall, a pair of bosses located below the flange and projecting from the wall for supporting an engine component, and a connecting piece arranged between the two bosses wherein an edge of the connecting piece is formed integrally with the flange.

[0013] In a further broad aspect, the connecting piece is not in contact with the wall.

[0014] A further aspect provides an oil pan structure for an engine comprising a wall and a support member extending from the wall for supporting an engine component, the member being arranged such that, when the wall and support member are formed by casting, casting deformities in the wall are substantially avoided.

[0015] Further aspects of the invention provide a mould for use in casting an oil pan structure and a method of casting an oil pan structure as described herein.

[0016] The invention extends to methods and/or apparatus substantially as herein described with reference to the accompanying drawings.

[0017] Any feature in one aspect of the invention may be applied to other aspects of the invention, in any appropriate combination. In particular, method aspects may be applied to apparatus aspects, and vice versa.

[0018] Preferred features of the present invention will now be described, purely by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a partial enlarged view of Fig. 3;
Fig. 2 is a front view of an engine;
Fig. 3 is a side view of the engine;
Fig. 4 is a sectional view taken in the direction of arrows 4-4 of Fig. 1;
Fig. 5 is a sectional view taken in the direction of arrows 5-5 of Fig. 1;
Fig. 6 is a plan view of an oil pan;
Fig. 7 is a bottom view of the oil pan; and
Fig. 8 is a perspective view of the oil pan.

[0019] In Figs. 1-5, reference numeral 1 designates a multiple-cylinder (four-cylinder), four-stroke engine (internal combustion engine) mounted on a vehicle such as an automobile.

[0020] The engine 1 comprises a crankcase 2 supported on a body of the vehicle, and a crankshaft 4 supported on the crankcase 2 for rotation about an axial center 3 extending approximately in the horizontal direction, a cylinder 5 supported on the crankcase 2 at its upper end, and an oil pan 8 supported on the crankcase 2 at its lower end with a fastening member 6, for retaining oil 7 inside.

[0021] Inside the oil pan 8 is disposed an oil pump 11, and the oil pump 11 is supported on the crankcase 2 at the under surface and connected drivably to the crankshaft 4 by chain-wound type power transmission means 12. Also, a component 14 of an engine 1, or an auxiliary machine 15, specifically an air compressor for air conditioning, is supported by a support device 16, extending between side surfaces of the crankcase 2 and the oil pan 8. The auxiliary machine 15 is connected drivably to the crankshaft 4 by timing belt-wound type power transmission means 17.

[0022] When the engine 1 is operated, the oil pump 11 is operated in association with the crankshaft 4, and oil 7 in the oil pan 8 is supplied to portions to be lubricated in the engine 1, for given lubrication. Also, the auxiliary machine 15 is operated in association with the crankshaft 4, for given air conditioning.

[0023] The support device 16 comprises a boss 20 provided integrally on the outside surface of the crankcase 2, a pair of bosses 21, 21 provided integrally on the outside surface of the oil pan 8, screw holes 23 formed in the bosses 20, 21 and having their axial centers 22 approximately perpendicular to the outside surface of the oil pan 8, and bolts 24 to be screwed in the screw holes 23; and the bosses 21, 21 are disposed in line in the axial direction of the crankshaft 4. The auxiliary machine 15 is supported on the bosses 20, 21 with bolts 24 screwed in the screw holes 23.

[0024] The oil pan 8 comprises a bottom plate 26, a vertical wall 27 integrally protruding upwardly from the outer edges of the bottom plate 26 and having a rectangular frame shape viewed in plan, and an outwardly extending flange 28 formed integral with the vertical wall 27 at the protruding end to be fixed to the lower end of the crankcase 2 with the fastening members 6.

[0025] The oil pan 8 comprises a pair of bosses 21, 21 integrally projecting laterally outwardly from the vertical middle portion of the outside surface of the vertical wall 27 such that the axial centers 22 are approximately perpendicular to the outside surface of the vertical wall 27 and located below the outwardly extending flange 28, a connecting piece 29 disposed between the bosses 21, 21, as viewed in profile of the oil pan 8 (Fig. 1), and extending on a line connecting the axial centers 22, 22 for integrally connecting the bosses 21, 21, and a pair of ribs 30, 30 provided integrally between the bosses 21, 21 and portions of the vertical wall 27 below the bosses 21, 21 for reinforcing the bosses 21, 21.

[0026] The bottom plate 26, vertical wall 27, outwardly extending flange 28, bosses 21, 21, connecting piece 29 and ribs 30, 30 of the oil pan 8 are formed integral with each other by casting with aluminum material.

[0027] More specifically, part of the base of each boss 21 is formed integral with the outwardly extending flange 28, so that the boss 21 is reinforced by the outwardly extending flange 28.

[0028] When the oil pan 8 is viewed in profile (Fig. 1), the upper surface and the lower surface of one boss 21 are each inclined such that it heads upwardly as they are apart from the other boss 21, and the inclination is approximately 40-50°. When the oil pan 8 is viewed in plan (Fig. 6), the outside surface of one boss 21 opposite the other boss 21 is inclined such that it is apart from the other boss 21 as it approaches the vertical wall 27, and the inclination is approximately 40-50°. Also in Fig. 4, the protruding edge of each rib 30 from the vertical wall 27 is inclined such that it approaches the vertical wall 27 as it heads downwardly, and the inclination is approximately 40-50°.

[0029] In Figs. 4, 5, the whole of the inner edge 29a of the connecting piece 29 on the side of the vertical wall 27 extends obliquely upwardly as it approaches the vertical wall 27 and the extending end is formed integral with the outer edge of the outwardly extending flange 28.

[0030] Therefore, the connecting piece 29 is not integrated with the vertical wall 27 at the vertical middle portion as in the prior art, so that a shrinkage cavity is prevented from being produced in the inside surface of the middle portion of the vertical wall 27 during casting of the oil pan 8, preventing the problem with a strength to the vertical wall 27.

[0031] The outwardly extending flange 28 has a sufficiently large thickness compared with the vertical wall 27, so that even if a shrinkage cavity is to be produced in the outwardly extending flange 28, this doesn't raise any problem with a strength when the outer edge of the outwardly extending flange 28 and the inner edge 29a of the connecting piece 29 are formed integral with each other.

[0032] The whole of the inner edge 29a of the connecting piece 29 is integrated with the outer edge of the outwardly extending flange 28 and no vertical through-opening is provided between the outwardly extending

flange 28 and the inner edge 29a. Here, if such an opening should exist, removal work is generally required for eliminating burrs produced on the opening edge of this opening by casting. However, as described above, the outwardly extending flange 28 and the inner edge 29a of the connecting piece 29 are wholly integrated, so that removal work of eliminating burrs is dispensed with because of no opening between them.

[0033] In Figs. 4, 5, the outer edge 29b of the connecting piece 29 in the projecting direction of the boss 21 has a thick plate shape extending approximately in the horizontal direction as a whole, and the inner edge 29a is thinner than the outer edge 29b.

[0034] Therefore, although the outwardly extending flange 28 and the inner edge 29a of the connecting piece 29 are integrated, as described above, the volume of the inner edge 29a of the connecting piece 29 is suppressed to a small value, so that shrinkage cavities are prevented more reliably from being produced in the outward extending flange 28 or portions of the vertical wall 27 in the vicinity of the outwardly extending flange 28.

[0035] In Figs. 1 and 4-8, the projecting end faces 21a, 21a of the bosses 21, 21, and the end face 29c of the outer edge 29b of the connecting piece 29 in the projecting direction of the bosses 21, 21 are flush with each other and constitute a continuous flat surface (21a, 29c) extending in the direction perpendicular to the axial center 22 of the screw hole 23.

[0036] Therefore, in the prior art, for the purpose of flattening the projecting end faces 21a of the bosses 21 machining work is performed individually to these faces, but by contrast, according to the foregoing embodiment, machining work for flattening the projecting end faces 21a of the bosses 21 can be carried out continuously and in a short time because of the end face 29c of the connecting piece 29 being included in the machining range. Thus, according to the embodiment, machining work for flattening the projecting end faces 21a of the bosses 21 can be performed easily.

[0037] Although the present invention has been described as related to an embodiment shown in the drawings, the bosses 21 are not limited to a pair of bosses, but three or more bosses may be provided.

[0038] Effects of preferred features of the present invention are as follows.

[0039] An aspect of the present invention provides an oil pan structure in an engine comprising a bottom plate, a vertical wall integrally protruding upwardly from outer edges of the bottom plate, an outwardly extending flange formed integral with the vertical wall at the protruding end and fixed to the lower end of a crankcase, a pair of bosses located below the outwardly extending flange and integrally projecting laterally outwardly from the outside surface of the vertical wall for supporting a component of an engine, and a connecting piece disposed between these two bosses for connecting the two bosses integrally, and said bottom plate, vertical wall, outwardly extending flange, bosses and connecting piece being formed by casting, wherein;

[0040] The inner edge of said connecting piece on the side of said vertical wall is formed integral with said outwardly extending flange.

[0041] Therefore, the connecting piece is not integrated with the vertical wall at the vertical middle portion as in the prior art, so that a shrinkage cavity is prevented from being produced in the inside surface of the middle portion of the vertical wall during casting of the oil pan, preventing the problem with a strength to the vertical wall.

[0042] Preferably outwardly extending flange has a sufficiently large thickness compared with the vertical wall, so that even if a shrinkage cavity is to be produced in the outwardly extending flange, this doesn't raise any problem with strength when the outer edge of the outwardly extending flange and the inner edge of the connecting piece are formed integral with each other.

[0043] Preferably said inner edge of said connecting piece is thinner than the outer edge of said connecting piece in the projecting direction of said bosses.

[0044] Therefore, although the outwardly extending flange and the inner edge of the connecting piece are integrated, as described above, the volume of the inner edge of the connecting piece is suppressed to a small value, so that shrinkage cavities are prevented more reliably from being produced in the outward extending flange or portions of the vertical wall in the vicinity of the outwardly extending flange.

[0045] Preferably projecting end faces of said bosses and the end face of said connecting piece at the outer edge are formed flush with each other.

[0046] Therefore, in the prior art, for the purpose of flattening the projecting end faces of the bosses, machining work is performed individually to these faces, but by contrast, according to the present invention, machining work for flattening the projecting end faces of the bosses can be carried out continuously and in a short time because of the end face of the connecting piece being included in the machining range. Thus, according to the present invention, machining work for flattening the projecting end faces of the bosses can be performed easily.

[0047] In a preferred example an oil pan 8 comprises a bottom plate 26, a vertical wall 27 integrally protruded upwardly from outer edges of the bottom plate 26, an outwardly extending flange 28 formed integral with the vertical wall 27 at the protruded end and fixed to the lower end of a crankcase 2, a pair of bosses 21, 21 located below the outwardly extending flange 28 and integrally projecting laterally outwardly from the outside surface of the vertical wall 27 for supporting a component 14 of an engine 1, and a connecting piece 29 disposed between these two bosses 21, 21 for connecting the two bosses 21, 21 integrally. The bottom plate 26, vertical wall 27, outwardly extending flange 28, bosses 21, 21 and connecting piece 29 are formed by casting. The inner edge 29a of the connecting piece 29 on the side of

the vertical wall 27 is formed integral with the outwardly extending flange 28.

[0048] Such an arrangement can prevent shrinkage cavities from being produced when a pair of bosses are provided on the outside surface of a vertical wall of an oil pan made by casting and these bosses are reinforced.

[0049] It will be understood that the present invention has been described above purely by way of example, and modification of detail can be made within the scope of the invention.

[0050] Each feature disclosed in the description, and (where appropriate) the claims and drawings may be provided independently or in any appropriate combination.

Explanation of Symbols

[0051] 1: engine 2: crankcase 3: axial center 4: crankshaft 6: fastening member 7: oil 8: oil pan 14: component 15: auxiliary machine 16: support device 21: boss 21a: projecting end face 22: axial center 23: screw hole 26: bottom plate 27: vertical wall 28: outwardly extending flange 29: connecting piece 29a: inner edge 29b: outer edge 29c: end face

Claims

1. An oil pan structure for an engine comprising a bottom plate, a substantially vertical wall integrally protruding upwardly from outer edges of the bottom plate, an outwardly extending flange formed integral with the vertical wall at the protruding end and fixed to the lower end of a crankcase, a pair of bosses located below the outwardly extending flange and integrally projecting laterally outwardly from the outside surface of the vertical wall for supporting an engine component, and a connecting piece disposed between these two bosses for connecting the two bosses integrally, and said bottom plate, vertical wall, outwardly extending flange, bosses and connecting piece being formed by casting, wherein the inner edge of said connecting piece on the side of said vertical wall is formed integral with said outwardly extending flange.

2. The oil pan structure for an engine as set forth in Claim 1, wherein said inner edge of said connecting piece is thinner than the outer edge of said connecting piece in the projecting direction of said bosses.

3. The oil pan structure for an engine as set forth in Claim 1 or 2, wherein projecting end faces of said bosses and the end face of said connecting piece at the outer edge are formed flush with each other.

4. An oil pan structure for an engine comprising a bottom plate, a wall protruding upwardly from the bottom plate, an outwardly extending flange extending from the wall, a pair of bosses located below the flange and projecting from the wall for supporting an engine component, and a connecting piece arranged between the two bosses wherein an edge of the connecting piece is formed integrally with the flange.

5. An engine comprising a wall and a support member extending from the wall for supporting an engine component, the member being arranged such that, when the wall and support member are formed by casting, casting deformities in the wall are substantially avoided.

6. A mould for use in casting an oil pan structure according to any of claims 1 to 5.

7. A method of casting an oil pan structure according to any of claims 1 to 5.

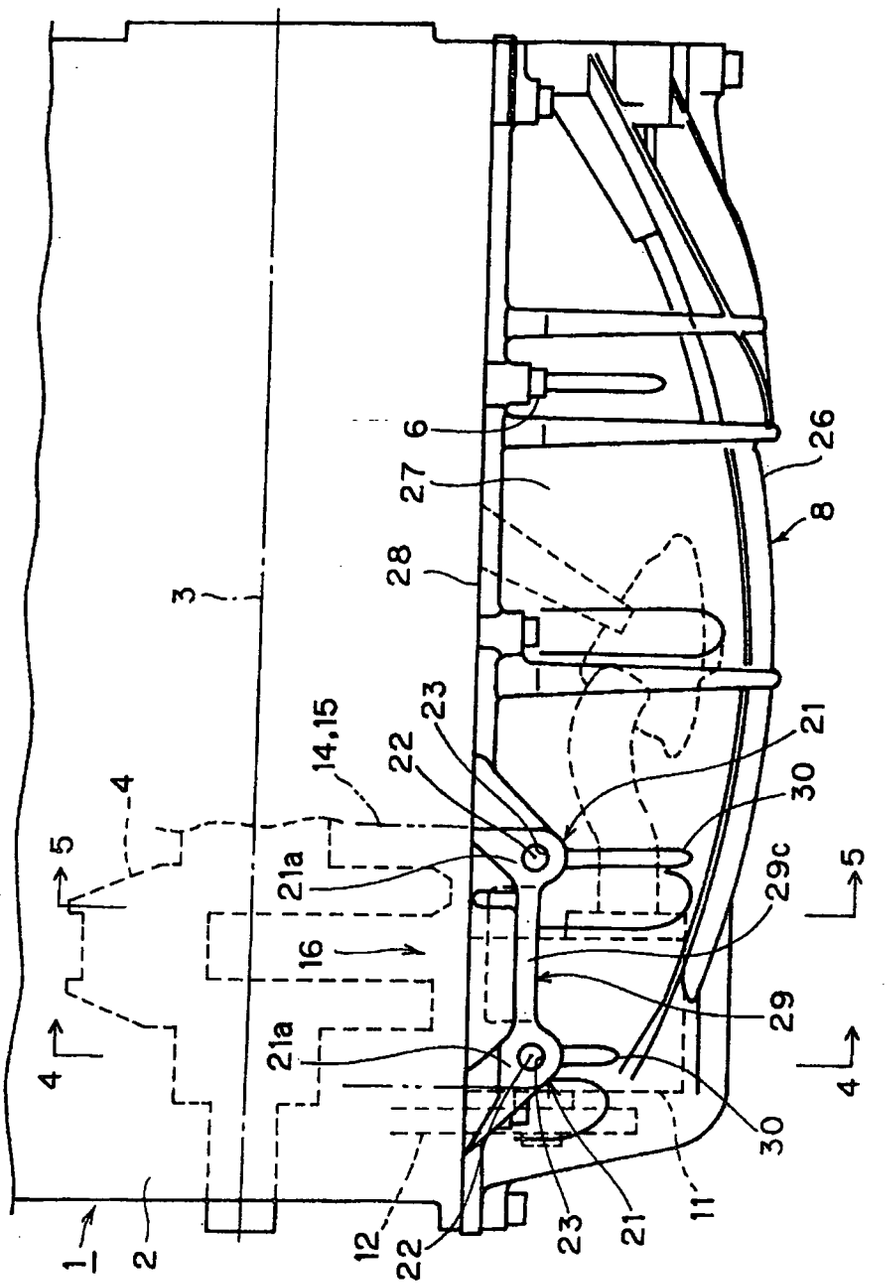

FIG. 1

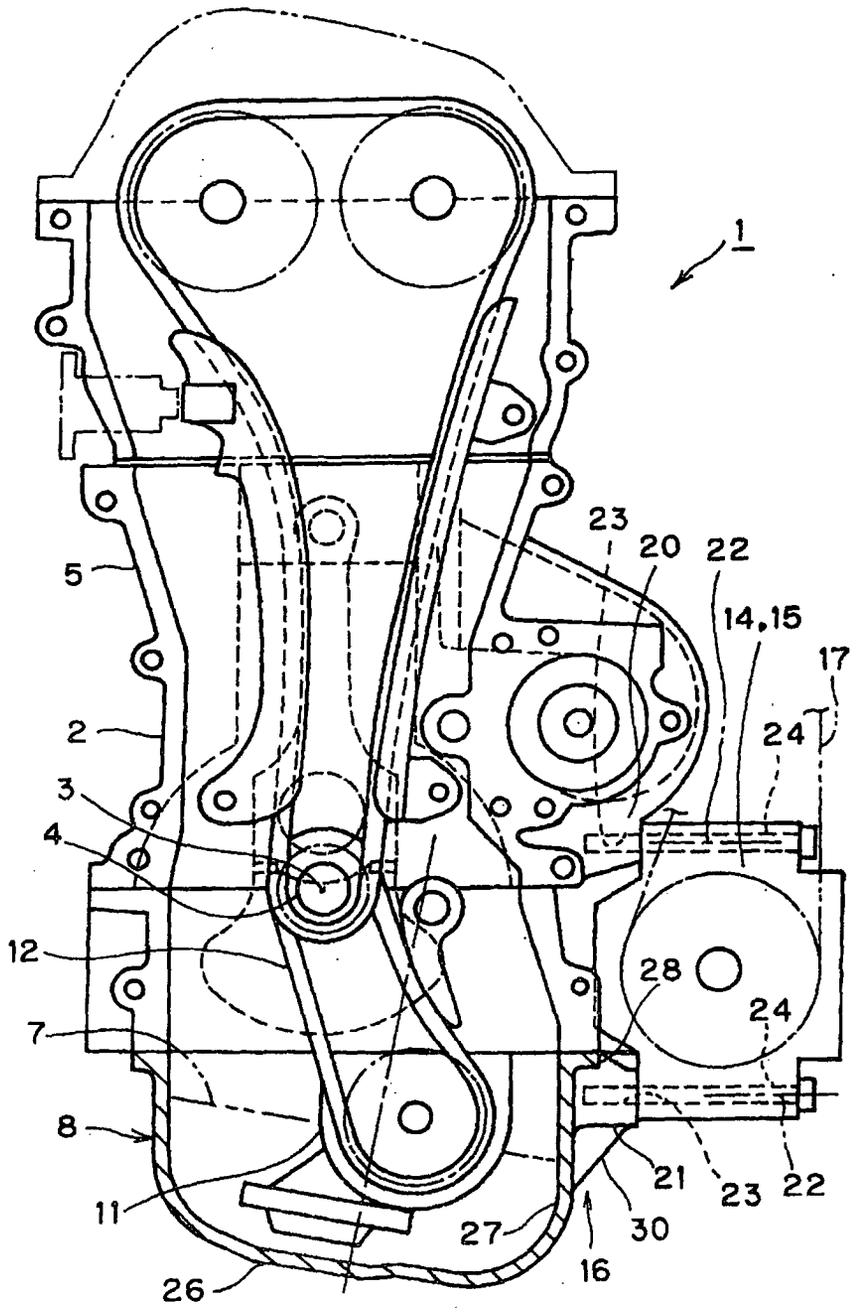

FIG. 2

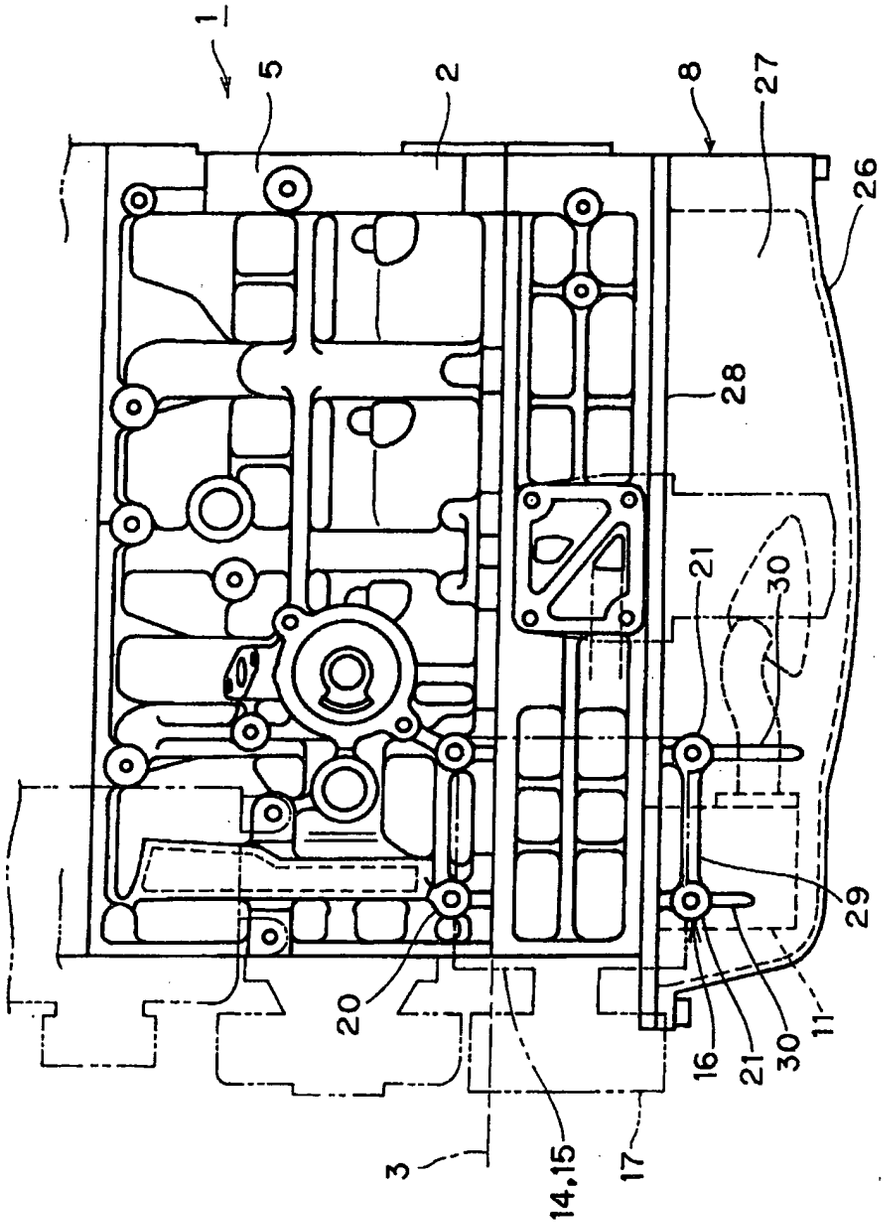

FIG. 3

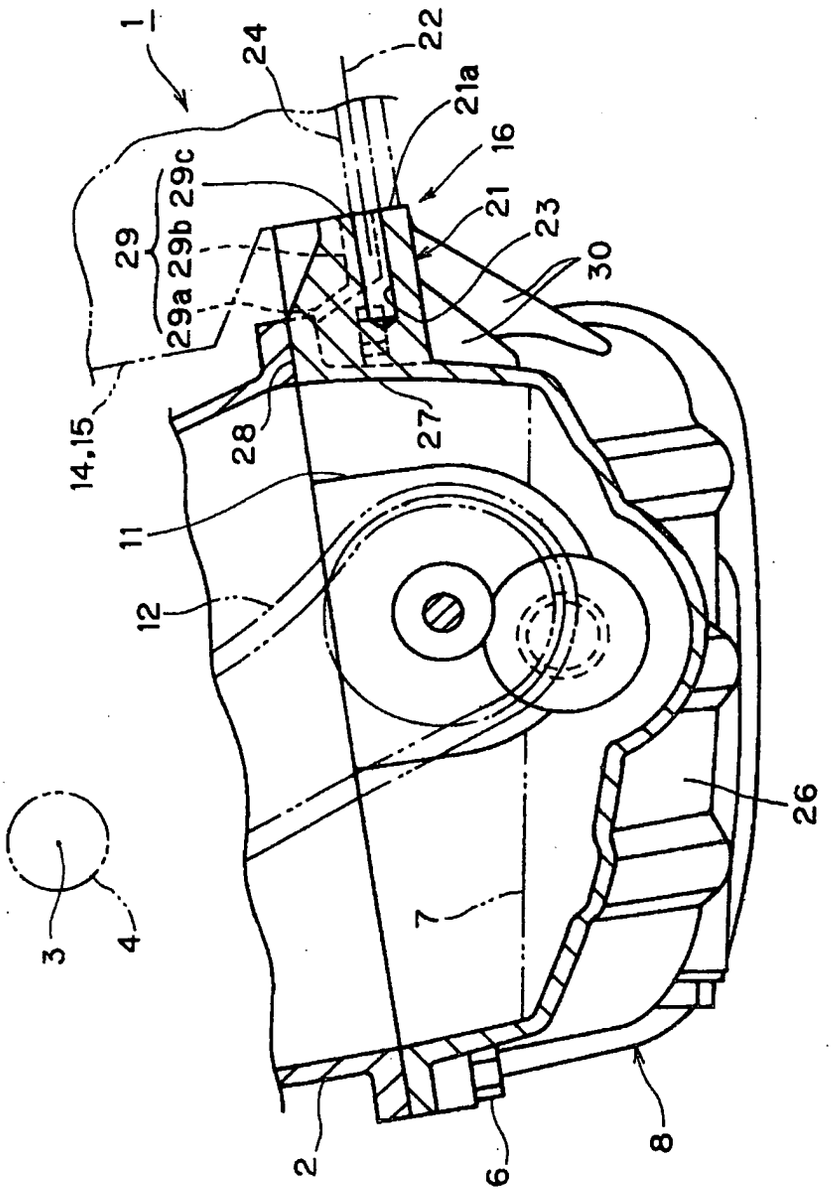

FIG. 4

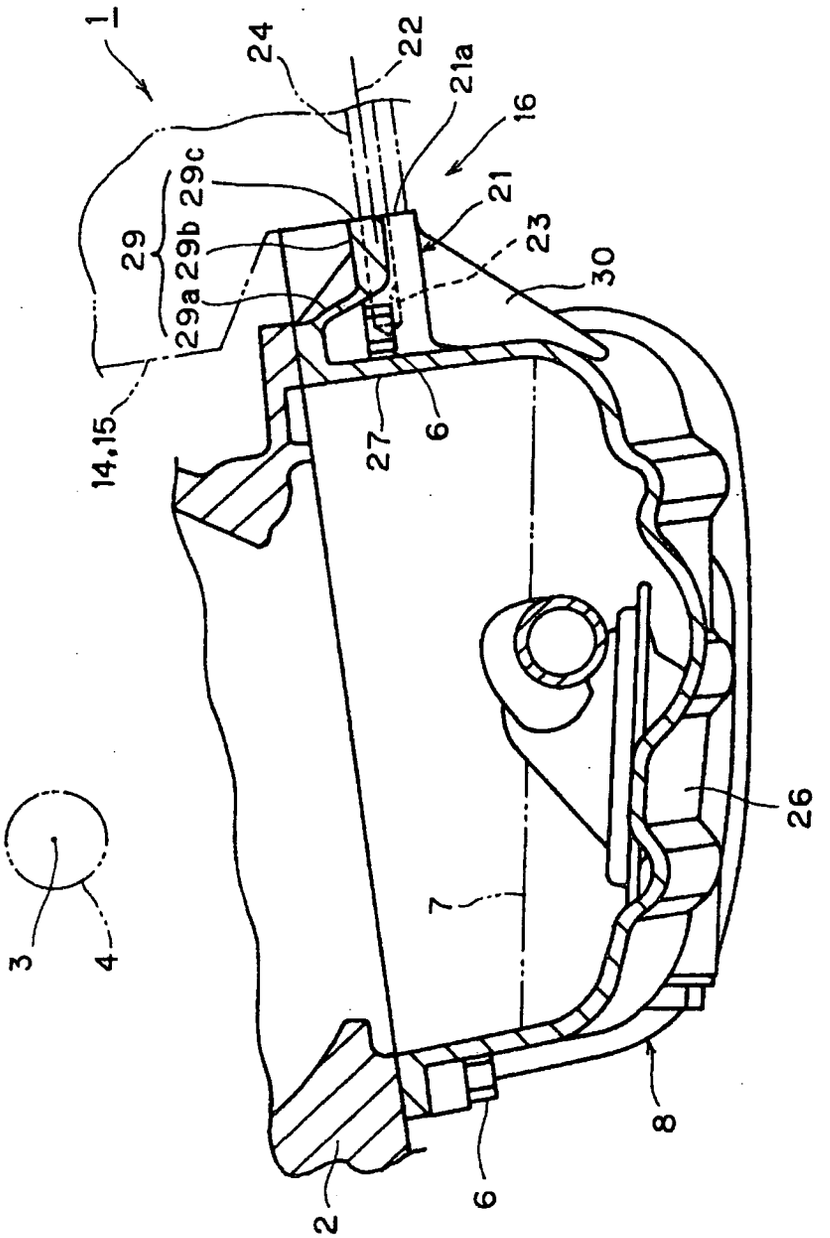

FIG. 5

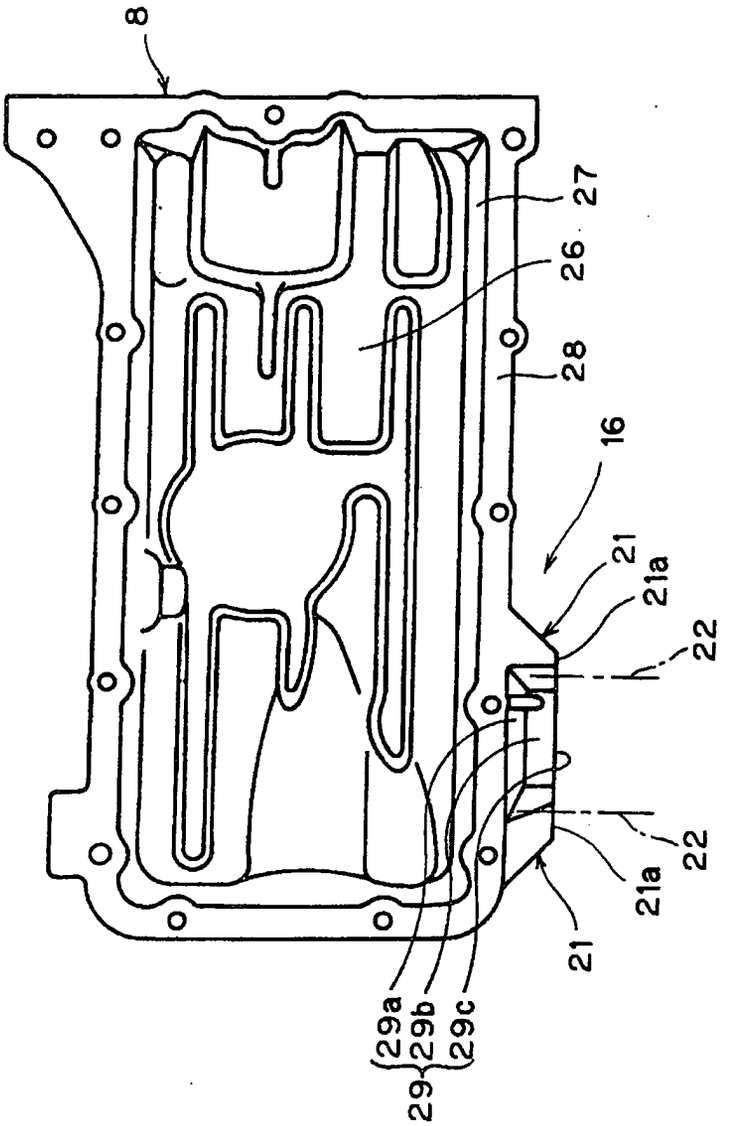

FIG. 6

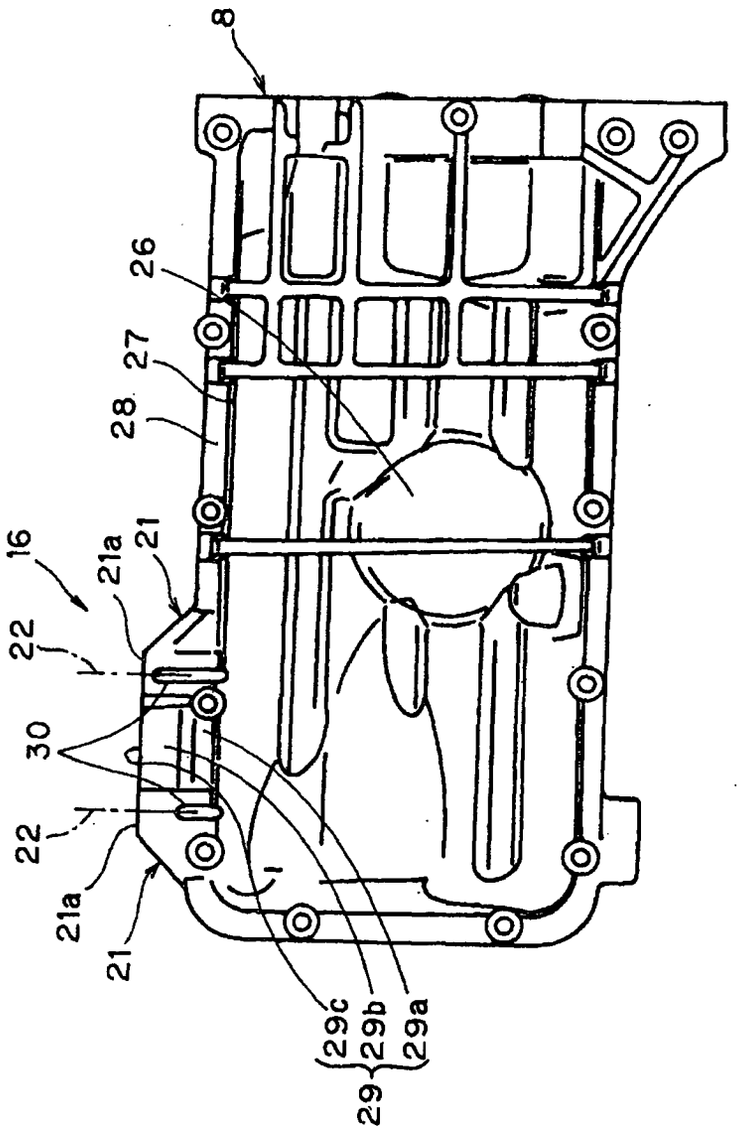

FIG. 7

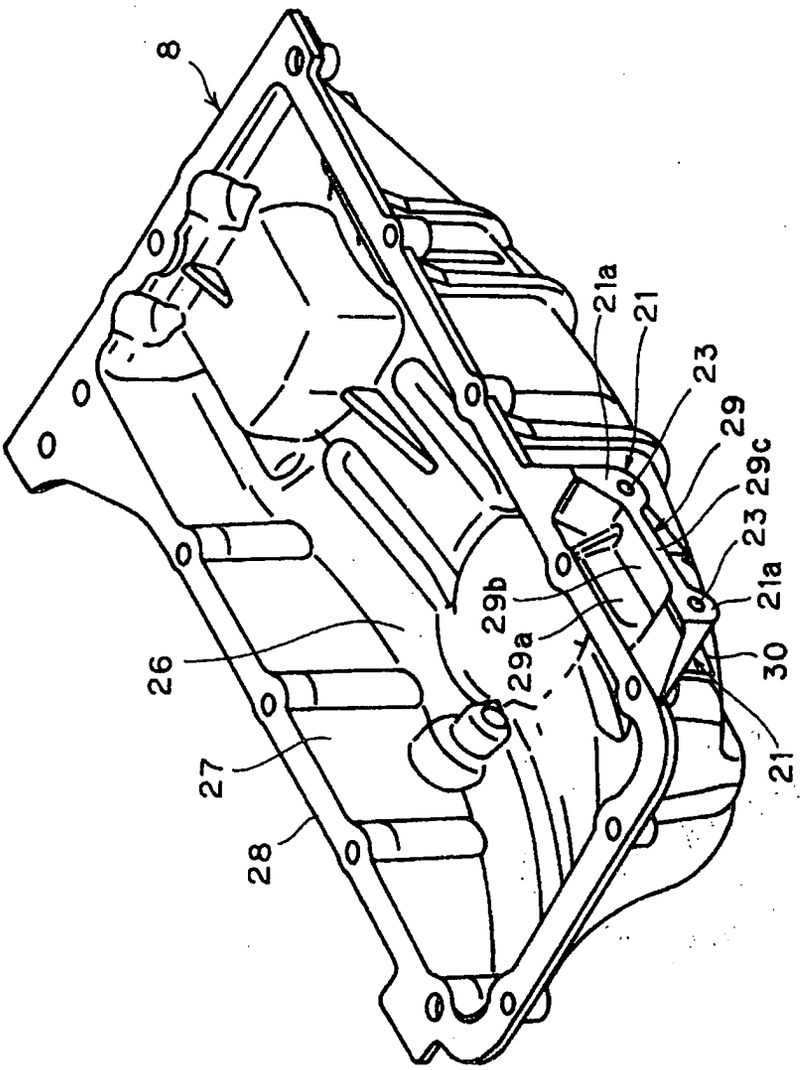

FIG. 8