



(11)

EP 3 211 189 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
30.08.2017 Bulletin 2017/35

(51) Int Cl.:
F01M 13/04 (2006.01) **F02M 35/04** (2006.01)
F02M 35/10 (2006.01) **F02M 35/14** (2006.01)

(21) Application number: **17152582.7**

(22) Date of filing: **23.01.2017**

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

(71) Applicant: **Toyota Boshoku Kabushiki Kaisha**
Kariya-shi, Aichi 448-8651 (JP)

(72) Inventor: **NAWA, Teruyoshi**
Kariya-shi, Aichi 448-8651 (JP)

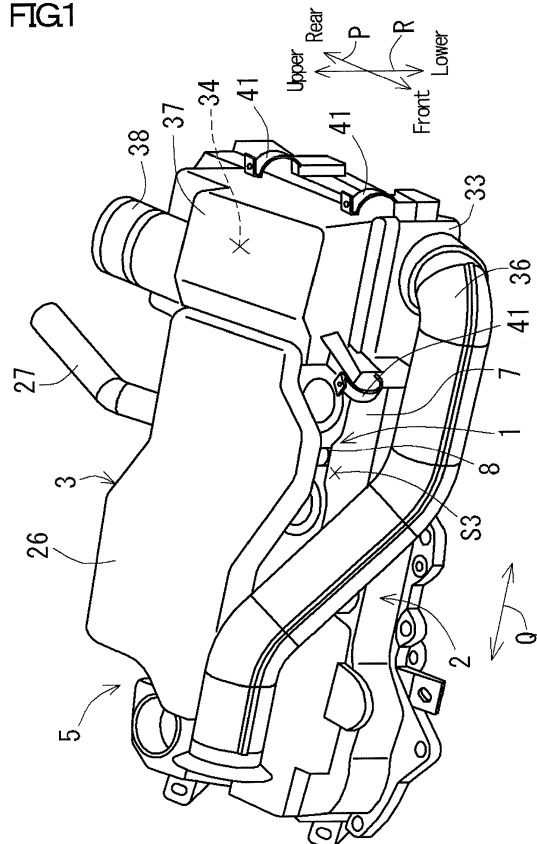
(74) Representative: **TBK**
Bavariaring 4-6
80336 München (DE)

(30) Priority: **25.02.2016 JP 2016034801**

(54) **CONNECTION STRUCTURE OF BLOW-BY GAS HOSE**

(57) A connection structure 1 of blowby gas hose according to the present invention is intended to connect a cylinder head cover 2 and an intake system member 3 of an automobile engine. The cylinder head cover has, on its upper surface part, a bulging section 7 provided to bulge upward and a blowby gas outflow section 8 provided to protrude upward. The intake system member is mounted on the cylinder head cover so as to cover the blowby gas outflow section from above. The blowby gas outflow section is provided, on its upper end side, with a connecting section 17 to which the lower end part of a blowby gas hose 4 extending from the intake system member is connected. The connecting section is arranged above the upper surface of the bulging section.

FIG1



Description

[Technical Field]

[0001] The present invention relates to a connection structure of blowby gas hose, and more specifically to a connection structure of blowby gas hose which connects a cylinder head cover and an intake system member of an automobile engine.

[Background Art]

[0002] A conventional connection structure of blowby gas hose which connects a cylinder head cover and an intake system member of an automobile engine is commonly known (for example, see Patent Literature 1: JP 2001-263036 A). As this connection structure 101 of blowby gas hose, there has been proposed a connection structure of blowby gas hose including a cylinder head cover 102 having, on its upper surface part, a bulging section 107 for forming a separation space S1 which separates oil in blowby gas generated in the engine, the bulging section 107 being provided to bulge upward, and a blowby gas outflow section 108 having therein a blowby gas outflow passage S2 which is connected to the separation space S1, the blowby gas outflow section 108 being provided to protrude upward, as shown in FIG. 11 and FIG. 12. An intake system member 103 is mounted on the cylinder head cover 102 so as to cover the blowby gas outflow section 108 from above. The blowby gas outflow section 108 is provided, on its upper end side, with a connecting section 117 to which the lower end part of a blowby gas hose 104 extending from the intake system member 103 is connected. The connecting section 117 is arranged below the upper surface of the bulging section 107. Further, a tightening tool 131 which tightens the lower end part connected to the connecting section 117 of the blowby gas hose 104 is provided on the outer peripheral side of the lower end part.

[0003] In the conventional connection structure 101 of blowby gas passage, however, the intake system member 103 covers the blowby gas outflow section 108 from above, and the connecting section 117 of the blowby gas outflow section 108 is arranged below the upper surface of the bulging section 107 and is hidden behind the bulging section 107, thereby making it difficult to confirm the connection state of the lower end part of the blowby gas hose 104 and the tightening state of the tightening tool 131 through the space S3 above the bulging section 107 in an engine room of an automobile. It is also conceivable to decrease the height of the bulging section 107 in order to solve this problem. In that case, however, the volume of the separation space S 1 which separates the oil contained in the blowby gas is also decreased, leading to deterioration in oil separation performance.

[0004] Patent Literature 1 indicated above describes a structure in which a gas outflow section of a cylinder head cover and an inlet pipe of an intake pipe are con-

nected by a rubber hose and the connecting section of the rubber hose is tightened by a clamp fitting, in a PCV system (Positive Crankcase Ventilation System) of an automobile engine (see FIG. 8 of Patent Literature 1).

Also, there is a case where, in an engine room of an automobile, the arrangements of various auxiliary machines of an engine are determined depending on the requirements of individual vehicles; an intake passage formed integrally with an air cleaner is arranged on a cylinder head cover; and a blowby gas passage which connects the cylinder head cover and the intake passage is provided along the vertical direction, as disclosed in Patent Literature 2 (JP 2005-083268 A). In this case, the connecting section of the blowby gas passage has a structure difficult to see from the outside. Especially when connection is established using the rubber hose and clamp fitting described in Patent Literature 1, it is difficult to confirm the connection state of the rubber hose and the tightening state of the clamp fitting.

[Citation List]

[Patent Literature]

[0005]

Patent Literature 1: JP 2001-263036 A

Patent Literature 2: JP 2005-083268 A

[Summary of Invention]

[0006] The embodiment of the present invention has been made in light of the actual situation described above, and an object thereof is to provide a connection structure of blowby gas hose, which ensures easy visual confirmation of the connection state of the blowby gas hose and also which can improve the oil separation performance of a blowby gas.

[0007] One aspect of the present embodiments provides a connection structure of a blowby gas hose for connecting a cylinder head cover and an intake system member of an automobile engine, wherein the cylinder head cover has, on its upper surface part, a bulging section for forming a separation space which separates oil in blowby gas generated in the engine, the bulging section being provided to bulge upward, and a blowby gas outflow section having therein a blowby gas outflow passage which is connected to the separation space, the blowby gas outflow section being provided to protrude upward, wherein the intake system member is mounted on the cylinder head cover so as to cover the blowby gas outflow section from above, wherein the blowby gas outflow section is provided, on its upper end side, with a connecting section to which the lower end part of the blowby gas hose extending from the intake system member is connected, and wherein the connecting section is arranged above the upper surface of the bulging section.

[0008] In a further aspect, the intake system member

may include a blowby gas passage section to which the upper end part of the blowby gas hose is connected and a flat resonator section which is provided in the upper part of the blowby gas passage section so as to cover the blowby gas passage section.

[0009] In a further aspect, the cylinder head cover may be provided with a case section whose upper part is opened to one end side in the vehicle width direction of an automobile, the intake system member may be provided with a lid section which closes the opening of the case section, and the case section closed by the lid section may have therein an air cleaner room which is connected to the resonator section.

[0010] In a further aspect, the blowby gas outflow section may include a bulking section which rises from the upper surface part of the cylinder head cover at a height equal to or higher than the height of the bulging section and which has the connecting section provided in its upper part, and the bulking section may have an internal space provided with an oil separation mechanism which separates oil contained in the blowby gas flowing in the internal space.

[0011] In a further aspect, the bulking section may include a cylindrical outer peripheral wall and a flange extending inward from the upper end of the outer peripheral wall, and the oil separation mechanism may include a cylindrical rib extending downward from the inner peripheral end of the flange.

[0012] In a further aspect, a tightening tool which tightens the lower end part connected to the connecting section of the blowby gas hose may be provided on the outer peripheral side of the lower end part.

[0013] In a further aspect, the engine may be a front engine, the blowby gas outflow section may be arranged behind the bulging section in the longitudinal direction of the automobile, the intake system member may cover the bulging section from above, and a space through which the lower end part of the blowby gas hose can be visually confirmed from the front of an engine room of the automobile may be formed between the intake system member and the bulging section.

[0014] According to the connection structure of blowby gas hose of this embodiment, the cylinder head cover has, on its upper surface part, a bulging section for forming a separation space which separates oil in blowby gas generated in the engine, the bulging section being provided to bulge upward, and a blowby gas outflow section having therein a blowby gas outflow passage which is connected to the separation space, the blowby gas outflow section being provided to protrude upward. The intake system member is mounted on the cylinder head cover so as to cover the blowby gas outflow section from above. The blowby gas outflow section is provided, on its upper end side, with a connecting section to which the lower end part of the blowby gas hose extending from the intake system member is connected. The connecting section is arranged above the upper surface of the bulging section connecting section. Thus, even in the case

of types in which the intake system member is mounted on the cylinder head cover, the connection state of the blowby gas hose can be easily visually confirmed through the space above the bulging section in the automobile engine room. As a result, the load of the confirming operation during engine assembling and maintenance is greatly reduced. Further, the increase in the protruding height of the blowby gas outflow section enlarges the space volume of the separation space plus the blowby gas outflow passage, and enhances the flow rate of the blowby gas flowing through the blowby gas outflow passage having a relatively small cross section. As a result, the oil separation performance of the blowby gas can be improved.

[0015] Also, when the intake system member includes a blowby gas passage section and a flat resonator section, the visibility from above would be further reduced by the flat resonator section, but the connection state of the blowby gas hose can be easily visually confirmed through the space above the bulging section in the automobile engine room. Further, the blowby gas outflow section is covered with the relatively thin flat resonator section, and thus not only the main part of the intake system member but also the entire engine can be made compact in the vertical direction.

[0016] Also, when the cylinder head cover is provided with a case section; the intake system member is provided with a lid section; and the case section closed by the lid section has therein an air cleaner room, not only the main part of the intake system member but also the entire engine can be made more compact in the vertical direction.

[0017] Also, when the blowby gas outflow section includes a bulking section which rises from the upper surface part of the cylinder head cover at a height equal to or higher than the height of the bulging section and which has the connecting section provided in its upper part; and the bulking section has an internal space having an oil separation mechanism provided therein, efficacious oil separating action can be exerted at the blowby gas outflow section, and the internal space of the bulking section for securing the visibility of the connection state of the blowby gas hose can be utilized more effectively.

[0018] Also, when the bulking section includes an outer peripheral wall and a flange; and the oil separation mechanism includes a cylindrical rib, oil can be trapped in a relatively narrow space enclosed by the outer peripheral wall, flange and cylindrical rib, so that the oil separation performance of the blowby gas is further enhanced.

[0019] Also, when a tightening tool which tightens the lower end part connected to the connecting section of the blowby gas hose is provided on the outer peripheral side of the lower end part, the tightening state of the tightening tool as well as the connection state of the blowby gas hose can be easily visually confirmed.

[0020] Further, when the engine is a front engine; the blowby gas outflow section is arranged behind the bulging section in the longitudinal direction of the automobile;

the intake system member covers the bulging section from above; and a space through which the lower end part of the blowby gas hose can be visually confirmed from the front of an engine room of the automobile is formed between the intake system member and the bulging section, the connection state of the blowby gas hose can be easily visually confirmed from the front of the automobile engine room.

[Brief Description of Drawings]

[0021] The present invention is further described in the detailed description which follows, in reference to the noted plurality of drawings by way of non-limiting examples of exemplary embodiments of the present invention, in which like reference numerals represent similar parts throughout the several views of the drawings, and wherein:

[Figure 1]

FIG. 1 is a perspective view of a cylinder head cover assembly including a connection structure of blowby gas hose according to an Example.

[Figure 2]

FIG. 2 is a plan view of the cylinder head cover assembly.

[Figure 3]

FIG. 3 shows a III-III line cross section in FIG. 2.

[Figure 4]

FIG. 4 is an enlarged view showing the essential part in FIG. 3.

[Figure 5]

FIG. 5 is a perspective view of a cylinder head cover according to the Example when viewed from the upper surface side.

[Figure 6]

FIG. 6 is a perspective view of an intake system member according to the Example when viewed from the lower surface side.

[Figure 7]

FIG. 7 is an enlarged view showing the essential part of the cylinder head cover (in a state where a baffle plate has been removed) when viewed from below.

[Figure 8]

FIG. 8 is a perspective view of a blowby gas hose and tightening tools according to the Example.

[Figure 9]

FIGS. 9(a) and 9(b) are explanatory views for explaining a connection structure of blowby gas hose according to Variation 1, in which FIG. 9(a) shows a vertical cross section of the essential part and FIG. 9(b) shows a b-b line cross section in FIG. 9(a).

[Figure 10]

FIGS. 10(a) and 10(b) are explanatory views for explaining a connection structure of blowby gas hose according to Variation 2, in which FIG. 10(a) shows a vertical cross section of the essential part and FIG. 10(b) shows a b-b line cross section in FIG. 10(a).

[Figure 11]

FIG. 11 is a perspective view of a cylinder head cover assembly including a conventional connection structure of blowby gas hose.

[Figure 12]

FIG. 12 shows a XII-XII line cross section in FIG. 11.

[Description of Embodiments]

[0022] The particulars shown herein are by way of example and for purposes of illustrative discussion of the embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the present invention. In this regard, no attempt is made to show structural details of the present invention in more detail than is necessary for the fundamental understanding of the present invention, the description is taken with the drawings making apparent to those skilled in the art how the forms of the present invention may be embodied in practice.

<Connection structure of blowby gas hose>

[0023] The connection structure of blowby gas hose according to this embodiment is a connection structure (1) of blowby gas hose for connecting a cylinder head cover (2) and an intake system member (3) of an automobile engine. In this structure, the cylinder head cover has, on its upper surface part, a bulging section (7) for forming a separation space (S1) which separates oil in blowby gas generated in the engine, the bulging section being provided to bulge upward, and a blowby gas outflow section (8) having therein a blowby gas outflow passage (S2) which is connected to the separation space, the blowby gas outflow section being provided to protrude upward (see, for example, FIG. 1 to FIG. 3). The intake system member (3) is mounted on the cylinder head cover (2) so as to cover the blowby gas outflow section (8) from above, and the blowby gas outflow section (8) is provided, on its upper end side, with a connecting section (17) to which the lower end part of a blowby gas hose (4) extending from the intake system member (3) is connected. The connecting section (17) is arranged above the upper surface of the bulging section (7) (see, for example, FIG. 4).

[0024] Above the bulging section (7), a space (S3) which ensures visual confirmation of the lower end part of the blowby gas hose (4) is normally formed (see, for example, FIG. 3). This space (S3) can be utilized, for example, to attach/detach the blowby gas hose (4) to/from the connecting section (17) and to attach/detach a tightening tool (31) to/from the blowby gas hose (4).

[0025] Examples of the connection structure of blowby gas hose according to this embodiment can include a form in which the intake system member (3) includes a blowby gas passage section (25) to which the upper end part of the blowby gas hose (4) is connected and a flat

resonator section (26) which is provided in the upper part of the blowby gas passage section to cover the blowby gas passage section (see, for example, FIG. 1 to FIG. 3).

[0026] In the case of the form described above, for example, the cylinder head cover (2) can be provided with a case section (33) whose upper part is opened to one end side in the vehicle width direction (Q) of the automobile; the intake system member (3) can be provided with a lid section (37) which closes the opening of the case section; and the case section closed by the lid section can have therein an air cleaner room (34) which is connected to the resonator section (26) (see, for example, FIG. 5 and FIG. 6). Thus, not only the main part of the intake system member but also the entire engine can be made more compact in the vertical direction.

[0027] Examples of the connection structure of blowby gas hose according to this embodiment can include a form in which the blowby gas outflow section (8) includes a bulging section (18) which rises from the upper surface part of the cylinder head cover (2) at a height equal to or higher than the height of the bulging section (7) and which has the connecting section (17) provided in its upper part; and the bulging section has an internal space provided with an oil separation mechanism (20, 20A, 20B) which separates oil contained in the blowby gas flowing in the internal space (see, for example, FIG. 4, FIG. 9 and FIG. 10).

[0028] In the case of the form described above, for example, the bulging section (18) can include a cylindrical outer peripheral wall (18a) and a flange (18b) extending inward from the upper end of the outer peripheral wall; and the oil separation mechanism (20, 20A, 20B) can include a cylindrical rib (21, 21A, 21B) extending downward from the inner peripheral end of the flange (see, for example, FIG. 4, FIG. 9 and FIG. 10). Thus, oil can be trapped in a relatively narrow space enclosed by the outer peripheral wall, flange and cylindrical rib, so that the oil separation performance of the blowby gas is further enhanced. From the viewpoint of further improvement in the oil separation performance, the axial length (L) of the cylindrical rib (21A) is preferably defined as 30% to 70% (preferably 40% to 60%) of the height (H) of the bulging section (18) (see, for example, FIG. 9). Further, the oil separation mechanism (20B) includes a plate-like rib (22B) connected to the inner peripheral surface of the outer peripheral wall (18a), the lower surface of the flange (18b) and the outer peripheral surface of the cylindrical rib (21B), and it is preferred to provide a plurality of the plate-like ribs along the circumferential direction of the cylindrical rib (see, for example, FIG. 10).

[0029] Examples of the connection structure of blowby gas hose according to this embodiment can include a form in which a tightening tool (31) which tightens the lower end part connected to the connecting section (17) of the blowby gas hose (4) is provided on the outer peripheral side of the lower end part (see, for example, FIG. 4 and FIG. 8).

[0030] Examples of the connection structure of blowby

gas hose according to this embodiment can include a form wherein the engine is a front engine; the blowby gas outflow section (8) is arranged behind the bulging section (7) in the longitudinal direction (P) of the automobile; the intake system member (3) covers the bulging section (7) from above; and a space (S3) through which the lower end part of the blowby gas hose (4) can be visually confirmed from the front of an engine room of the automobile is formed between the intake system member (3) and the bulging section (7) (see, for example, FIG. 1 to FIG. 3).

[0031] The reference signs in parentheses following the components described in the above embodiment indicate the correlation with the specific components described in the Example which will be described later.

[Examples]

[0032] Hereinafter, the present invention will be described in detail by way of the Examples. In this Example, a transversely-mounted front engine along the vehicle width direction is exemplified as the automobile engine. Also, the symbols P, Q and R in the drawings represent the vehicle longitudinal direction P, vehicle width direction Q and vehicle vertical direction R, respectively, in a state where the engine is mounted in an engine room.

(1) Configuration of connection structure of the blowby gas hose

[0033] A connection structure 1 of blowby gas hose according to this Example includes a blowby gas hose 4 for connecting a cylinder head cover 2 and an intake system member 3 which constitute an automobile engine, as shown in FIG. 1 to FIG. 3. This intake system member 3 is mounted on the cylinder head cover 2 to thereby constitute a cylinder head cover assembly 5.

[0034] The cylinder head cover 2 extends along the vehicle width direction Q and is formed in a box shape whose lower part is opened, as shown in FIG. 3. This cylinder head cover 2 has, on its upper surface part, a bulging section 7 for forming a separation space S 1 which separates oil in blowby gas generated in the engine, the bulging section 7 being provided to bulge upward, and a blowby gas outflow section 8 having therein a blowby gas outflow passage S2 which is connected to the separation space S1, the blowby gas outflow section 8 being provided to protrude upward (see FIG. 5).

[0035] The bulging section 7 extends along the vehicle width direction Q and is formed in a box shape whose lower part is opened. Also, the blowby gas outflow section 8 extends along the vehicle vertical direction R and is formed in a pipe shape which is opened in the vertical direction R. This blowby gas outflow section 8 is arranged adjacent to the rear side of the bulging section 7 in the vehicle longitudinal direction P. Also, the cylinder head cover 2 has, on its back surface side, a baffle plate 9 provided so as to cover the lower openings of the bulging section 7 and the blowby gas outflow section 8. A sepa-

ration space S1 is formed between this baffle plate 9 and the cylinder head cover 2. Also, an oil return hole 10 which returns the oil separated within the separation space S1 to the engine side is formed in the baffle plate 9.

[0036] The separation space S1 is formed in a planar, substantially U-letter shape by a rib 12 protruded downward from the back surface of the cylinder head cover 2 and a rib 13 protruded upward from the upper surface of the baffle plate 9, as shown in FIG. 7. This separation space S1 communicates, on one end side, with a communication hole 14 formed on the outer peripheral side of the cylinder head cover 2, and also communicates, on the other end side, with the blowby gas outflow section 8. This communication hole 14 communicates with a blowby gas flow passage (not shown) connected into the crankcase of the engine.

[0037] The blowby gas outflow section 8 is provided, on its upper end side, with a pipe-like connecting section 17 to which the lower end part of the blowby gas hose 4 extending from the intake system member 3 is connected, as shown in FIG. 4. This connecting section 17 is arranged above the upper surface of the bulging section 7. Also, the blowby gas outflow section 8 includes a bulking section 18 which rises from the upper surface part of the cylinder head cover 2 at a height equal to or higher than the height H of the bulging section 7 and which has the connecting section 17 provided in its upper part. This bulking section 18 includes a cylindrical outer peripheral wall 18a and a flange 18b extending inward from the upper end of the outer peripheral wall 18a. The connecting section 17 rises on this flange 18b. Also, the bulking section 18 has an internal space (i.e., blowby gas outflow passage S2) provided with an oil separation mechanism 20 which separates oil contained in the blowby gas flowing in the internal space. This oil separation mechanism 20 includes a cylindrical rib 21 extending downward from the inner peripheral end of the flange 18b of the bulking section 18. The axial length L of this cylindrical rib 21 is defined as about 30% of the height H of the bulking section 18.

[0038] The intake system member 3 includes a blowby gas passage section 25 to which the upper end part of the blowby gas hose 4 is connected and a flat resonator section 26 provided integrally with the upper part of the blowby gas passage section 25 so as to cover the blowby gas passage section 25, as shown in FIG. 3 (see FIG. 6). This blowby gas passage section 25 extends along the plane direction of the resonator section 26. Also, one end side of the blowby gas passage section 25 is formed in a substantially L-letter shape, and serves as a connecting section 25a to which the upper end part of the blowby gas hose 4 is connected. Also, one end side of a communication pipe 27 connected to an intake passage (not shown) is connected to the other end side of the blowby gas passage section 25. Also, the resonator section 26 is formed in a flat bag shape so as to cover the bulging section 7 and the blowby gas outflow section 8 from above. A space S3 through which the upper and

lower end parts of the blowby gas hose 4 can be visually confirmed from the front of the engine room of the automobile is formed between the bulging section 7 and the resonator section 26. Incidentally, the resonator section 26 exerts, for example, the function of reducing the intake noise of air flowing through the intake passage.

[0039] The blowby gas hose 4 is connected, in its upper end part, to the connecting section 25a of the blowby gas passage section 25, and connected, in its lower end part, to the connecting section 17 of the blowby gas outflow section 8, as shown in FIG. 4. Specifically, the blowby gas hose 4 is made of an elastic material such as rubber, and the upper end part thereof is press-fitted into the outer peripheral side of the connecting section 25a, and the lower end part thereof is press-fitted into the outer peripheral side of the connecting section 17. The blowby gas hose 4 includes, on the outer peripheral sides of its upper and lower end parts, tightening tools 31 which tighten the respective end parts. These tightening tools 31 each include diametrically-expandable coil-like linear bodies 31a and operating sections 31b provided at both end parts of the linear bodies 31a so as to expand the diameters of the linear bodies 31a (see FIG. 8). The operating sections 31b of the respective tightening tools 31 are arranged above the bulging section 7 so as to face the space S3.

[0040] Here, the cylinder head cover 2 is provided with a case section 33 whose upper part is opened to one end side in the vehicle width direction Q, as shown in FIG. 5. The opening of this case section 33 is closed by a lid section 37, which will be described later, of the intake system member 3 to thereby form an air cleaner room 34 in the case section 33 (see FIG. 2). This air cleaner room 34 is connected to the internal space of the resonator section 26 of the intake system member 3. Also, a filter element (not shown) is housed in the air cleaner room 34. Also, an inflow port 35 through which air flows into the air cleaner room 34 is formed on a side surface of the case section 33. To this inflow port 35, one end side of an intake pipe 36 extending in the vehicle width direction Q is connected (see FIG. 2). Further, as shown in FIG. 6, the lid section 37 which closes the case section 33 is provided at a position adjacent to the resonator section 26 of the intake system member 3. This lid section 37 is formed in a box shape whose lower part is opened. This lid section 37 has, in its side surface, a tubular outflow port 38 through which air flows out from the inside of the air cleaner room 34.

[0041] The case section 33 is provided, on its outer peripheral side, with clamp tools 41 that can be engaged with the lid section 37 (see FIG. 5). Further, the lid section 37 is provided, on its outer peripheral side, with a clamp tool 42 that can be engaged with the case section 33 (see FIG. 6). The engagement between these clamp tools 41 and 42 results in the attachment of the lid section 37 to the case section 33, whereby the intake system member 3 is mounted on the cylinder head cover 2.

(2) Action of connection structure of blowby gas hose

[0042] Next, the action of the connection structure 1 of blowby gas hose having the above configuration will be described. During engine assembling and maintenance, the connection state of the blowby gas hose 4 and the tightening state of the respective tightening tools 31 are visually confirmed from the front of the automobile engine room through the space S3 formed between the bulging section 7 and the resonator section 26, as shown in FIG. 3. Examples of the confirmation items concerning these tightening tools 31 include the height position of the tightening tools 31 in the axial direction of the blowby gas hose 4 and the angle position of the operating sections 31b of the tightening tools 31 around the axis of the blowby gas hose 4.

[0043] Also, during engine operation, the air passing through the intake pipe 36 and filtered in the air cleaner room 34 is fed to the intake side of the engine via a throttle valve and an intake manifold (which are not shown), as indicated by a dashed arrow in FIG. 2. Also, at the time of high load of the engine, the blowby gas generated in the crankcase is introduced through the communication hole 14 into the separation space S1 and, for example, collides with the wall surfaces so that oil is separated and introduced into the blowby gas outflow passage S2 of the blowby gas outflow section 8, as indicated by a dashed arrow in FIG. 7.

[0044] Then, the blowby gas introduced into the blowby gas outflow passage S2 flows into the space enclosed by the outer peripheral wall 18a, flange 18b and cylindrical rib 21 in the bulging section 18 and, for example, collides with the wall surfaces so that oil is separated, as indicated by a dashed arrow in FIG. 4. The blowby gas from which the oil has been separated flows through the blowby gas hose 4 and the blowby gas passage section 25 in turn, and fed to the intake passage. Incidentally, at the time of low load of the engine, the air flowing through the intake passage flows through the blowby gas passage section 25, blowby gas hose 4, blowby gas outflow section 8 and separation space S1 in turn, whereby the air cleaning performance within the crankcase is enhanced.

(3) Advantageous Effect of Example

[0045] According to the connection structure 1 of blowby gas hose of this Example, the cylinder head cover 2 has, on its upper surface part, a bulging section 7 for forming a separation space S1 which separates oil in blowby gas generated in the engine, the bulging section 7 being provided to bulge upward, and a blowby gas outflow section 8 having therein a blowby gas outflow passage S2 which is connected to the separation space S1, the blowby gas outflow section 8 being provided to protrude upward. The intake system member 3 is mounted on the cylinder head cover 2 so as to cover the blowby gas outflow section 8 from above; the blowby gas outflow

section 8 is provided, on its upper end side, with a connecting section 17 to which the lower end part of a blowby gas hose 4 extending from the intake system member 3 is connected; and the connecting section 17 is arranged above the upper surface of the bulging section 7. Thus, even in the case of types in which the intake system member 3 is mounted on the cylinder head cover 2, the connection state of the blowby gas hose 4 can be easily visually confirmed through the space S3 above the bulging section 7 in the automobile engine room. As a result, the load of the confirming operation during engine assembling and maintenance is greatly reduced. Further, the increase in the protruding height of the blowby gas outflow section 8 enlarges the space volume of the separation space S1 plus the blowby gas outflow passage S2, and enhances the flow rate of the blowby gas flowing through the blowby gas outflow passage S2 having a relatively small cross section. As a result, the oil separation performance of the blowby gas can be improved. Further, during engine assembling and maintenance, the blowby gas hose 4 can be attached to/detached from the connecting section 17 of the blowby gas outflow section 8, and the tightening tools 31 can be attached to/detached from the blowby gas hose 4.

[0046] Also, in this Example, the intake system member 3 includes a blowby gas passage section 25 and a flat resonator section 26. Thus, the visibility from above would be further reduced by the flat resonator section 26, but the connection state of the blowby gas hose 4 can be easily visually confirmed through the space S3 above the bulging section 7 in the automobile engine room. Further, the blowby gas outflow section 8 is covered with the relatively thin flat resonator section 26, and thus not only the main part of the intake system member 3 but also the entire engine can be made compact in the vertical direction. On the other hand, in the conventional connection structure 101 of blowby gas hose, the blowby gas outflow section 108 is covered with a relatively thick intake duct 103a, as shown in FIG. 12, and thus not only the main part of the intake system member 103 but also the entire engine is made high in the vertical direction. Incidentally, reference sign 126 in FIG. 11 designates the resonator section.

[0047] Also, in this Example, the cylinder head cover 2 is provided with a case section 33 whose upper part is opened to one end side in the vehicle width direction Q of the automobile; the intake system member 3 is provided with a lid section 37 which closes the opening of the case section 33; and the case section 33 closed by the lid section 37 has therein an air cleaner room 34 which is connected to the resonator section 26. Thus, not only the main part of the intake system member 3 but also the entire engine can be made more compact in the vertical direction.

[0048] Also, in this Example, the blowby gas outflow section 8 includes a bulging section 18 which rises from the upper surface part of the cylinder head cover 2 at a height equal to or higher than the height of the bulging

section 7 and which has the connecting section 17 provided in its upper part, and the bulking section 18 has an internal space having an oil separation mechanism 20 provided therein. Thus, efficacious oil separating action can be exerted at the blowby gas outflow section 8, and the internal space of the bulking section 18 for securing the visibility of the connection state of the blowby gas hose 4 can be utilized more effectively.

[0049] Also, in this Example, the bulking section 18 includes a cylindrical outer peripheral wall 18a and a flange 18b extending inward from the upper end of the outer peripheral wall 18a, and the oil separation mechanism 20 includes a cylindrical rib 21 extending downward from the inner peripheral end of the flange 18b. Thus, oil can be trapped in a relatively narrow space enclosed by the outer peripheral wall 18a, flange 18b and cylindrical rib 21, so that the oil separation performance of the blowby gas is further enhanced.

[0050] Also, in this Example, tightening tools 31 which tighten the lower end part connected to the connecting section 17 of the blowby gas hose 4 are provided on the outer peripheral side of the lower end part. Thus, the tightening state of the tightening tools 31 as well as the connection state of the blowby gas hose 4 can be easily visually confirmed.

[0051] Further, in this Example, the engine is a front engine; the blowby gas outflow section 8 is arranged behind the bulging section 7 in the longitudinal direction P of the automobile; the intake system member 3 covers the bulging section 7 from above; and a space S3 through which the lower end part of the blowby gas hose 4 can be visually confirmed from the front of an engine room of the automobile is formed between the intake system member 3 and the bulging section 7. Thus, the connection state of the blowby gas hose 4 can be easily visually confirmed from the front of the automobile engine room.

<Variation 1>

[0052] Next, explanation will be made about a connection structure of blowby gas hose according to Variation 1 of the above Example. The same reference signs are attached to components substantially identical with those of the connection structure 1 of blowby gas hose according to the Example, which are not explained in detail. The oil separation mechanism, which is a difference between the structures, will be described in detail.

[0053] In a connection structure 1A of blowby gas hose according to this Variation 1, a bulking section 18 has an internal space provided with an oil separation mechanism 20A which separates oil contained in blowby gas flowing in the internal space, as shown in FIGS. 9 (a) and 9(b). This oil separation mechanism 20A includes a cylindrical rib 21A extending downward from the inner peripheral end of a flange 18b of the bulking section 18. The axial length L of this cylindrical rib 21A is defined as about 50% of the height H of the bulking section 18.

[0054] The connection structure 1A of blowby gas hose

according to this Variation 1 provides substantially the same action and effect as those of the connection structure 1 of blowby gas hose according to the Example. Additionally, the oil separation mechanism 20A includes a cylindrical rib 21A extending downward from the inner peripheral end of the flange 18b of the bulking section 18, and the axial length L of the cylindrical rib 21A is defined as about 50% of the height H of the bulking section 18. Therefore, the axial length of the cylindrical rib 21A is increased, so that the area of the wall surfaces with which the blowby gas collides is also increased. Accordingly, the oil separation performance of the blowby gas is further enhanced.

15 <Variation 2>

[0055] Then, explanation will be made about a connection structure of blowby gas hose according to Variation 2 of the Example. The same reference signs are attached to components substantially identical with those of the connection structure 1 of blowby gas hose according to the Example, which are not explained in detail. The oil separation mechanism, which is a difference between the structures, will be described in detail.

25 [0056] In a connection structure 1B of blowby gas hose according to this Variation 2, a bulking section 18 has an internal space provided with an oil separation mechanism 20B which separates oil contained in blowby gas flowing in the internal space, as shown in FIGS. 10 (a) and 10(b). This oil separation mechanism 20B includes a cylindrical rib 21B extending downward from the inner peripheral end of a flange 18b of the bulking section 18 and a plate-like rib 22B connected to the inner peripheral surface of an outer peripheral wall 18a, the lower surface of the flange 18b and the outer peripheral surface of the cylindrical rib 21B. A plurality of the plate-like ribs 22B (six in the figure) are provided along the circumferential direction of the cylindrical rib 21B.

[0057] The connection structure 1B of blowby gas hose according to this Variation 2 provides substantially the same action and effect as those of the connection structure 1 of blowby gas hose according to the Example. Additionally, the oil separation mechanism 20B includes a cylindrical rib 21B extending downward from the inner peripheral end of a flange 18b of the bulking section 18 and a plate-like rib 22B connected to the inner peripheral surface of an outer peripheral wall 18a, the lower surface of the flange 18b and the outer peripheral surface of the cylindrical rib 21B; and a plurality of the plate-like ribs 22B are provided along the circumferential direction of the cylindrical rib 21B. Therefore, the space enclosed by the outer peripheral wall 18a, flange 18b and cylindrical rib 21B is partitioned into a plurality of spaces by the plate-like rib 22B. Accordingly, the area of the wall surfaces with which the blowby gas collides is increased, so that the oil separation performance of the blowby gas is further enhanced.

[0058] The present invention is not limited to the above

Example, and can encompass Examples variously modified within the scope of the present invention depending on the intended purpose and use. Specifically, the intake system member 3 which covers the bulging section 7 as well as the blowby gas outflow section 8 has been exemplified in the Example. However, the present invention is not limited to this, and, for example, an intake system member which covers only the blowby gas outflow section 8 and does not cover the bulging section 7 may be employed.

[0059] Also, the Example has exemplified the intake system member 3 including the resonator section 26 which covers the blowby gas outflow section 8. However, the present invention is not limited to this, and, for example, an intake system member including an intake duct 103a which covers the blowby gas outflow section 8 (see FIG. 12) may be employed. In this case, for example, the upper end part of the blowby gas hose 4 is connected to the intake duct 103a.

[0060] Also, the Example has been designed so that the upper end part of the blowby gas hose 4 is connected to a portion directly above the connecting section 17 (specifically, connecting section 25a of the blowby gas passage section 25) in the intake system member 3. However, the present invention is not limited to this, and, for example, there may be employed such design that the upper end part of the blowby gas hose 4 is connected to a portion other than directly above the connecting section 17 in the intake system member 3. In this case, the blowby gas hose 4 is, for example, extends in the vertical direction in a curved or bent state.

[0061] Further, the Example has exemplified the oil separation mechanism 20 including the cylindrical rib 21. However, the present invention is not limited to this, and, for example, there may be employed an oil separation mechanism including a baffle wall which distributes blowby gas in a meandering manner or an oil separation mechanism including a centrifuging room which distributes blowby gas in a swirling manner.

[0062] Further, the Example has exemplified a front engine as the automobile engine. However, the present invention is not limited to this, and, for example, a rear engine or a midship engine may be employed. Further, a vertically-mounted engine along the vehicle longitudinal direction P may be employed.

[0063] It is noted that the foregoing examples have been provided merely for the purpose of explanation and are in no way to be construed as limiting of the present invention. While the present invention has been described with reference to exemplary embodiments, it is understood that the words which have been used herein are words of description and illustration, rather than words of limitation. Changes may be made, within the purview of the appended claims, as presently stated and as amended, without departing from the scope and spirit of the present invention in its aspects. Although the present invention has been described herein with reference to particular structures, materials and embodi-

ments, the present invention is not intended to be limited to the particulars disclosed herein; rather, the present invention extends to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims.

[0064] The present invention is not limited to the above-described embodiments, and various variations and modifications may be possible without departing from the scope of the present invention.

[0065] The present invention is widely utilized as the technique for feeding blowby gas generated in an automobile engine to an intake system member via a cylinder head cover.

[0066] A connection structure 1 of blowby gas hose according to the present invention is intended to connect a cylinder head cover 2 and an intake system member 3 of an automobile engine. The cylinder head cover has, on its upper surface part, a bulging section 7 provided to bulge upward and a blowby gas outflow section 8 provided to protrude upward. The intake system member is mounted on the cylinder head cover so as to cover the blowby gas outflow section from above. The blowby gas outflow section is provided, on its upper end side, with a connecting section 17 to which the lower end part of a blowby gas hose 4 extending from the intake system member is connected. The connecting section is arranged above the upper surface of the bulging section.

Claims

1. A connection structure of a blowby gas hose for connecting a cylinder head cover and an intake system member of an automobile engine, wherein the cylinder head cover has, on its upper surface part, a bulging section for forming a separation space which separates oil in blowby gas generated in the engine, the bulging section being provided to bulge upward, and a blowby gas outflow section having therein a blowby gas outflow passage which is connected to the separation space, the blowby gas outflow section being provided to protrude upward, wherein the intake system member is mounted on the cylinder head cover so as to cover the blowby gas outflow section from above, wherein the blowby gas outflow section is provided, on its upper end side, with a connecting section to which the lower end part of the blowby gas hose extending from the intake system member is connected, and wherein the connecting section is arranged above the upper surface of the bulging section.
2. The connection structure of the blowby gas hose according to claim 1, wherein the intake system member comprises a blowby gas passage section to which the upper end part of the blowby gas hose is

connected and a flat resonator section which is provided in the upper part of the blowby gas passage section so as to cover the blowby gas passage section.

5

3. The connection structure of the blowby gas hose according to claim 2,
 wherein the cylinder head cover is provided with a case section whose upper part is opened to one end side in the vehicle width direction of an automobile,
 wherein the intake system member is provided with a lid section which closes the opening of the case section, and
 wherein the case section closed by the lid section has therein an air cleaner room which is connected to the resonator section. 10 15

4. The connection structure of the blowby gas hose according to any one of claims 1 to 3,
 wherein the blowby gas outflow section comprises a bulking section which rises from the upper surface part of the cylinder head cover at a height equal to or higher than the height of the bulging section and which has the connecting section provided in its upper part, and
 wherein the bulking section has an internal space provided with an oil separation mechanism which separates oil contained in the blowby gas flowing in the internal space. 20 25 30

5. The connection structure of the blowby gas hose according to claim 4,
 wherein the bulking section comprises a cylindrical outer peripheral wall and a flange extending inward from the upper end of the outer peripheral wall, and
 wherein the oil separation mechanism comprises a cylindrical rib extending downward from the inner peripheral end of the flange. 35

6. The connection structure of the blowby gas hose according to any one of claims 1 to 5, wherein a tightening tool which tightens the lower end part connected to the connecting section of the blowby gas hose is provided on the outer peripheral side of the lower end part. 40 45

7. The connection structure of the blowby gas hose according to any one of claims 1 to 6,
 wherein the engine is a front engine,
 wherein the blowby gas outflow section is arranged behind the bulging section in the longitudinal direction of the automobile,
 wherein the intake system member covers the bulging section from above, and wherein a space through which the lower end part of the blowby gas hose can be visually confirmed from the front of an engine room of the automobile is formed between the intake system member and the bulging section. 50 55

FIG1

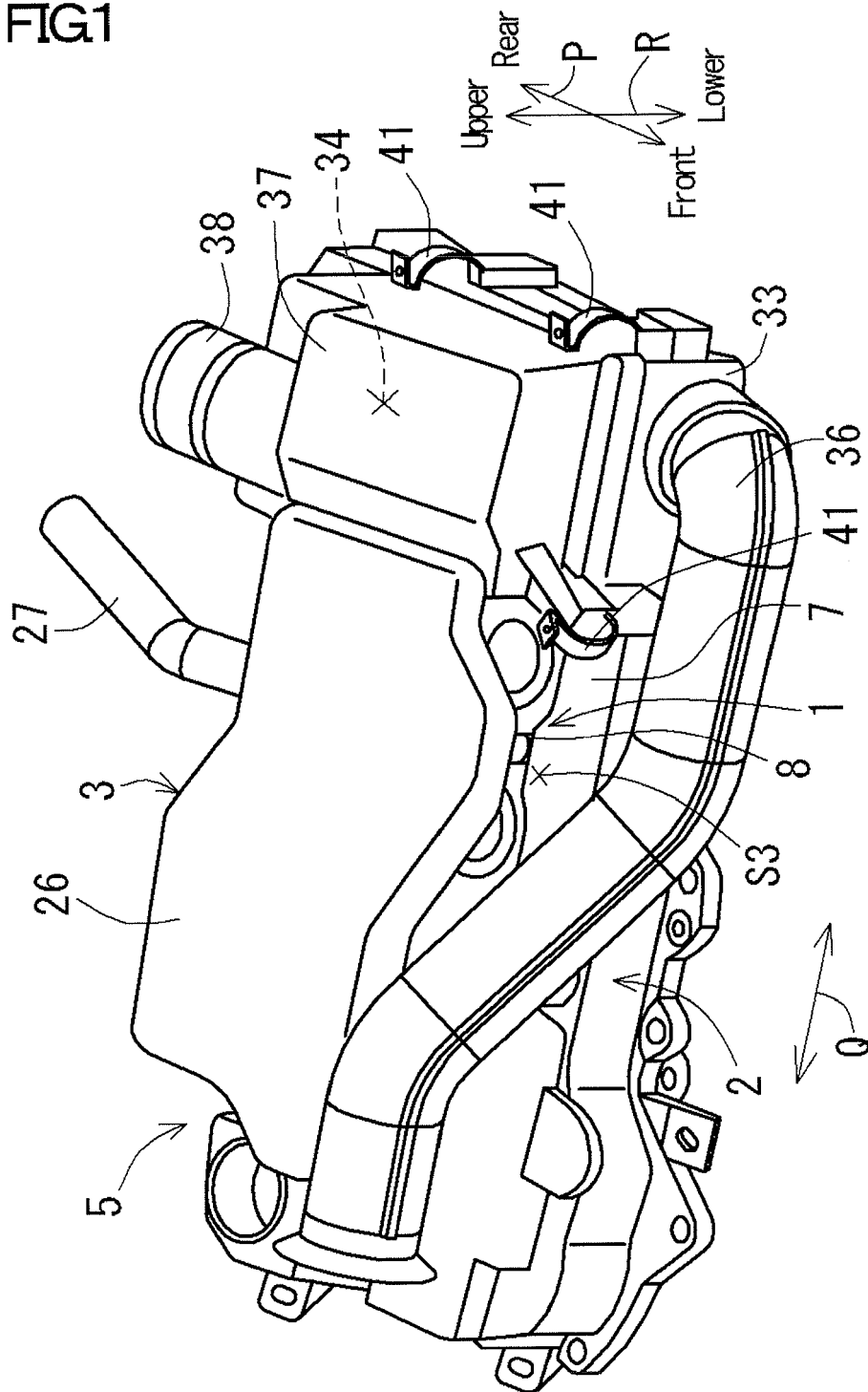


FIG2

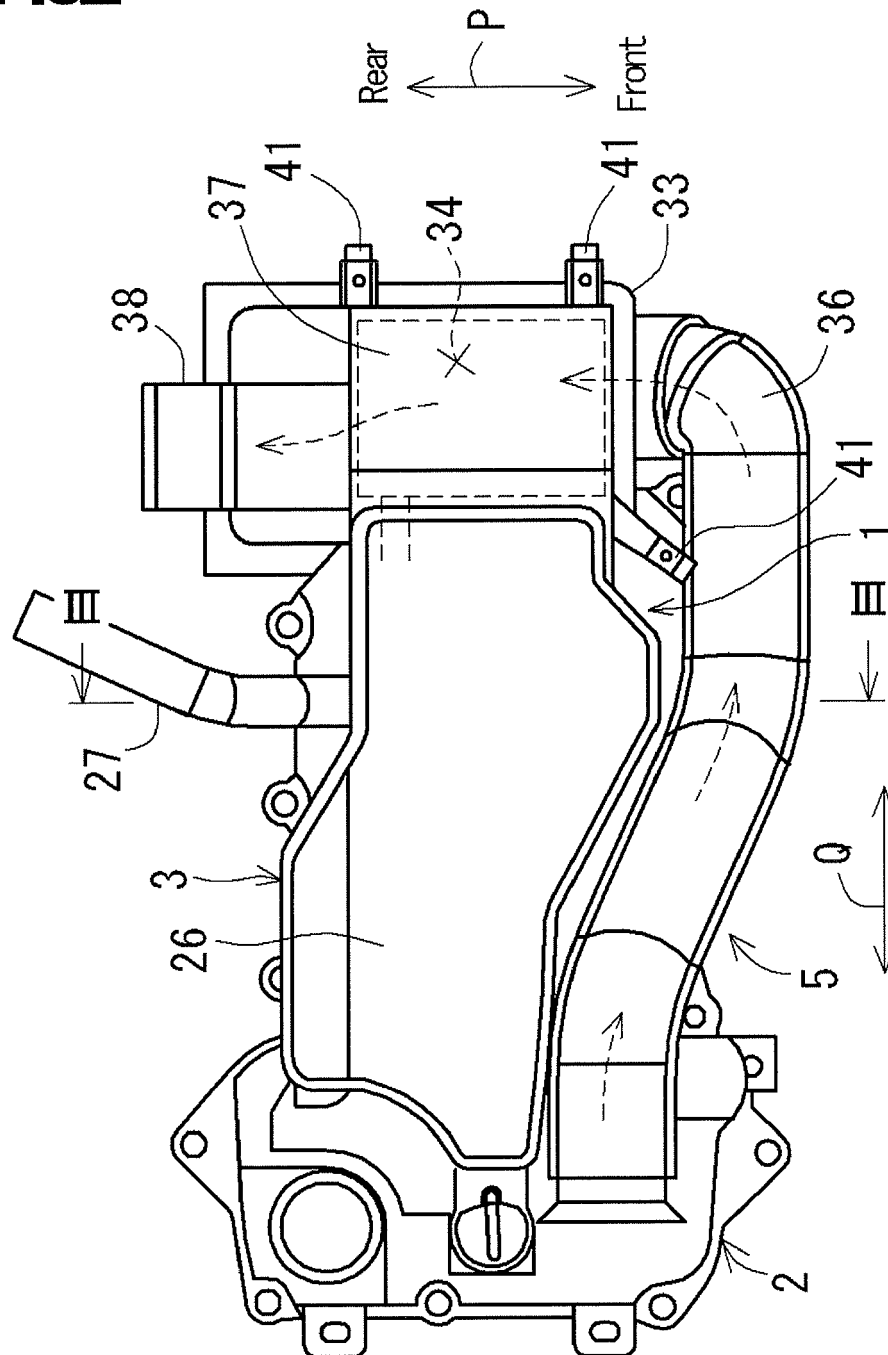


FIG3

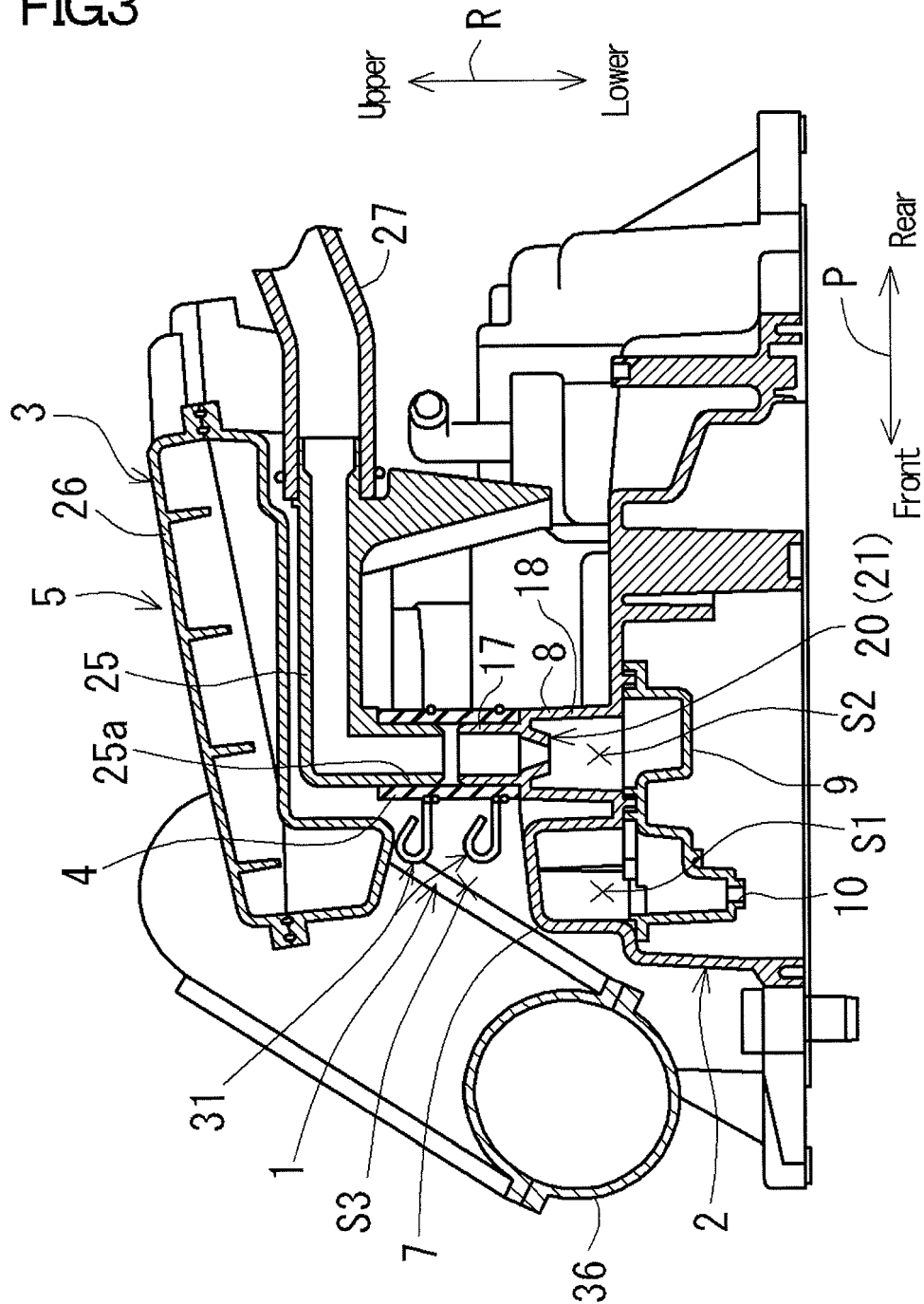


FIG4

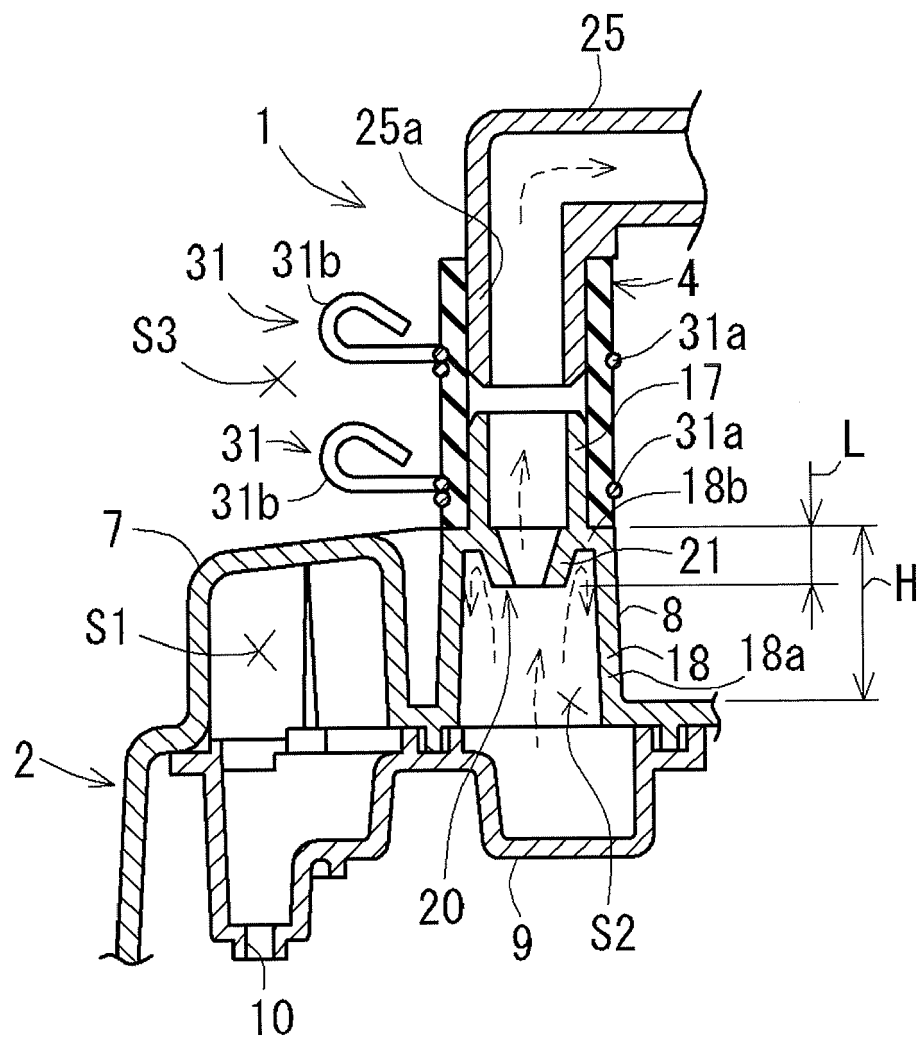


FIG5

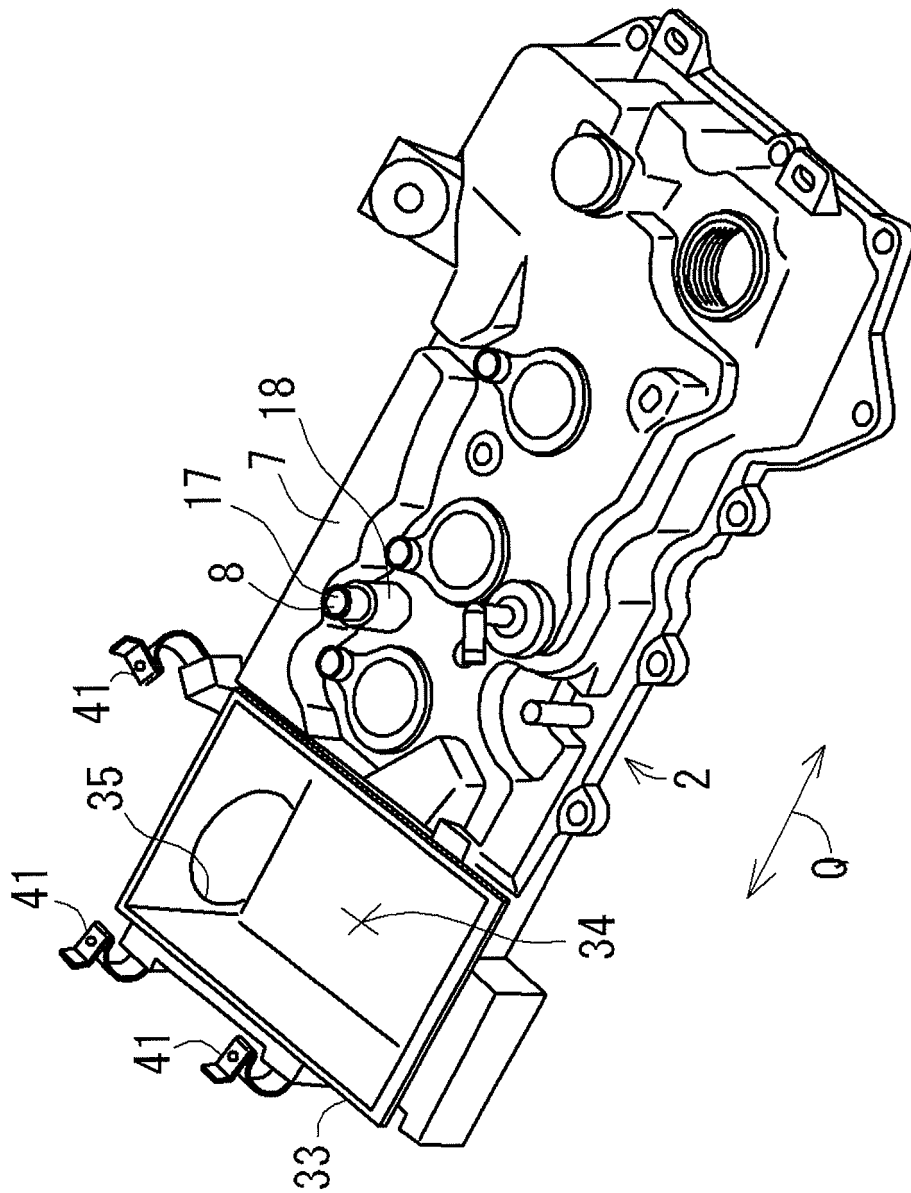


FIG.6

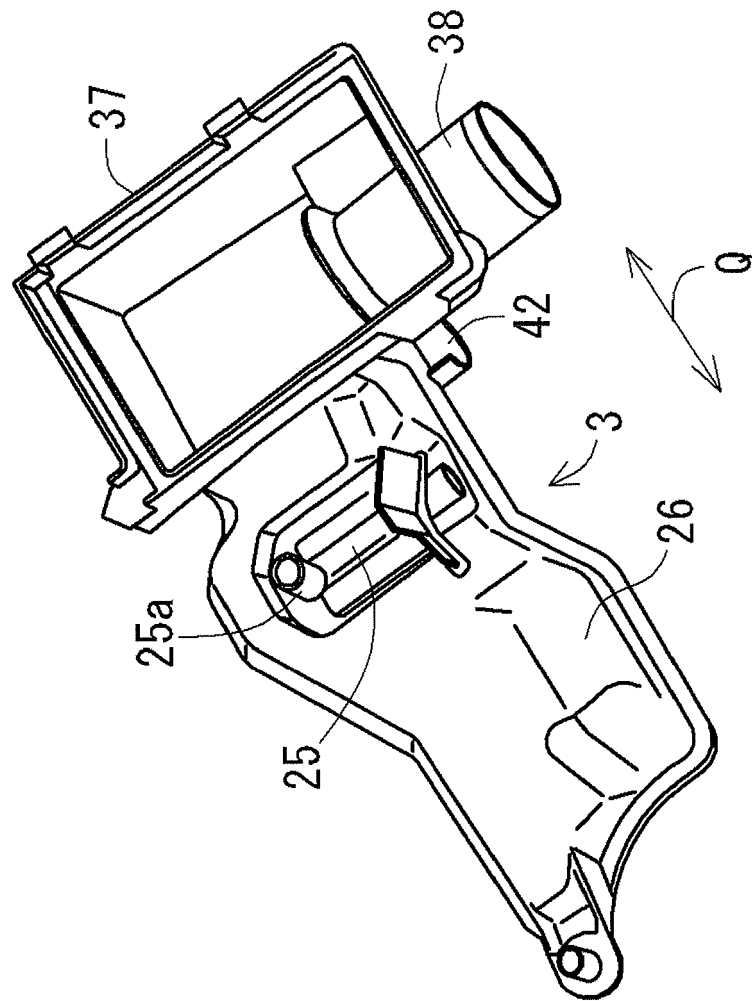


FIG.7

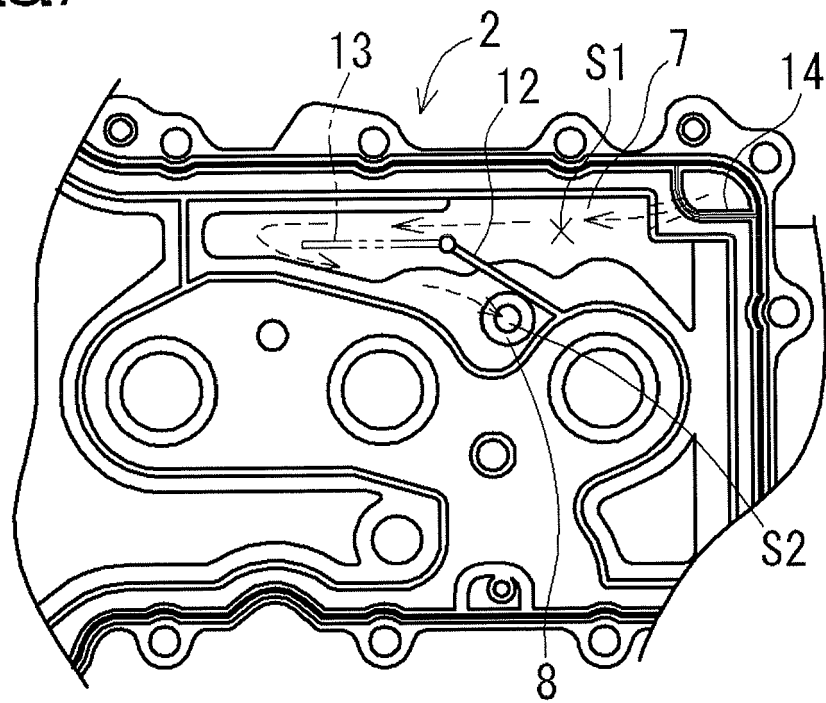


FIG.8

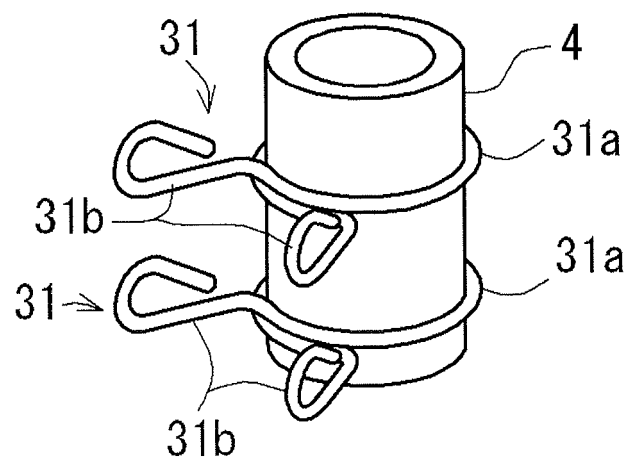


FIG9

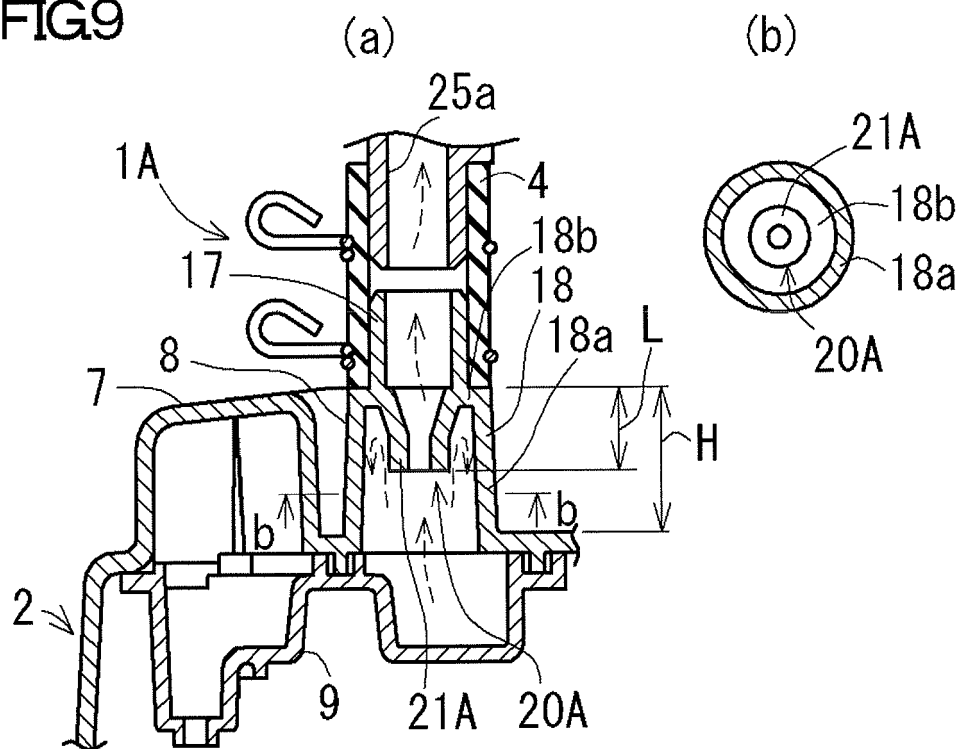


FIG10

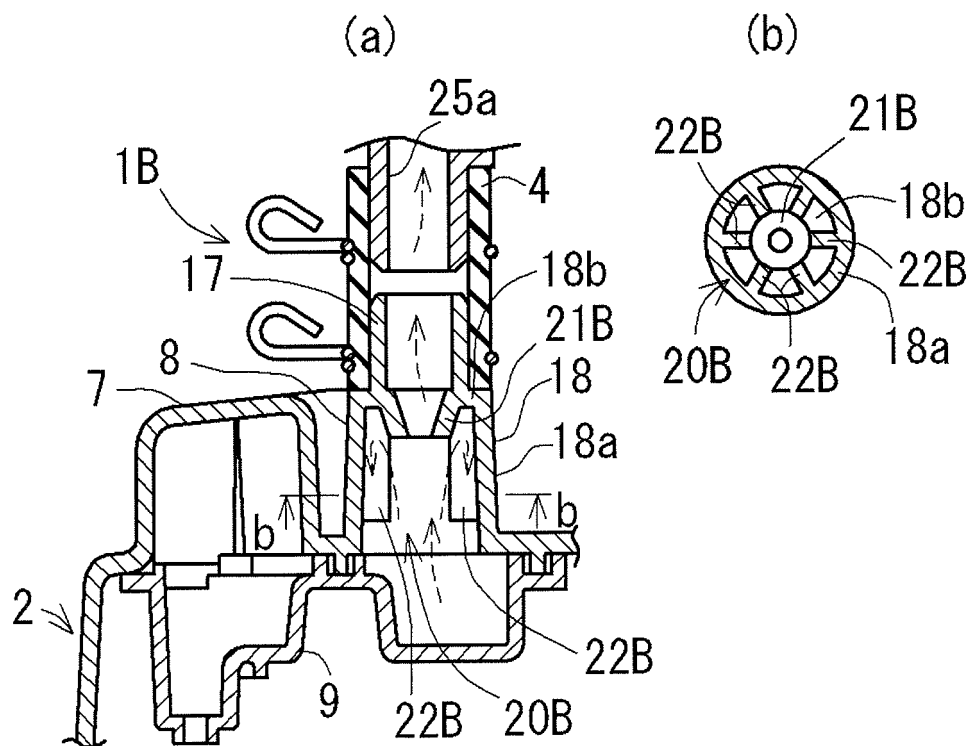


FIG11

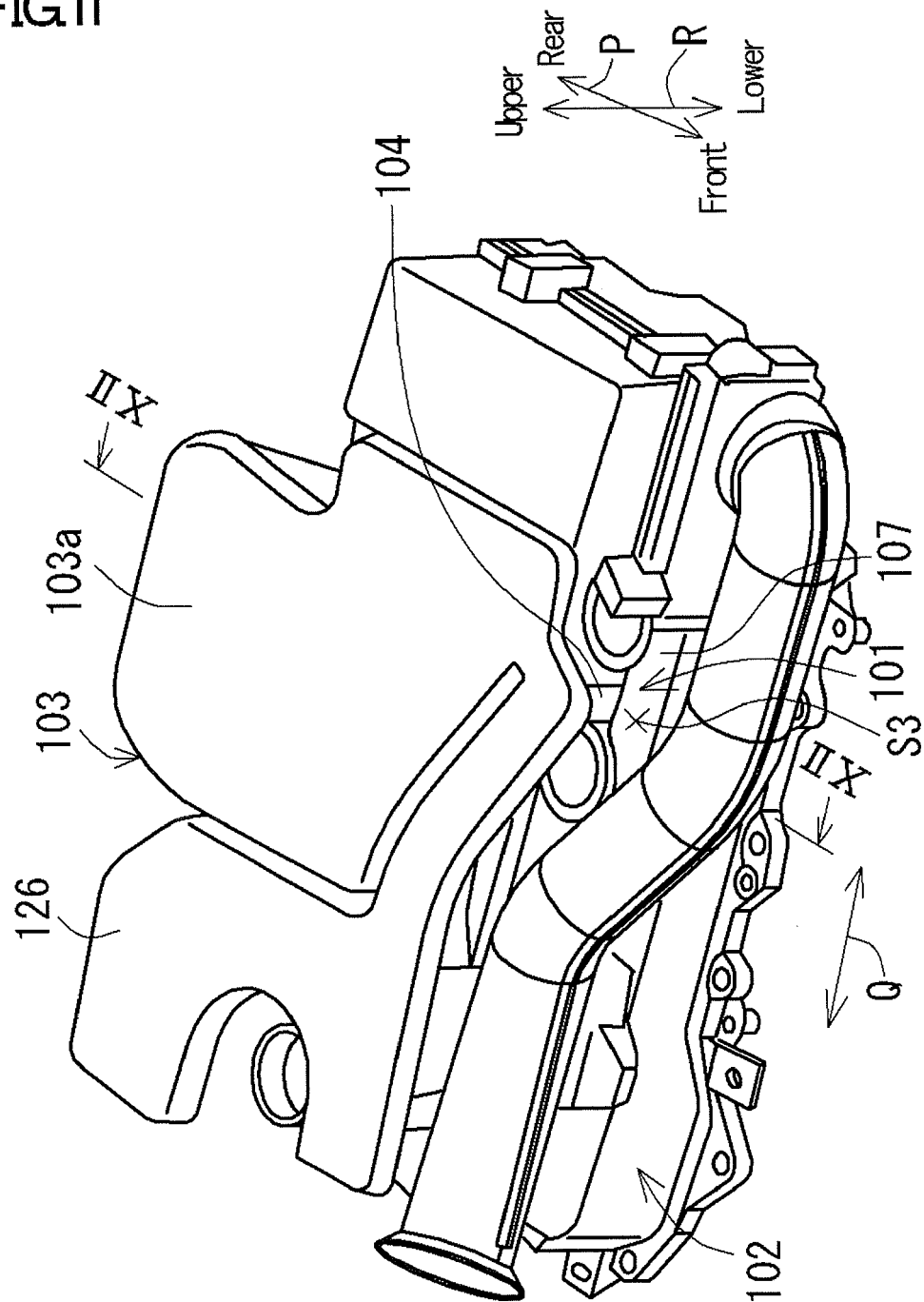
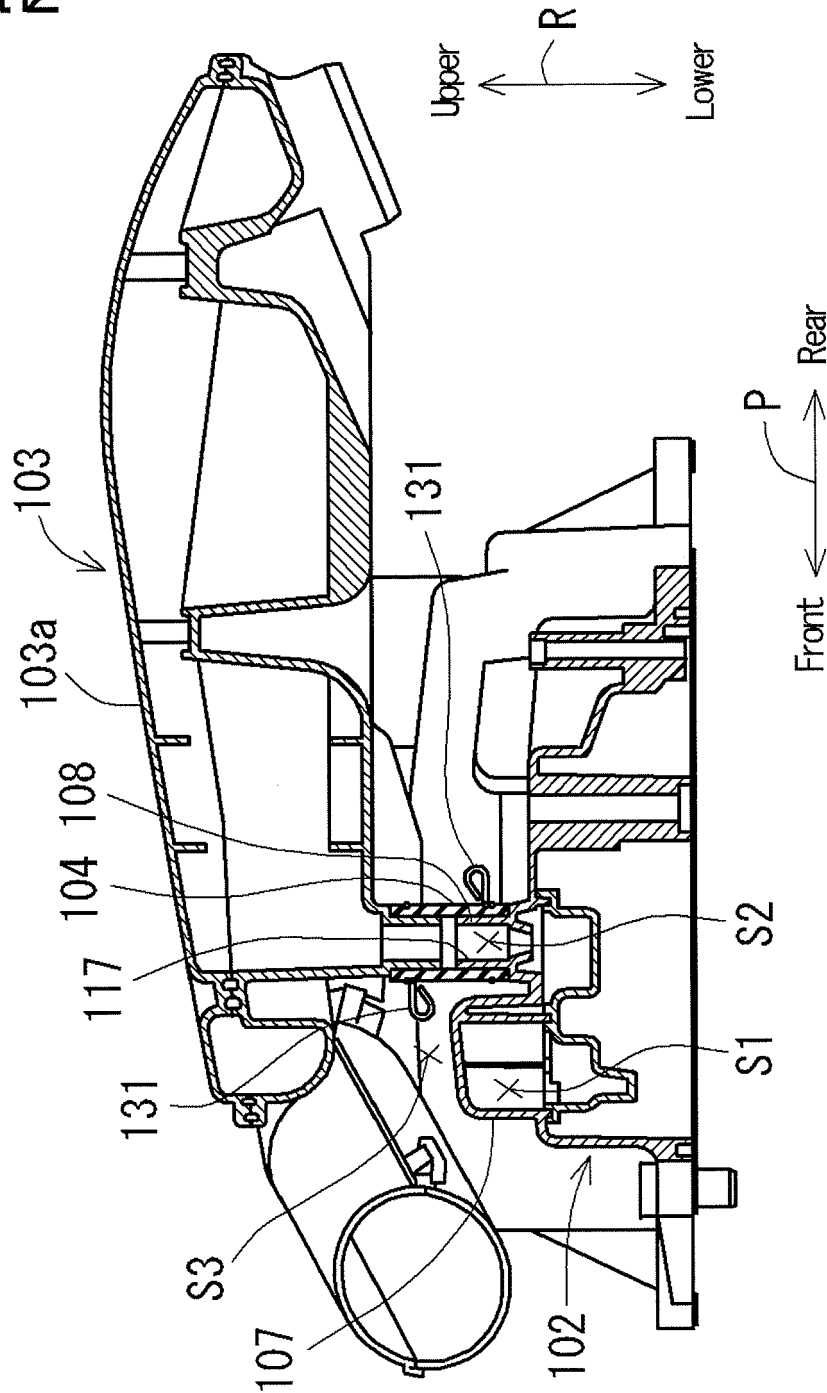


FIG12





EUROPEAN SEARCH REPORT

Application Number
EP 17 15 2582

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2010/071676 A1 (ARVAN GARY J [US]) 25 March 2010 (2010-03-25) * the whole document *	1,2,4,5	INV. F01M13/04 F02M35/04 F02M35/10 F02M35/14
X	EP 1 182 343 A2 (DAIHATSU MOTOR CO LTD [JP]) 27 February 2002 (2002-02-27) * the whole document *	1,4,7	
X	EP 2 927 442 A1 (HONDA MOTOR CO LTD [JP]) 7 October 2015 (2015-10-07) * the whole document *	1,6,7	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F01M F02M
Place of search		Date of completion of the search	Examiner
The Hague		17 July 2017	Van Zoest, Peter
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

 1
EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 17 15 2582

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-07-2017

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010071676 A1	25-03-2010	CN 101684764 A DE 102009042335 A1 US 2010071676 A1	31-03-2010 29-04-2010 25-03-2010
EP 1182343 A2	27-02-2002	DE 60123350 T2 EP 1182343 A2	10-05-2007 27-02-2002
EP 2927442 A1	07-10-2015	EP 2927442 A1 JP 2015187409 A US 2015275717 A1	07-10-2015 29-10-2015 01-10-2015

15

20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2001263036 A [0002] [0005]
- JP 2005083268 A [0004] [0005]