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

(11) **EP 2 163 738 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
17.03.2010 Bulletin 2010/11

(21) Application number: **08790973.5**

(22) Date of filing: **08.07.2008**

(51) Int Cl.:
F01M 13/00 *(2006.01)* ***F01M 13/04*** *(2006.01)*

(86) International application number:
PCT/JP2008/062336

(87) International publication number:
WO 2009/008427 (15.01.2009 Gazette 2009/03)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

(30) Priority: **09.07.2007 JP 2007179244**

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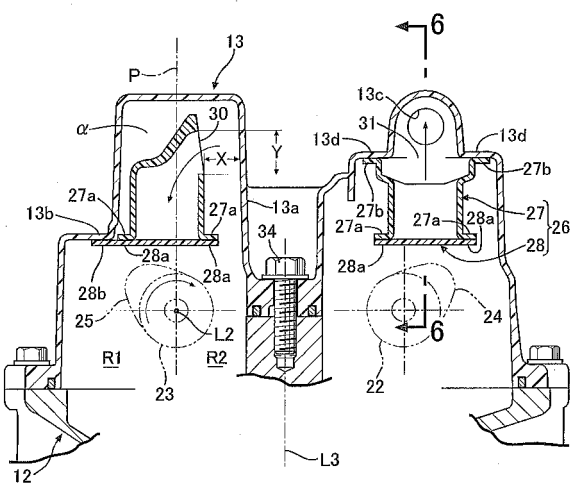
(54) BREATHER DEVICE FOR ENGINE

(57) In a breather device for an engine, since a predetermined gap (α) is formed between an outer surface of a breather chamber (26) disposed in the interior of a head cover (13) and an inner surface of the head cover (13), even if the outside temperature decreases, the gap (α) functions as an insulating space, thereby preventing blow-by gas from freezing in the interior of the breather chamber (26). Moreover, since a blow-by gas inlet (30) formed in a wall face of the breather chamber (26) is made to open at a position that faces the inner surface of the head cover (13), compared with a case in which the blow-by gas inlet (30) is made to open in a lower face of the breather chamber (26), not only can the degree of freedom for the position of the blow-by gas inlet (30) be increased, but it is also possible for an effect in separating oil to be exhibited by means of the gap (α) between the breather chamber (26) and the head cover (13), thereby preventing oil from entering the breather chamber (26).

FIG.5



EP 2 163 738 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a breather device for an engine in which a breather chamber is disposed in the interior of a head cover joined to an engine cylinder head, and oil contained in blow-by gas returning to an intake system via the breather chamber is separated, a predetermined gap being formed between an outer surface of the breather chamber and an inner surface of the head cover.

BACKGROUND ART

[0002] When returning engine blow-by gas to an engine intake system via a breather chamber provided within a head cover, oil contained in the blow-by gas is separated in the breather chamber, thereby preventing oil from contaminating the intake system.

[0003] When the outside temperature becomes low, since the engine head cover is cooled, blow-by gas within the breather chamber disposed in the interior of the engine head cover freezes, and there is a possibility that a blow-by gas passage will be blocked. An arrangement is known from Patent Publication 1 below in which a gap is formed between a head cover and a breather chamber (oil separator), the gap functioning as an insulating space, thus preventing blow-by gas from freezing when the temperature is low.

Patent Publication 1: Japanese Utility Model Registration Publication No. 6-25623

DISCLOSURE OF INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004] However, in the above-mentioned arrangement, since a blow-by gas inlet of the breather chamber is formed in a lower face of the breather chamber, there is the problem that oil that has been swept up by a camshaft rotating in the interior of the cylinder head or oil that has gone to one side as a result of centrifugal force due to turning of a vehicle easily enters the interior of the breather chamber from the blow-by gas inlet.

[0005] The present invention has been accomplished in the light of the above-mentioned circumstances, and it is an object thereof to reliably prevent oil from entering the interior of a breather chamber from a blow-by gas inlet while preventing blow-by gas from freezing in the interior of the breather chamber.

MEANS FOR SOLVING THE PROBLEMS

[0006] In order to attain the above object, according to a first aspect of the present invention, there is provided a breather device for an engine in which a breather chamber is disposed in the interior of a head cover joined to an engine cylinder head, and oil contained in blow-by gas returning to an intake system via the breather chamber is separated, a predetermined gap being formed between an outer surface of the breather chamber and an inner surface of the head cover, **characterized in that** a blow-by gas inlet formed in a wall face of the breather chamber opens at a position that faces an inner surface of the head cover.

[0007] According to a second aspect of the present invention, in addition to the first aspect, a recess in which a combustion chamber interior inserted member is disposed is formed in an upper wall of the head cover, the breather chamber is disposed at a position that avoids the recess, and the blow-by gas inlet opens at a position that faces an inner surface of the recess.

[0008] According to a third aspect of the present invention, in addition to the first or second aspect, when an area around a camshaft that is disposed beneath the breather chamber and is the closest to the blow-by gas inlet is divided by a plane that contains an axis of the camshaft and is parallel to a cylinder axis into a first region on the side where the tip of a cam passes through from bottom to top and a second region on the side where the tip of the cam passes through from top to bottom, the blow-by gas inlet opens in the second region.

[0009] According to a fourth aspect of the present invention, in addition to any one of the first to third aspects, a minimum distance between the inner surface of the head cover and the outer surface of the breather chamber is set smaller than a vertical length of the blow-by gas inlet at a position in which the blow-by gas inlet is formed.

[0010] According to a fifth aspect of the present invention, in addition to any one of the first to fourth aspect, the breather chamber communicates with a blow-by gas outlet passage, and the area of an opening of the blow-by gas inlet is formed larger than the area of the minimum passage cross-section of the blow-by gas outlet passage.

[0011] An exhaust camshaft 23 of an embodiment corresponds to the camshaft of the present invention, an exhaust cam 25 of the embodiment corresponds to the cam of the present invention, an injector 29 of the embodiment corresponds to the combustion chamber interior inserted member of the present invention, and a blow-by gas outlet 31 and coupling 13c of the embodiment correspond to the blow-by gas outlet passage of the present invention.

EFFECTS OF THE INVENTION

[0012] In accordance with the first aspect of the present invention, since the predetermined gap is formed between the outer surface of the breather chamber disposed in the interior of the head cover and the inner surface of the head cover, even if the outside temperature decreases, the gap functions as an insulating space, thereby preventing blow-by gas from freezing. Moreover, since the blow-by gas inlet formed in the wall face of the breather chamber is made to open at a position that faces

the inner surface of the head cover, compared with a case in which a blow-by gas inlet is made to open in a lower face of the breather chamber, not only can the degree of freedom for the position of the blow-by gas inlet be increased, but it is also possible for an effect in separating oil by means of the gap between the breather chamber and the head cover to be exhibited, thereby preventing oil from entering the breather chamber.

[0013] Furthermore, in accordance with the second aspect of the present invention, since the breather chamber is disposed at a position that avoids the recess formed on the upper wall of the head cover, and the blow-by gas inlet is made to open at a position facing the inner surface of the recess, it is possible to make the breather chamber have a complex shape, thereby enhancing the effect in separating oil.

[0014] Moreover, in accordance with the third aspect of the present invention, when the area around the camshaft that is disposed beneath the breather chamber and is the closest to the blow-by gas inlet is divided into the first region on the side where the tip of the cam passes through from bottom to top and the second region on the side where the tip of the cam passes through from top to bottom, since the blow-by gas inlet is made to open in the second region, the blow-by gas inlet is disposed on the opposite side to the side where the cam splashes up oil due to rotation of the camshaft, and it is possible to minimize the amount of oil entering the interior of the breather chamber.

[0015] Furthermore, in accordance with the fourth aspect of the present invention, since the minimum distance between the inner surface of the head cover and the outer surface of the breather chamber at the position where the blow-by gas inlet is formed is set smaller than the vertical length of the blow-by gas inlet, it is possible to exhibit an effect in separating oil by narrowing the passage for the blow-by gas prior to the blow-by gas inlet.

[0016] Moreover, in accordance with the fifth aspect of the present invention, since the area of the opening of the blow-by gas inlet of the breather chamber is set larger than the area of the minimum passage cross-section of the blow-by gas outlet passage, it is possible to reduce the flow rate of the blow-by gas flowing into the blow-by gas inlet and make it difficult for oil to enter the interior of the breather chamber together with the blow-by gas.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

[FIG. 1] FIG. 1 is a sectional view of an engine head part (a sectional view along line 1-1 in FIG. 2). (first embodiment)

[FIG. 2] FIG. 2 is a view from arrow 2 in FIG. 1. (first embodiment)

[FIG. 3] FIG. 3 is a view from arrowed line 3-3 in FIG. 1. (first embodiment)

[FIG. 4] FIG. 4 is an exploded perspective view of a head cover, a breather chamber main body, and a cover plate. (first embodiment)

[FIG. 5] FIG. 5 is a sectional view along line 5-5 in FIG. 3. (first embodiment)

[FIG. 6] FIG. 6 is a sectional view along line 6-6 in FIG. 5. (first embodiment)

[FIG. 7] FIG. 7 is a sectional view along line 7-7 in FIG. 3. (first embodiment)

[FIG. 8] FIG. 8 is a sectional view along line 8-8 in FIG. 7. (first embodiment)

EXPLANATION OF REFERENCE NUMERALS AND SYMBOLS

[0018]

12	Cylinder head
13	Head cover
13a	Recess
13c	Coupling (blow-by gas outlet passage)
23	Exhaust camshaft (camshaft)
25	Exhaust cam (cam)
26	Breather chamber
29	Injector (combustion chamber interior inserted member)
30	Blow-by gas inlet
31	Blow-by gas outlet (blow-by gas outlet passage)
L2	Camshaft axis
L3	Cylinder axis
P	Plane containing camshaft: axis and parallel to cylinder axis
R1	First region
R2	Second region
X	Minimum distance between inner surface of head cover and outer surface of breather chamber
Y	Vertical length of blow-by gas inlet
α	Gap

BEST MODE FOR CARRYING OUT THE INVENTION

[0019] A mode for carrying out the present invention is explained below by reference to the attached drawings.

EMBODIMENT 1

[0020] FIG. 1 to FIG. 8 show an embodiment of the present invention.

[0021] As shown in FIG. 1, in a direct fuel-injection engine, a cylinder head 12 is joined to the upper end of a cylinder block 11, and a head cover 13 is joined to the upper end of the cylinder head 12. In the present specification, the vertical direction is defined such that the cylinder block 11 side is the lower side, and the head cover 13 side is the upper side.

[0022] Formed in the cylinder head 12 are a combustion chamber 14, and an intake port 15 and an exhaust port 16 communicating with the combustion chamber 14, the intake port 15 being opened and closed by an intake

valve 17 and the exhaust port 16 being opened and closed by an exhaust valve 18. A camshaft holder 19 and a cap 20 are superimposed on an upper face of the cylinder head 12 and secured by means of a plurality of bolts 21, and an intake cam 24 and an exhaust cam 25 are provided respectively on an intake camshaft 22 and an exhaust camshaft 23 rotatably supported between the camshaft holder 19 and the cap 20. A breather chamber 26 is disposed between an upper face of the cap 20 and a lower face of the head cover 13. The breather chamber 26 is made of a synthetic resin, and is formed by joining a breather chamber main body 27 on the upper side and a cover plate 28 on the lower side.

[0023] The structure of the breather chamber 26 is now explained by reference to FIG. 2 to FIG. 8.

[0024] As shown in FIG. 2 to FIG. 5, a recess 13a that is recessed toward the cylinder head 12 side along a crankshaft axis L1 (see FIG. 2 and FIG. 3) is formed in a central part of the head cover 13, which has an open lower face, and four injectors 29 (see FIG. 1 and FIG. 2) are disposed therein. The breather chamber 26 is substantially U-shaped overall; a blow-by gas inlet 30 is formed at one end, and a blow-by gas outlet 31 is formed at the other end. An annular space is formed in the interior of the head cover 13 between an outer peripheral wall thereof and the recess 13a, and the U-shaped breather chamber 26 is disposed in this space.

[0025] As clearly shown in FIG. 4, the breather chamber main body 27 is a trough-shaped member having an open lower face, and the open part is blocked by the plate-shaped cover plate 28. That is, a joining face 28a (section shown by light-colored shading) formed on the outer periphery of the cover plate 28 is joined by vibration welding to a joining flange 27a formed along the outer periphery of the breather chamber main body 27, thereby forming the breather chamber 26 in a tubular shape. A plurality (15 in the embodiment) of joining flanges 28b (section shown by dark-colored shading) are projectingly provided on the outside of the joining face 28a of the cover plate 28 in an adjacent state, and these joining flames 28b are vibration welded to joining faces 13b (see FIG. 5) on the inner surface of the head cover 13. The joining faces 13b of the head cover are also shown by shading in FIG. 3.

[0026] In a state in which the breather chamber 26 is fixed to the interior of the head cover 13 as above, a gap α (see FIG. 1, FIG. 5 to FIG. 7) for forming an insulating space is formed between the outer surface of the breather chamber main body 27 and the inner surface of the head cover 13.

[0027] As is clear from FIG. 4, the blow-by gas inlet 30 formed at one end of the breather chamber main body 27 opens sideways. The blow-by gas outlet 31 formed at the other end of the breather chamber main body 27 opens upward, and an annular joining flange 27b is formed on the periphery thereof. An oil drop hole 28c is formed in an intermediate section of the cover plate 28, and paired first and second baffle plates 28d and 28e are provided as two pairs between the oil drop hole 28c and the blow-by gas inlet 30.

[0028] As is clear from FIG. 3, FIG. 7 and FIG. 8, a first hanging wall 27c and a second hanging wall 27d hang from an upper wall of the breather chamber main body 27; the first hanging wall 27c is formed in a comb shape separated into three, and the second hanging wall 27d has a large number of vertically extending ribs 27e formed on a face on the first hanging wall 27c side. The first baffle plate 28d, the first hanging wall 27c, the second baffle plate 28e and the second hanging wall 27d are disposed in turn, and they form a labyrinth 32 for suppressing the flow of blow-by gas. Two labyrinths 32 having the above arrangement are disposed in series.

[0029] As is clear from FIG. 3 to FIG. 5, the blow-by gas inlet 30 of the breather chamber 26 opens sideways so as to face the inner surface of the recess 13a of the head cover 13. The exhaust camshaft 23, which is on the side close to the blow-by gas inlet 30 of the breather chamber 26, is disposed therebeneath, and the exhaust camshaft 23 rotates clockwise in FIG. 5. With a plane P passing through an axis L2 of the exhaust camshaft 23 and extending in the direction of a cylinder axis L3 as a reference, in a first region R1 on the left side thereof the exhaust cam 25 rotates from bottom to top, and in a second region R2 on the right side thereof the exhaust cam 25 rotates from top to bottom. The blow-by gas inlet 30 of the breather chamber 26 opens in a direction away from the plane P in the second region R2.

[0030] As is clear from FIG. 3, FIG. 5, and FIG. 6, the joining flange 27b surrounding the blow-by gas outlet 31 of the breather chamber main body 27 is joined to a lower face of an upper wall of the head cover 13 by vibration welding. A coupling 13c is integrally formed on the breather chamber main body 27 in the vicinity of the blow-by gas outlet 31, and this coupling 13c is connected to an engine intake system via a breather hose, which is not illustrated.

[0031] The area of an opening of the blow-by gas inlet 30 is set larger than the minimum passage cross-sectional area of the blow-by gas outlet passage, that is, the blow-by gas outlet 31 or the coupling 13c. This is because, since the quantity of flow of a fluid is the product of the flow path cross-sectional area and the flow rate, the larger the flow path cross-sectional area, the lower the flow rate can be made. It is therefore possible by ensuring a large area for the opening of the blow-by gas inlet 30 to reduce the flow rate of blow-by gas in this section and prevent effectively oil from entering the breather chamber 26 together with blow-by gas.

[0032] As is clear from FIG. 1, the oil drop hole 28c formed in the cover plate 28 of the breather chamber 26 communicates with an oil pan, which is not illustrated, via an oil return passage 20a formed in the cap 20, an oil return passage 19a formed in the camshaft holder 19, an oil return passage 12a formed in the cylinder head 12, and an oil return passage 11a formed in the cylinder block 11. In this way, forming the oil return passages 19a

and 20a from the breather chamber 26 by utilizing the camshaft holder 19 and the cap 20 enables the lateral width of the head cover 13 to be made small compared with a case in which they are formed on the exterior of the camshaft holder 19 and the cap 20.

[0033] As is clear from FIG. 5, at the position where the blow-by gas inlet 30 is formed, a minimum distance X between the inner surface of the recess 13a of the head cover 13 and the outer surface of the breather chamber 26 is set smaller than a vertical length Y of the blow-by gas inlet 30.

[0034] As shown in FIG. 2, FIG. 3, and FIG. 5, with regard to the head cover 13 provided with the breather chamber 26 having the above-mentioned structure, its outer peripheral part is fixed to the upper face of the cylinder head 12 via a plurality of bolts 33, and its recess 13a is fixed to the upper face of the cylinder head 12 via a plurality of bolts 34.

[0035] The operation of the embodiment of the present invention having the above-mentioned arrangement is now explained.

[0036] Since the breather chamber 26, to which blow-by gas is supplied, is provided with the gap α, which functions as an insulating space, between itself and the head cover 13, it is possible to prevent blow-by gas within the breather chamber 26 from freezing when the outside temperature decreases, thereby avoiding blockage of the blow-by gas passage.

[0037] Blow-by gas within the head cover 13 flows into the interior of the breather chamber 26 through the blow-by gas inlet 30 provided at one end of the breather chamber 26, which has a substantially U-shaped form, and since the blow-by gas inlet 30 opens sideways so as to face the inner surface of a side wall of the recess 13a of the head cover 13 rather than opening downward, even if the blow-by gas inlet 30 is formed large so as to reduce the flow rate of blow-by gas, it is possible to prevent effectively oil splashed up by a valve operating mechanism disposed beneath the breather chamber 26 from entering the interior of the breather chamber 26 through the blow-by gas inlet 30. Moreover, compared with a case in which the blow-by gas inlet 30 opens downward, the degree of freedom in layout of the blow-by gas inlet 30 can be enhanced.

[0038] In particular, in FIG. 5 since the blow-by gas inlet 30 is disposed in the second region R2 in which the exhaust cam 25 provided on the exhaust camshaft 23 moves from top to bottom, that is, a region in which oil is not splashed up toward the breather chamber 26, it is possible to further reliably prevent oil from entering the breather chamber 26.

[0039] Furthermore, since in the vicinity of the blow-by gas inlet 30 the minimum distance X between the inner surface of the recess 13a of the head cover 13 and the outer surface of the breather chamber 26 is set smaller than the vertical length Y of the blow-by gas inlet 30, it becomes difficult for oil to enter between the inner surface of the recess 13a of the head cover 13 and the outer surface of the breather chamber 26, and it is thereby also possible to prevent oil from entering the breather chamber 26.

[0040] Although a trace amount of oil is still contained in blow-by gas that has flowed into the interior of the breather chamber 26 through the blow-by gas inlet 30, since the blow-by gas passes through the two labyrinths 32 and 32 (see FIG. 3, FIG. 7, and FIG. 8) while flowing through the interior of the breather chamber 26, oil is reliably separated from the blow-by gas. The oil that has been separated from blow-by gas flows along a bottom wall of the breather chamber 26 and is returned to the oil pan through the oil drop hole 28c (see FIG. 1 and FIG. 3) via the oil return passages 20a, 19a, 12a, and 11a.

[0041] Blow-by gas from which oil has been separated as above further flows toward the blow-by gas outlet 31 through the interior of the breather chamber 26, and oil that has not been separated by the two labyrinths 32 and 32 is further separated here. In this process, since the shape of the breather chamber 26 is a U shape that surrounds the recess 13a formed in a central part of the head cover 13, the shape of the breather chamber 26 is complex, thus promoting separation of oil. Blow-by gas from which oil has finally been separated returns to the engine intake system from the blow-by gas outlet 31 via the coupling 13c and the breather hose, which is not illustrated.

[0042] An embodiment of the present invention is explained above, but the present invention may be modified in a variety of ways as long as the modifications do not depart from the spirit and scope thereof.

[0043] For example, in the embodiment a direct fuel-injection engine is illustrated, but the present invention may be applied to both a gasoline engine and a diesel engine, and may also be applied to a port-injection type gasoline engine. In this case, instead of the injectors 29 an ignition plug becomes the combustion chamber interior inserted member.

[0044] Furthermore, in the embodiment the blow-by gas inlet 30 of the breather chamber 26 opens sideways toward the inner surface of the recess 13a of the head cover 13, but when the blow-by gas inlet 30 opens sideways toward the inner surface of an outer peripheral wall of the head cover 13 or opens upward toward the inner surface of a ceiling wall of the head cover 13, it is also possible to prevent effectively oil from entering the interior of the breather chamber 26 through the blow-by gas inlet 30.

Claims

1. A breather device for an engine in which a breather chamber (26) is disposed in the interior of a head cover (13) joined to an engine cylinder head (12), and oil contained in blow-by gas returning to an intake system via the breather chamber (26) is separated, a predetermined gap (α) being formed be-

tween an outer surface of the breather chamber (26) and an inner surface of the head cover (13),
characterized in that a blow-by gas inlet (30) formed in a wall face of the breather chamber (26) opens at a position that faces an inner surface of the head cover (13).

2. The breather device for an engine according to Claim 1, wherein a recess (13a) in which a combustion chamber interior inserted member (29) is disposed is formed in an upper wall of the head cover (13), the breather chamber (26) is disposed at a position that avoids the recess (13a), and the blow-by gas inlet (30) opens at a position that faces an inner surface of the recess (13a).

3. The breather device for an engine according to Claim 1 or Claim 2, wherein when an area around a camshaft (23) that is disposed beneath the breather chamber (26) and is the closest to the blow-by gas inlet (30) is divided by a plane (P) that contains an axis (L2) of the camshaft (23) and is parallel to a cylinder axis (L3) into a first region (R1) on the side where the tip of a cam (25) passes through from bottom to top and a second region (R2) on the side where the tip of the cam (25) passes through from top to bottom, the blow-by gas inlet (30) opens in the second region (R2).

4. The breather device for an engine according to any one of Claim 1 to Claim 3, wherein a minimum distance (X) between the inner surface of the head cover (13) and the outer surface of the breather chamber (26) is set smaller than a vertical length (Y) of the blow-by gas inlet (30) at a position in which the blow-by gas inlet (30) is formed.

5. The breather device for an engine according to any one of Claim 1 to Claim 4, wherein the breather chamber (26) communicates with a blow-by gas outlet passage (31, 13c), and the area of an opening of the blow-by gas inlet (30) is formed larger than the area of the minimum passage cross-section of the blow-by gas outlet passage (31, 13c).

FIG.1

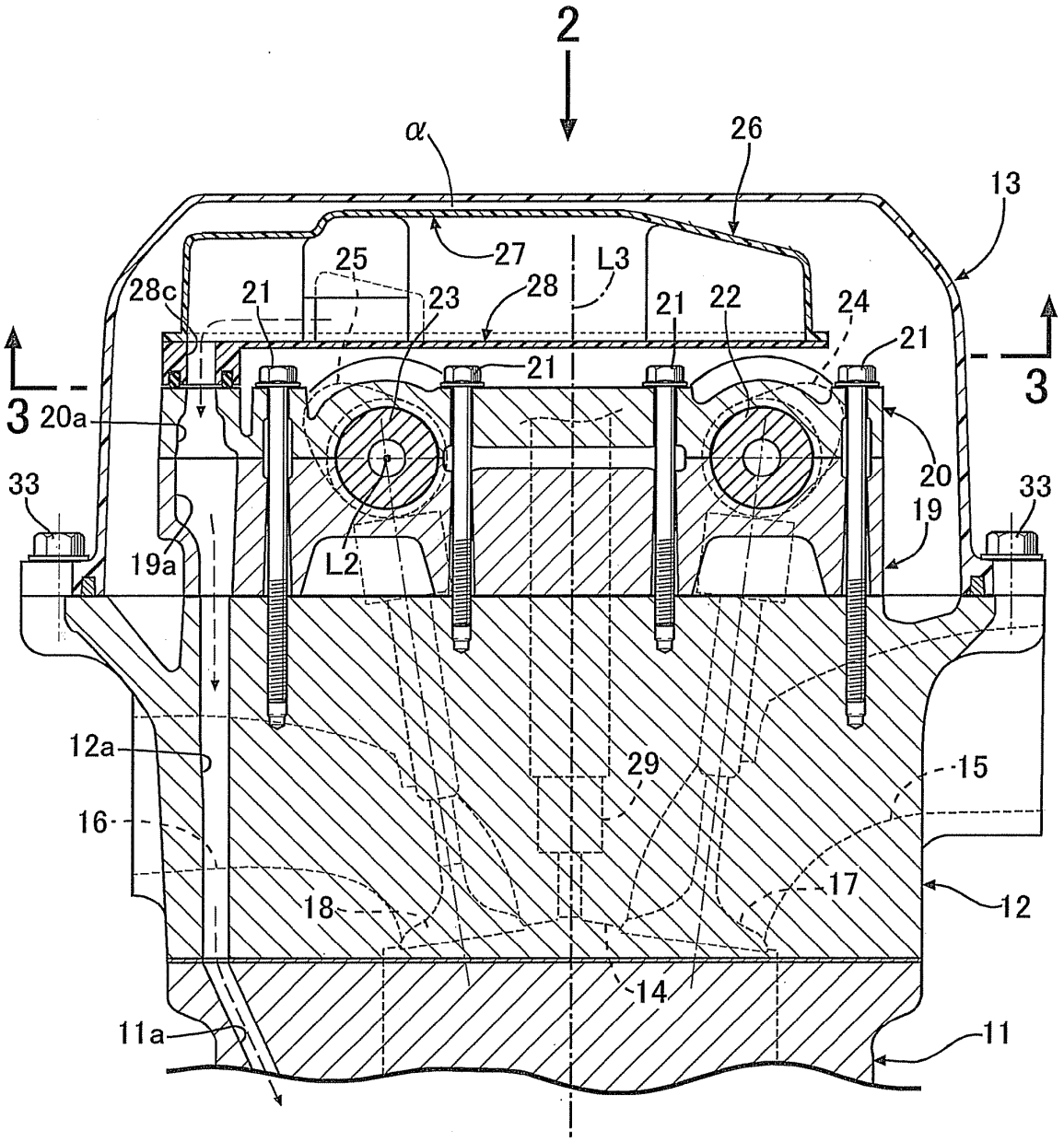

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FIG.2

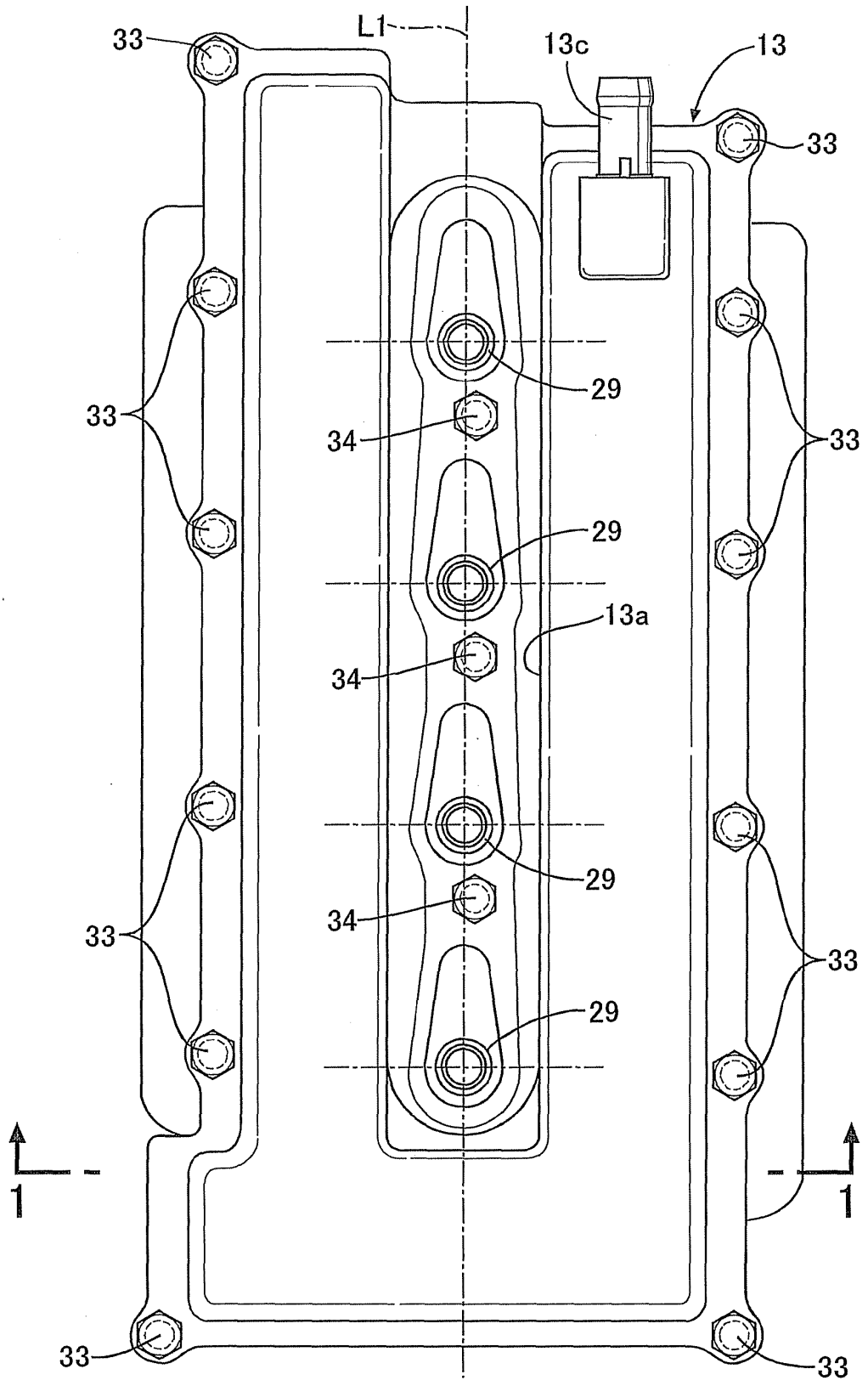

FIG.3

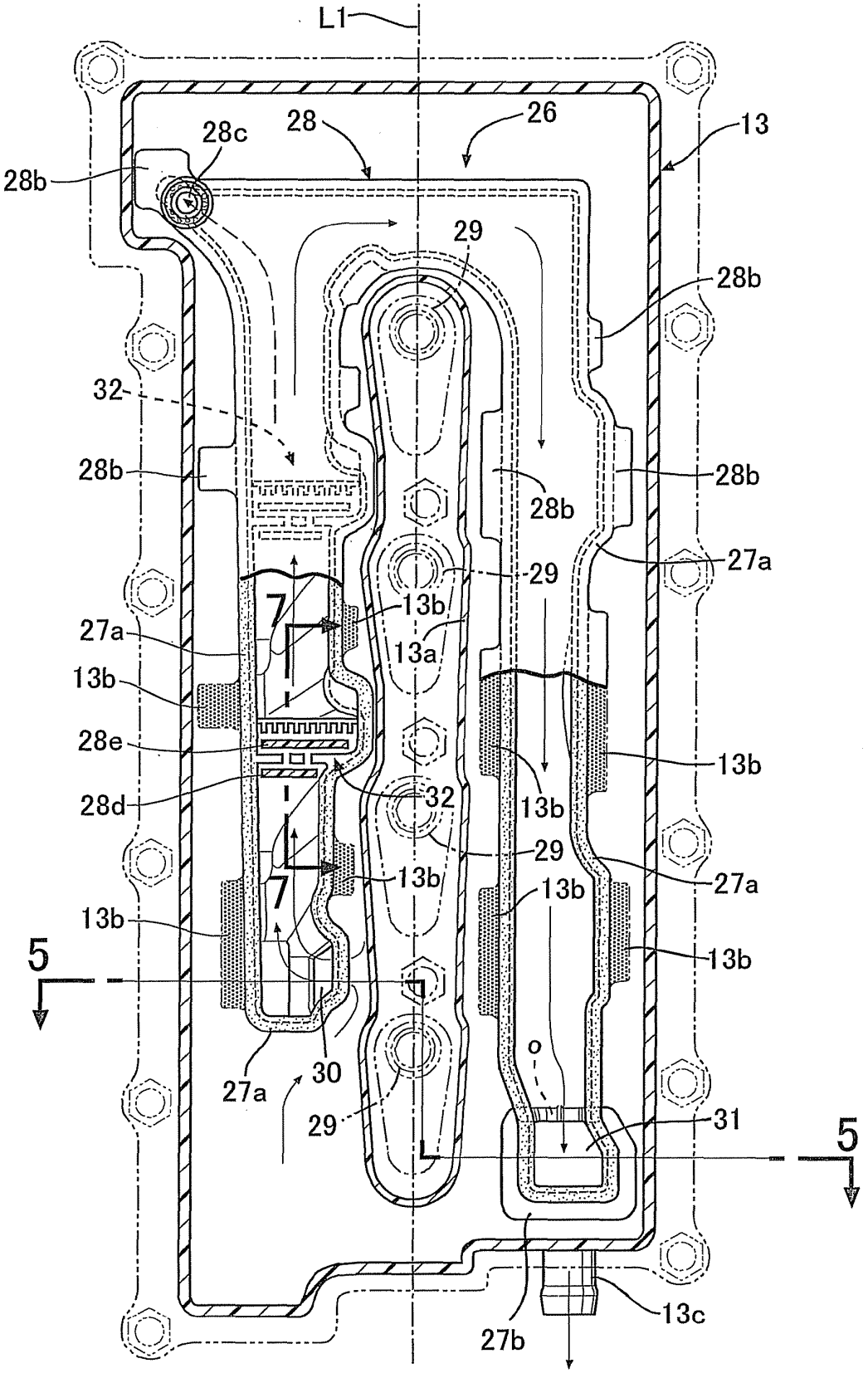
L1
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FIG.4

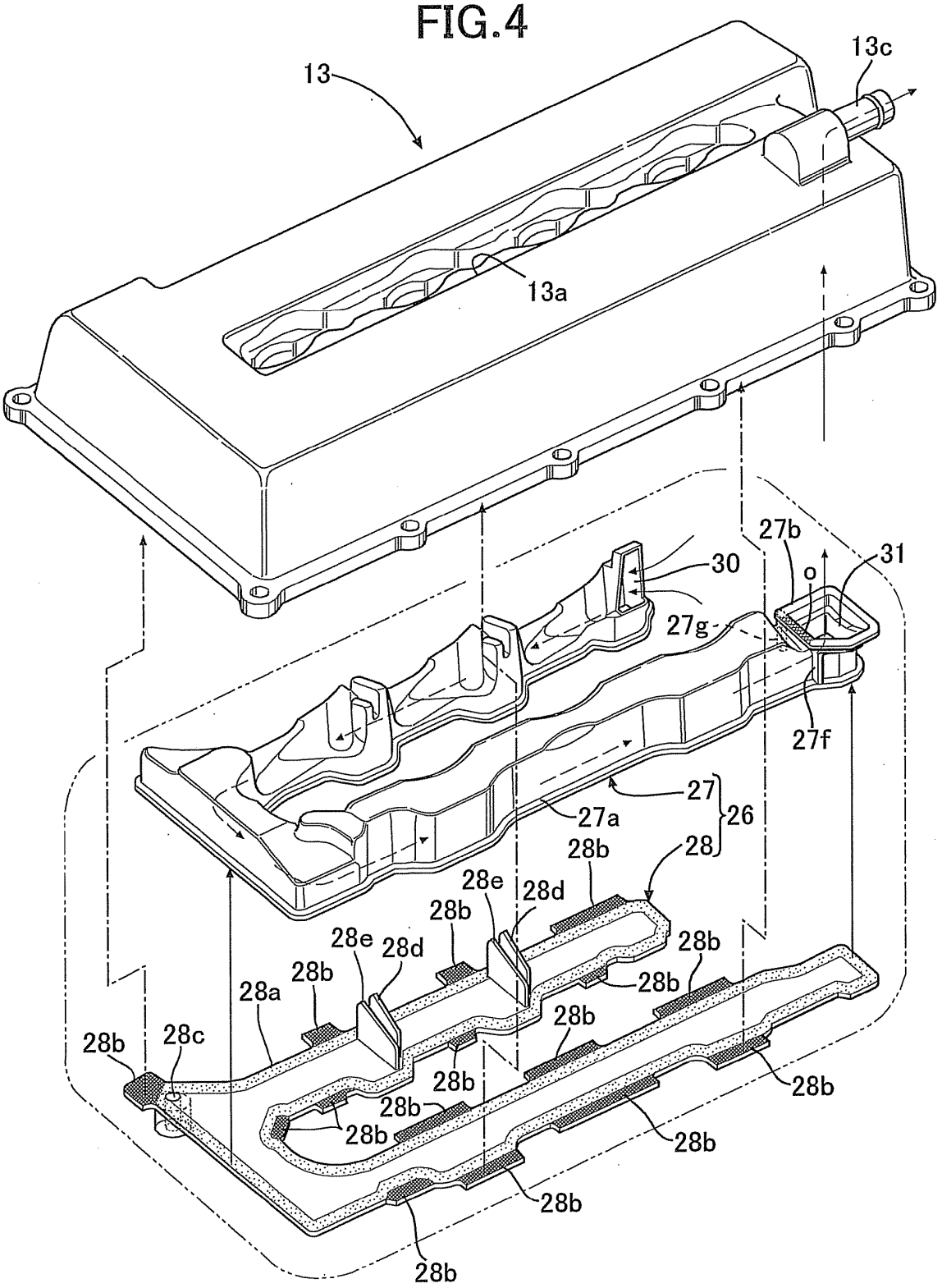
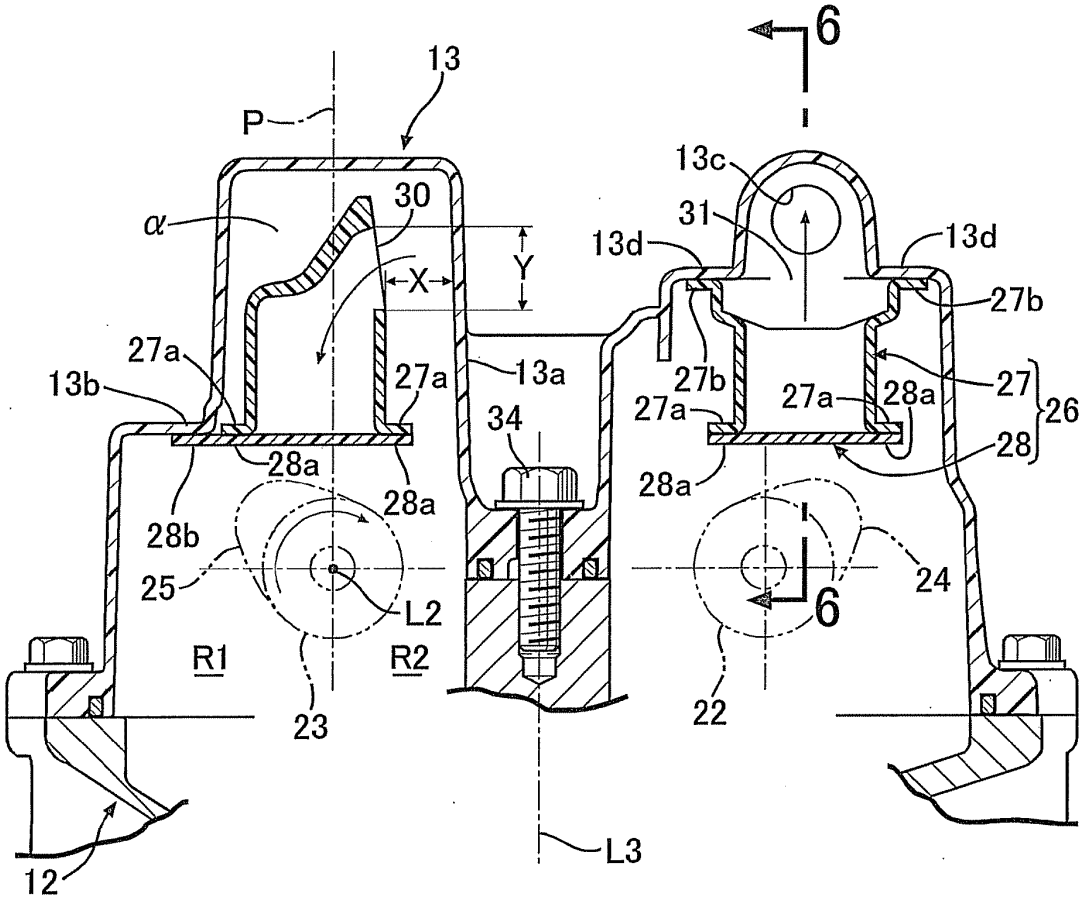


FIG.5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26
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L3
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FIG.6

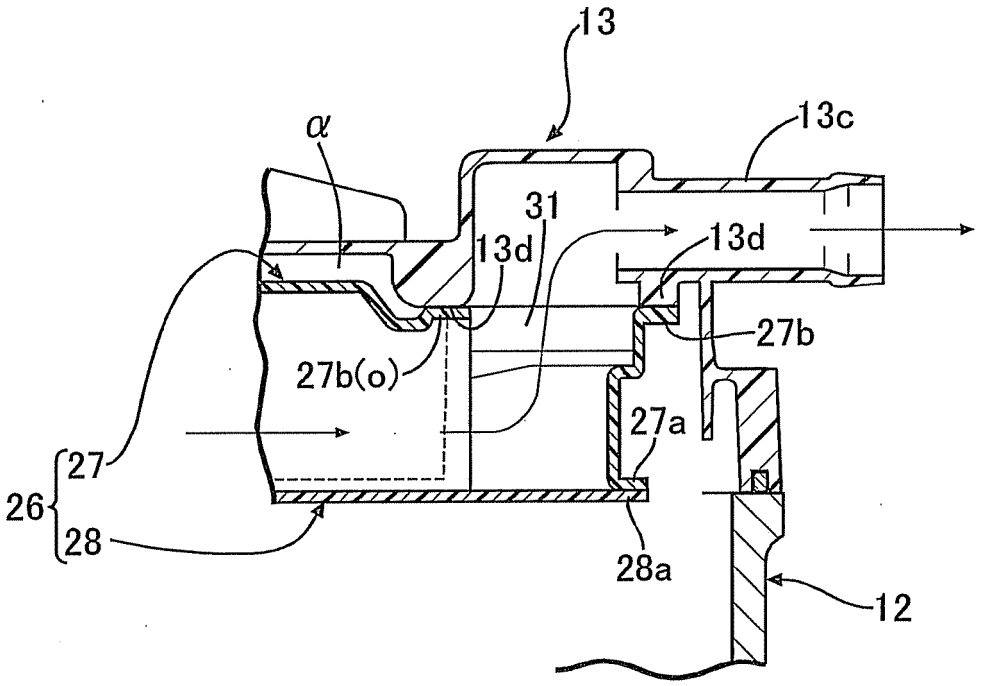


FIG.7

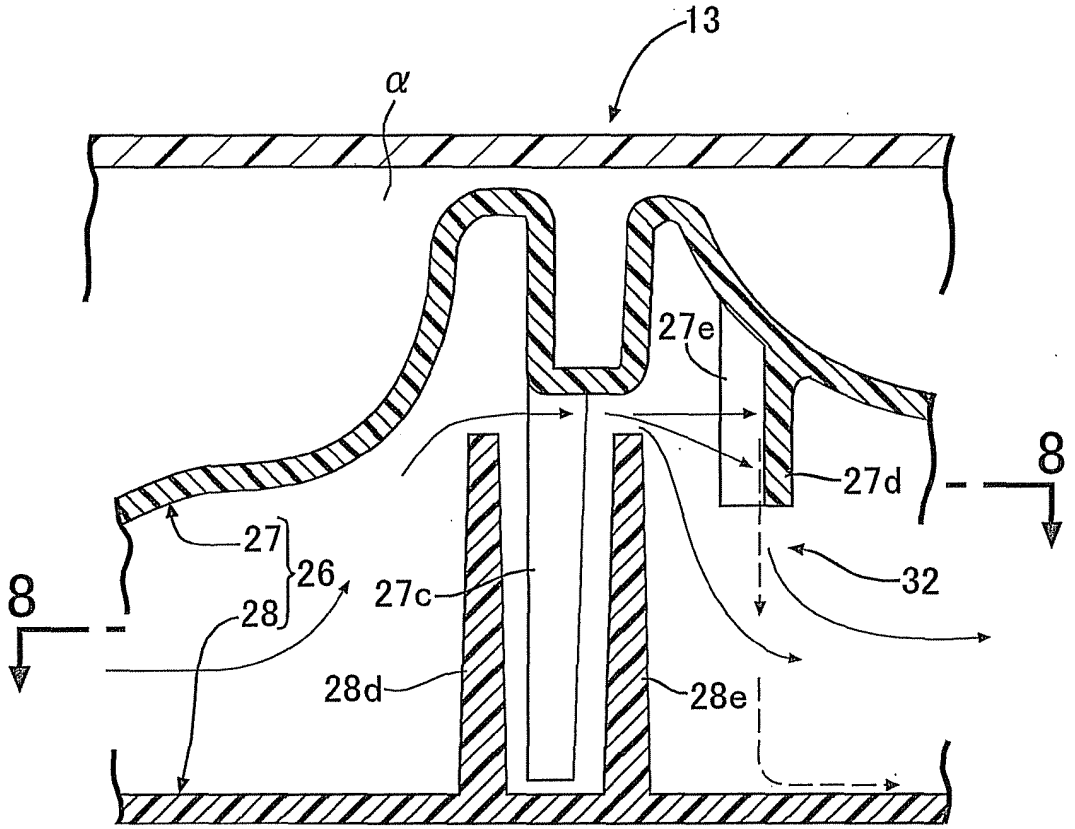
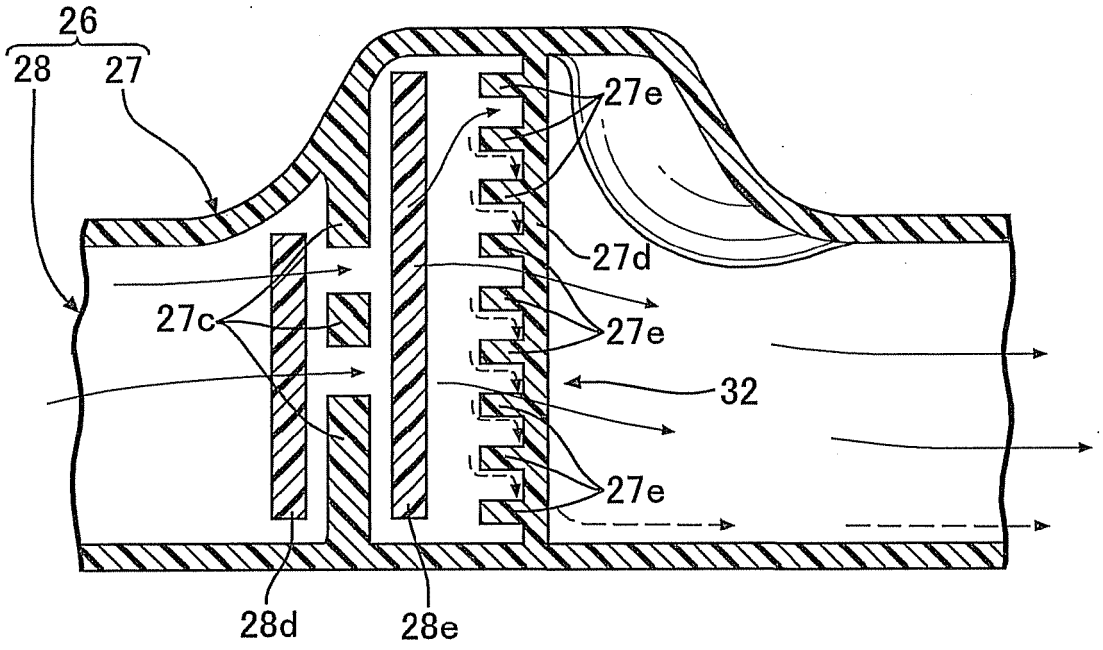


FIG.8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/062336

A. CLASSIFICATION OF SUBJECT MATTER
F01M13/00(2006.01)i, *F01M13/04*(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)
F01M13/00, F01M13/04

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 1996-2008
Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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 6-288219 A (Suzuki Motor Corp.), 11 October, 1994 (11.10.94), Full text; Fig. 1 (Family: none)	1-5
Y	JP 5-171916 A (Mazda Motor Corp.), 09 July, 1993 (09.07.93), Full text; Figs. 2, 3, 7 (Family: none)	1-5
A	JP 2006-22700 A (Toyota Motor Corp.), 26 January, 2006 (26.01.06), Par. Nos. [0033] to [0035]; Fig. 5 (Family: none)	1

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 October, 2008 (07.10.08)	21 October, 2008 (21.10.08)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/062336

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 88378/1985(Laid-open No. 204908/1986) (Mazda Motor Corp.), 24 December, 1986 (24.12.86), Description, page 7, line 9 to page 8, line 2; Fig. 4 (Family: none)	4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 6025623 A **[0003]**