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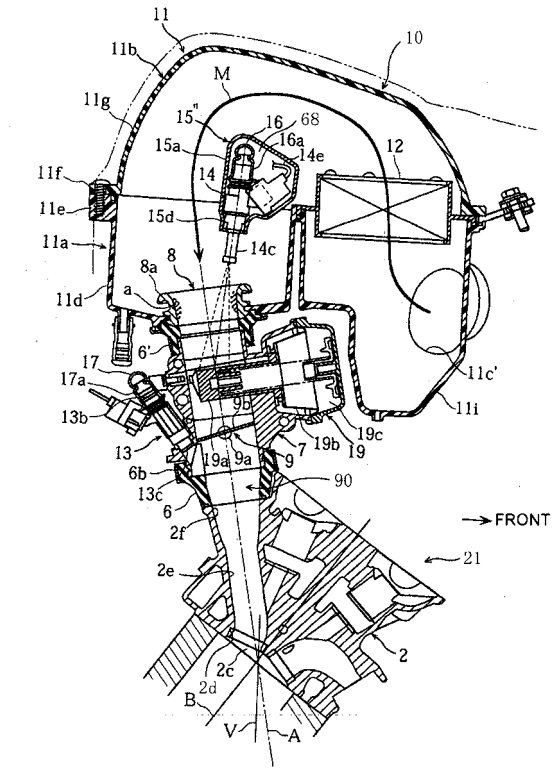
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(54) FUEL SUPPLY DEVICE, VEHICLE, AND FUEL SUPPLY DEVICE ASSEMBLING METHOD

(57) A fuel supply device comprises an air-cleaner case (11) composed of a lower case (11a) and an upper case (11b), an intake passage (90) opened into the air-cleaner case (11), a fuel injector (14) for injection of a fuel in the air-cleaner case (11), and a support bracket (15") to support the fuel injector (14). The support bracket (15") defines a separate chamber (68) in the air-cleaner case (11). An injector body of the fuel injector (14) is accommodated in the separate chamber (68) .

[Fig. 2]



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Description

Technical Field

[0001] The present invention relates to a fuel supply device that supplies a fuel to an engine, a vehicle provided with the same, and an assembly method of a fuel supply device.

Background Art

[0002] As a fuel supply device that supplies a fuel to an engine, there is one, in which a fuel injector is arranged upstream of an opening of an intake pipe in an intake box (see, for example, Patent Document 1). In the fuel supply device disclosed in Patent Document 1, the fuel injector is arranged substantially in parallel to an axis of the intake pipe.

[0003] Also, there is known a fuel supply device, in which a fuel injector for injection of a fuel into an air chamber (intake box) is arranged outside the air chamber (see, for example, Patent Document 2).

Patent Document 1: JP-A-10-196494
Patent Document 2: JP-A-7-247924

Disclosure of the Drawings

Problems to be Solved by the Invention

[0004] With the conventional fuel supply devices, a certain air flow directed toward the opening of the intake pipe is formed upstream of the opening within the intake box. With the fuel supply device described in Patent Document 1, the fuel injector is arranged in the air flow. Therefore, there is caused a problem that the fuel injector causes an increase in air resistance to constitute a factor to obstruct an increase in engine output.

[0005] On the other hand, with the fuel supply device described in Patent Document 2, since the fuel injector is arranged outside the air chamber, it is necessary to pay close attention to ensuring a waterproof quality in a connection between the fuel injector and the air chamber. That is, with the fuel supply device, the fuel injector is connected from outside the air chamber. Therefore, it is necessary to provide a highly waterproofing sealing mechanism in the connection of the fuel injector so as to prevent water from entering inside from outside the air chamber. Also, it is necessary to accurately assemble not only the fuel injector but also its sealing mechanism to the air chamber.

[0006] The invention has been thought of in view of the problems of the prior art and has its object to improve a waterproof quality while suppressing the air resistance provided by a fuel injector in a fuel supply device, in which a fuel is injected upstream of an opening of an intake passage.

Measure for Solving the Problems

[0007] A fuel supply device according to the invention comprises an intake chamber having an introducing portion for introduction of an air, an intake passage having an opening opened to the intake chamber and guiding an air in the intake chamber from the opening to an engine, a compartment member to form a separate chamber inside the intake chamber, and an injector having an injector body and a nozzle, at least the injector body being accommodated within the separate chamber, the injector acting to inject a fuel between the introducing portion in the intake chamber and the opening.

[0008] A further fuel supply device according to the invention comprises an intake chamber having an introducing portion for introduction of an air, a plurality of intake passages each having an opening opened to the intake chamber and guiding an air in the intake chamber from the opening to an engine, a compartment member to form a separate chamber inside the intake chamber, and a plurality of injectors each having an injector body and a nozzle, and acting to inject a fuel between the introducing portion in the intake chamber and the respective openings, and at least the injector bodies of the plurality of injectors are accommodated together within the separate chamber.

[0009] A method of assembling a fuel supply device, according to the invention, which fuel supply device comprises an intake chamber box having a first case, and a second case joined to the first case to cooperate therewith to compartment an intake chamber, an intake passage having an opening opened to the intake chamber and guiding an air in the intake chamber from the opening to an engine, a compartment member to form a separate chamber inside the intake chamber, and an injector having an injector body and a nozzle, at least the injector body being accommodated within the separate chamber, the injector acting to inject a fuel between the introducing portion in the intake chamber and the opening, comprises the steps of mounting the compartment member to an inner surface of the first case while arranging the injector between the inner surface of the first case and the compartment member, or arranging the injector inside the compartment member, and assembling the first case, to which the compartment member is mounted, and the second case.

[0010] With the fuel supply device, since the injector body is accommodated in the separate chamber, the injector body is not exposed to an air flow in the intake chamber, so that air resistance caused by the injector is decreased. Besides, since the fuel injector is accommodated inside the intake chamber, the waterproof quality is improved.

Advantage of the Invention

[0011] According to the invention, a fuel supply device, in which a fuel is injected upstream of an opening of an

intake passage, canbe improved in waterproof quality-while air resistance caused by an injector is suppressed.

Brief Description of the Drawings

[0012]

[Fig. 1] Fig. 1 is a side view showing an example of a motorcycle according to an embodiment of the invention.
[Fig. 2] Fig. 2 is a cross sectional view showing a fuel supply device according to a first embodiment of the invention.
[Fig. 3] Fig. 3 is a plan view showing the fuel supply device according to the first embodiment.
[Fig. 4] Fig. 4 is a cross sectional view showing an air funnel. [Fig. 5] Fig. 5 is a cross sectional view showing a fuel supply device according to a second embodiment of the invention.
[Fig. 6] Fig. 6 is a cross sectional view take along the line VI-VI in Fig. 5.
[Fig. 7] Fig. 7 is an exploded, perspective view showing a fuel supply device.
[Fig. 8] Fig. 8 is a cross sectional view showing a fuel supply device according to a third embodiment of the invention and take along the line VIII-VIII in Fig. 9.
[Fig. 9] Fig. 9 is a plan view showing the fuel supply device according to the third embodiment.
[Fig. 10] Fig. 10 is a cross sectional view take along the line X-X in Fig. 9.
[Fig. 11] Fig. 11 is a cross sectional view take along the line XI-XI in Fig. 9.

Description of Reference Numerals and Signs

[0013]

8: air funnel (opening)
11: air-cleaner case (intake chamber box)
11a: lower case (second case)
11b: upper case (first case)
11c': air inlet (introducing portion)
14: fuel injector (injector)
14c: injection nozzle
14e: electric power supply harness
15": support bracket (compartment member)
16: fuel supply pipe
90: intake passage

Best Mode for Carrying Out the Invention

[0014] Embodiments of the invention will be described with reference to the drawings.

[0015] (First embodiment)

Fig. 1 is a side view showing an example of a vehicle according to an embodiment of the invention. The vehicle according to the embodiment comprises a motorcycle (including motorbike, scooter, etc.) 100. In the figure, a left side corresponds to a front side of the vehicle and a right side corresponds to a rear side of the vehicle. The motorcycle 100 comprises an inlet port 81 for introduction of an air, an air cleaner 10, an engine 21, and a muffler 84. In addition, the engine 21 in the embodiment comprises a water-cooled four-cycle parallel four-cylinder engine. The inlet port 81 and the air cleaner 10 are connected to each other through an intake duct 82. The air cleaner 10 and a combustion chamber 2c (not shown in Fig. 1. see Fig. 2) are connected to each other through an intake passage 90. The combustion chamber 2c and the muffler 84 are connected to each other through an exhaust passage 83. An upstream-side fuel injector 14 is arranged inside the air cleaner 10 and a downstream-side fuel injector 13 is arranged in the intake passage 90.

[0016] In the motorcycle 100, an air sucked from the inlet port 81 is led to the air cleaner 10 through the intake duct 82. An air purified by the air cleaner 10 and a fuel injected from the fuel injector 14 are sucked into the intake passage 90. A fuel is further injected into the intake passage 90 from the fuel injector 13. An air and a fuel in the intake passage 90 are fed to the combustion chamber 2c in the suction stroke of the engine 21.

[0017] The air and the fuel fed to the combustion chamber 2c are compressed in the compression stroke, burned in the combustion stroke, and forwarded into the exhaust passage 83 in the exhaust stroke. Exhaust gases forwarded into the exhaust passage 83 are exhausted outside from the muffler 84.

[0018] In the following description, an upstream in a flow direction of an air supplied to the combustion chamber 2c of the engine 21 through the air cleaner 10 and the intake passage 90 from the inlet port 81 is simply referred to as upstream and a downstream in the flow direction is simply referred to as downstream.

[0019] As shown in Fig. 2, a recess to form a part of the combustion chamber 2c is formed in a cylinder head 2 of the engine 21. The engine 21 is mounted in a forward tilting position or an upright position relative to a vehicle frame, and a cylinder bore axis B of the engine 21 forms an angle of 0 to 50 degrees relative to a plumb line V.

[0020] An intake valve opening 2d and an exhaust valve opening, which are opened to the combustion chamber 2c, are opened and closed by an intake valve and an exhaust valve, respectively. Although illustration is omitted, the intake valve and the exhaust valve, respectively, are drivenly opened and closed by an intake cam shaft and an exhaust cam shaft.

[0021] The intake valve opening 2d is formed at a downstream end of an intake port 2e, and an outside connection port 2f is formed at an upstream end of the intake port 2e. A cylindrical-shaped throttle body 7 is connected to the outside connection port 2f through a cylindrical-shaped joint member 6. Further, an air funnel 8 is connected to an upstream end of the throttle body 7. The air funnel 8, the throttle body 7, the joint member 6, and the intake port 2e define the intake passage 90 having a

straight center line A. In addition, the center line A forms an angle of 20 to 50 degrees relative to the cylinder bore axis B.

[0022] The joint member 6 is cylindrical-shaped and made of heat-resisting rubber, and a lower-end flange (not shown) of the joint member 6 is bolted and fixed to a peripheral edge of the outside connection port 2f of the cylinder head 2. A downstream opening of the throttle body 7 is inserted into an upper-end connection port of the joint member 6, and the joint member 6 and the throttle body 7 are clamped and fixed together by a fixing band 6b.

[0023] The throttle body 7 is cylindrical-shaped and a throttle valve 9 is arranged midway in a lengthwise direction of the throttle body. The throttle valve 9 comprises a valve shaft 9a extending through the throttle body 7 in a direction (referred to as cam shaft direction) in parallel to the cam shaft, and a valve disk 9b fixed to the valve shaft 9a. Although illustration is omitted, the valve shaft 9a is connected to an adjacent valve shaft of the throttle valve by a connection body. A throttle pulley is mounted on the connection body, and the throttle pulley is connected to a throttle grip of a steering handle through a throttle cable.

[0024] The air funnel 8 is connected to the throttle body 7 through a joint member 6'. The air funnel 8 is opened into the air cleaner 10. The air cleaner 10 comprises a box-shaped air-cleaner case 11 extending in a vehicle-width direction (cam shaft direction). An intake chamber is defined inside the air-cleaner case 11 and an element 12 is arranged in the intake chamber.

[0025] The air-cleaner case 11 is of a vertical split type to comprise a lower case 11a and an upper case 11b. Flanges 11e, 11f, respectively, are formed at peripheral edges of split surfaces of the lower case 11a and the upper case 11b, and the flanges 11e, 11f are fixed together by means of fasteners such as vis, screw, bolt, etc.

[0026] The lower case 11a is compartmented into a front portion (a right portion in Fig. 2) and a rear portion (a left portion in Fig. 2). The front portion of the lower case 11a expands downward in size, and an expansion portion 11i is formed at a side wall thereof with an air inlet 11c'. The rear portion of the lower case 11a comprises a downwardly expanded outlet 11d. The outlet 11d mounts to a bottom surface thereof four sets of air funnels 8 of the respective cylinders. In addition, the respective air funnels 8 are fitted into the connection ports of the throttle bodies 7 of the respective cylinders when the air cleaner 10 is arranged in a predetermined position.

[0027] The upper case 11b is substantially arcuate-shaped in a cross section extending from the front portion to a rear wall 11g. Since the upper case 11b is arcuate-shaped in this manner, a necessary volume is ensured on a secondary side (downstream of the element 12) of the element 12.

[0028] A main flow of an air sucked from the air inlet 11c' is led to the air funnels 8 such that a center line M of the flow assumes an arcuate shape as shown in Fig. 2.

[0029] The downstream-side fuel injectors 13 are arranged every cylinder on downstream sides of the throttle valves 9 of the respective throttle bodies 7, and the upstream-side fuel injectors 14 are arranged every cylinder on upstream sides.

[0030] A boss to support the fuel injector 13 is formed on a rear wall of the throttle body 7, that is, a wall positioned on an opposite side of the center line A of the intake passage to the cylinder bore axis B. The respective fuel injectors 13 are fixed in a state of being inserted into the bosses. Fuel introduction portions 13b are provided on upper ends of the respective fuel injectors 13, the respective fuel introduction portions 13b being connected to pipes 17a branching off a fuel supply pipe 17. The fuel supply pipe 17 extends in the cam shaft direction and is common to the respective fuel injectors 13. In addition, the reference numeral 13c denotes nozzles of the fuel injectors 13.

[0031] The throttle body 7 comprises a diaphragm type cushion valve 19 on an upstream side of the throttle valve 9. In the cushion valve 19, a piston valve 19a to increase or decrease , an area of the intake passage is biased toward a closed side. Also, the piston valve 19a is connected to a diaphragm 19b to introduce into a diaphragm chamber 19c negative pressure in the intake passage 90. Owing to the provision of such cushion valve 19, when the throttle valve 9 is abruptly opened, the piston valve 19a opens the intake passage 90 a little later to adjust an increase in air quantity to an increase in fuel injection quantity whereby it is possible to achieve a smooth increase in rotation of the engine.

[0032] The upstream-side fuel injectors 14 are arranged inside (toward a center of the arcuate shape) the center line M of the main flow within the air-cleaner case 11. The respective fuel injectors 14 are supported on a cylindrical-shaped support bracket 15" . The support bracket 15" comprises a vertical wall 15a extending lengthwise of the fuel injectors 14. In addition, the vertical wall 15a has the function of leading the air flow M to the air funnels 8. The support bracket 15" extends through left and right side walls of the air-cleaner case 11 (see Fig. 3). The extending-through portions are interposed by flanges of the lower case 11a and the upper case 11b and sealed so as not to prevent an outside air from entering the air cleaner.

[0033] The fuel injectors 14 comprise an injection nozzle 14c and an injector body (a portion except the injection nozzle 14c). The injector body is fixed in a state of being inserted into a boss 15d of the support bracket 15", and the injection nozzle 14c projects downward from the support bracket 15". The support bracket 15" defines a separate chamber 68 in the air cleaner 10 to be compartmented from the intake chamber. The injector bodies of the fuel injectors 14 are accommodated inside the separate chamber 68.

[0034] Also, a common fuel supply pipe 16 is connected to an upper end of the respective fuel injectors 14. The respective fuel injectors 14 are connected to pipes

16a branching off the fuel supply pipe 16 within the separate chamber 68. As shown in Fig. 3, an end of the fuel supply pipe 16 projects outside the air-cleaner case 11, and the projecting portion is connected to a fuel supply pump (not shown).

[0035] Also, the respective fuel injectors 14 are connected to electric power supply harnesses 14e within the separate chamber 68. Although illustration is omitted, four sets of electric power supply harnesses 14e in a bundled state extend through the air-cleaner case 11 to be led outside. Provided on the led ends is a connection connector.

[0036] In this manner, the four fuel injectors 14 along with the fuel supply pipe 16 and the electric power supply harnesses 14e are mounted to the support bracket 15" to be made integral as an injector unit. The injector unit is arranged in the air cleaner 10 (more specifically, within the separate chamber 68 compartmented by the support bracket 15") . On the other hand, a joint of the fuel supply pipe 16 and the connector connected to edges of the harnesses 14e are connected to external circuits outside the air cleaner 10.

[0037] According to the embodiment, the air funnels 8 are tapered in shape with a suction side thereof being slightly large in diameter, and tip ends of the air funnels 8 are formed by a bellmouth. The bellmouth forms a separation layer inducing portion 8a, which is provided by arcuately outwardly bending a peripheral edge of a suction port 8b (see Fig. 4). The separation layer inducing portion 8a is structured such that a separation layer a of an air flow sucked into the throttle body 7 through the air funnel 8 is positively formed on an inner surface of the air funnel 8.

[0038] Concretely, as shown in Fig. 4, the separation layer inducing portion 8a defines an arcuate curved surface, of which a radius of curvature r in the air flow direction is in the order of 0.33 to 0.01xD where D indicates a diameter of the suction port 8b of the air funnel 8. Here, when the radius of curvature r is 0.33xD, the contraction of flow assumes about 0.99. By the way, when the radius of curvature r is 0.33xD, contraction of flow is not caused by a corner of an intake inlet but when the radius of curvature r is less than 0.33xD, the flow coefficient is degraded and flow separation is generated. However, when a separation layer a is formed at an opening of the air funnel 8, a fuel riding on a pulsating wave to flow backward in the intake passage 90 can be caught by the separation layer a. Hereupon, according to the embodiment, blowing-back of the fuel is prevented by making effective use of flow separation at the funnel opened end. Therefore, the radius of curvature r described above is adopted. That is, according to the embodiment, suction resistance is suppressed by providing the air funnel 8 at an upstream end of the intake passage 90 and blowing-back of the fuel is prevented by forming the separation layer a at the opening end of the air funnel 8.

[0039] Also, according to the embodiment, the fuel injectors 14 are arranged in a manner to inject a fuel toward a center of the intake passage from the separation layer a.

[0040] A fuel supply device according to the embodiment is assembled in the following manner. That is, the respective fuel injectors 14 are first mounted to the support bracket 15" . Then, the branch pipes 16a of the fuel supply pipe 16 and the electric power supplyharnesses 14e are mounted to the respective fuel injectors 14. Subsequently, the support bracket 15" is mounted to the upper case 11b. Then, the upper case 11b with the support bracket 15" mounted thereto is mounted to the lower case 11a.

[0041] With the present fuel supply device, the separate chamber 68 is compartmented by the support bracket 15" in the air cleaner 10 and the injector bodies of the fuel injectors 14 are accommodated inside the separate chamber 68. Therefore, the injector bodies are not exposed to the air flow M in the air cleaner 10. Accordingly, it is possible to suppress the air resistance caused by the fuel injectors 14. Besides, since the fuel injectors 14 are accommodated inside the air cleaner 10, it is possible to improve the air cleaner 10 in waterproof quality. As described above, with the present fuel supply device, it is possible to make reduction in air resistance and an improvement in waterproof quality compatible with each other in spite of the fuel injectors 14 being arranged upstream of the openings of the intake passage 90.

[0042] Also, with the present fuel supply device, the support bracket 15" (the fuel injectors 14) are arranged inside the arcuate-shaped center line M of the main flow of an air. Therefore, from the viewpoint of arrangement, the fuel injectors 14 can be suppressed in making resistance to the air flow. Accordingly, it is possible to avoid that the air resistance of the fuel injectors 14 constitutes a factor to obstruct an increase in engine output.

[0043] Also, with the present fuel supply device, the single support bracket 15" the common separate chamber 68 to accommodate the plurality of fuel injectors 14. Accordingly, as compared with the case where separate chambers 68 are individually formed for the respective fuel injectors 14, it is possible to achieve reduction in the number of parts.

[0044] Also, since the support bracket 15" supporting thereon the fuel injectors 14 is mounted to the upper case 11b and thereafter the upper case 11b is assembled to the lower case 11a, the fuel supply device can be relatively easily assembled in spite of the fuel injectors 14 being arranged inside the air cleaner 10.

[0045] Also, with the present fuel supply device, connection between the fuel injectors 14 and the fuel supply pipe 16 and connection between the fuel injectors 14 and the electric power supply harnesses 14e are both effected in the separate chamber 68 within the support bracket 15". Accordingly, it suffices that such connection be performed when the support bracket 15" is mounted to the upper case 11b. With the present fuel supply device, these elements can be connected together before the upper case 11b and the lower case 11a are assembled

together.

[0046] In addition, with the present fuel supply device, the fuel injectors 14 do not project outside the air-cleaner case 11. Therefore, it is possible to make the fuel supply device look better.

[0047] (Second embodiment)

Figs. 5 to 7 are views illustrating a fuel supply device according to a second embodiment. As shown in Fig. 5, a cylinder head 2 is mounted on an upper mating surface 1a of a cylinder body 1 of an engine 21. The cylinder head 2 and the cylinder body 1 are clamped together by means of head bolts (not shown) . A head cover 3 is mounted on an upper mating surface 2a of the cylinder head 2.

[0048] A recess to form a part of a combustion chamber 2c is formed on a lower mating surface 2b of the cylinder head 2. An intake valve opening 2d and an exhaust valve opening (not shown), which are opened to the combustion chamber 2c, are opened and closed by an intake valve 4a and an exhaust valve 4b, respectively. The intake valve 4a and the exhaust valve 4b, respectively, are drivenly opened and closed by an intake cam shaft 5a and an exhaust cam shaft 5b.

[0049] Also, according to the embodiment, a lower case 11a is compartmented into a front portion (a right portion in Fig. 5) and a rear portion (a left portion in Fig. 5). According to the embodiment, however, an air inlet 11c opened downward is formed in the front portion. The rear portion comprises a downwardly expanded outlet 11d. The outlet 11d mounts to a bottom surface thereof four sets of air funnels 8 of respective cylinders.

[0050] An element 12 is in the form of a thick plate to cover the air inlet 11c of the lower case 11a and interposed by both flanges 11e, 11f. An upper case 11b is substantially arcuate-shaped as viewed in cross section. A main flow of an air sucked from the air inlet 11c is changed in a flow direction to be led to air funnels 8 such that a center line M of the flow assumes an arcuate shape.

[0051] A boss 7c is formed on a rear wall of a throttle body 7, that is, a wall positioned on an opposite side of a center line A of an intake passage to a cylinder bore axis B. Respective fuel injectors 13 are fixed in a state of being inserted into the bosses 7c. In addition, a tip end of an injection nozzle 13c of the fuel injector 13 is positioned near to an inner surface of the throttle body 7. As viewed in a cam shaft direction (in addition, the cam shaft direction is also a crankshaft direction), an injection axis 13a of the fuel injector 13 intersects an intake passage axis A in the vicinity of an inlet of an intake port 2e and is directed toward a roof wall of the intake port 2e.

[0052] Respective fuel injectors 14 are supported on a rear wall 11g of the upper case 11b of an air cleaner 10 through a common support bracket 15. The support bracket 15 is formed to be substantially L-shaped in cross section to have a vertical wall 15a and a transverse wall 15b. In addition, the vertical wall 15a also functions as a guide plate to direct a main flow M of an air flowing in the air cleaner 10, toward the air funnels 8. Both left and right ends of the vertical wall 15a and the transverse wall 15b, respectively, are connected to substantially triangular-shaped end walls 15c (see Fig. 6). A substantially trigonal prism shaped separate chamber 68 is defined between the support bracket 15 and the rear wall 11g. Flanges 15f are formed at peripheral edges of the vertical wall 15a, the transverse wall 15b, and the end walls 15c, the flanges 15f being detachably bolted and fixed to the rear wall 11g. In addition, a sealing member 15e is present between the flanges 15f and the rear wall 11g.

[0053] The transverse wall 15b is formed with cylindrical-shaped bosses 15d, which expand downward. The respective fuel injectors 14 are fixed in a state of being inserted into the bosses 15d, and injection nozzles 14c project downward from the bosses 15d. Fuel introduction portions 14b are provided on upper ends of the respective fuel injectors 14, the fuel introduction portions 14b being inserted into and connected to pipes 16a branching off a single common fuel supply pipe 16.

[0054] As shown in Fig. 6, both ends of the fuel supply pipe 16 extend through the rear wall 11g of the upper case 11b to project rearward (toward a back side of a plane of Fig. 6), and joints 16b, 16c are provided on outer projecting portions of the fuel supply pipe 16 to be connected to fuel pipes on a fuel supply side and on a fuel return side. As shown in Figs. 5 and 7, electric power supply harnesses 14e, respectively, are connected to the respective fuel injectors 14. Although illustration is omitted, the four sets of electric power supply harnesses 14e in a bundled state extend through insertion ports 11j (see Fig. 7) of the rear wall 11g to be led outside. Provided on the led ends is a connection connector (not shown).

[0055] In this manner, the four fuel injectors 14 along with the fuel supply pipe 16 and the electric power supply harnesses 14e are mounted on the support bracket 15 to be made integral as an injector unit. The injector unit is arranged in the air cleaner 10, especially, within the separate chamber 68 compartmented by the support bracket 15 and the upper case 11b. On the other hand, the joints 16b, 16c of the fuel supply pipe 16 and the connector connected to edges of the harnesses 14e are connected to external circuits outside the air cleaner 10.

[0056] As shown in Fig. 5, the respective fuel injectors 14 are arranged outside (an opposite side to a center of the arcuate shape) the arcuate-shaped center line M of the main flow of an air. As viewed in the cam shaft direction, in the valve axis portion 9a of the throttle valve, an injection axis 14a of each fuel injector 14 intersects a center line A of an intake passage 90 and hence the center line M of the main flow. Also, the injection axis 14a is directed toward a rear surface (a surface on the right in Fig. 6) of a valve disk 9b (shown by two-dot chain lines in Fig. 5) in a fully closed position.

[0057] The fuel supply device according to the embodiment is assembled in the following manner. That is, the respective fuel injectors 14 are first mounted to the support bracket 15. Then, the branch pipes 16a of the fuel supply pipe 16 and the electric power supplyharnesses

14e are mounted to the respective fuel injectors 14. Subsequently, the support bracket 15 is mounted to an inner surface of the rear wall 11g of the upper case 11b. Thereby, the fuel injectors 14 are mounted to the upper case 11b from inside. Then, the upper case 11b with the support bracket 15 mounted thereto is mounted to the lower case 11a.

[0058] Thus, according to the embodiment, the separate chamber 68 is formed inside the air cleaner 10 by the support bracket 15 and the fuel injectors 14 are accommodated inside the separate chamber 68. Accordingly, in the same manner as in the first embodiment, it is possible to achieve reduction in air resistance and an improvement in waterproof quality.

[0059] According to the embodiment, the support bracket 15 (the fuel injectors 14) is arrangedoutside the arcuate-shaped center line M of the main flow of an air. Accordingly, in the same manner as in the first embodiment, from the viewpoint of arrangement, the support bracket 15 (the fuel injectors 14) can be suppressed in making resistance to the air flow.

[0060] Also, according to the embodiment, the fuel injectors 14, the fuel supply pipe 16, and the electric power supply harnesses 14e are mounted to the support bracket 15 to be made integral as an injector unit. Then, the injector unit is arranged in the air cleaner 10 (especially, the separate chamber 68) and detachably bolted and fixed to the air-cleaner case 11. Therefore, the mounting operation of the fuel injectors 14, the fuel supply pipe 16, and the like can be made easy in spite of the plurality of fuel injectors 14 being provided. Also, since the injector unit is positioned as a whole in the air-cleaner case 11, and in particular, the fuel injectors 14 do not project outside, it is possible to avoid a problem that the fuel injectors 14 interfere with other vehicle-mounted parts to be damaged or the like.

[0061] Also, with the present fuel supply device, the both ends of the fuel supply pipe 16 are caused to project outside the air-cleaner case 11, and the joints 16b, 16c are provided on the projecting portions of the fuel supply pipe. Also, the connector connected to the edges of the harnesses 14e is arranged outside the air-cleaner case 11. Therefore, the operations of connection and disconnection of a fuel circuit and an electric circuit can be easily performed in spite of the injector unit being arranged inside the air cleaner 10.

[0062] (Third embodiment)

A fuel supply device according to a third embodiment will be described with reference to Figs. 8 to 11.

[0063] Also, according to the embodiment, a separate chamber 68 is compartmented by a support bracket 15 in an intake chamber in an air cleaner 10. Fuel injectors 14 are accommodated inside the separate chamber 68. In addition, according to the embodiment, not only injector bodies but also injection nozzles 14c are accommodated within the separate chamber 68. That is, while opening ends of the nozzles are opened to the intake chamber, the injection nozzles 14c are substantially accommodated within the separate chamber 68.

[0064] Also, according to the embodiment, an air-cleaner case 11 comprises a lower case 11a and an upper case 11b, and flanges 11e, 11f of the cases 11a, 11b are detachably joined together by means of bolts 65 and nuts 66. The support bracket 15 and the upper case 11b are fixed together by bolts 67 inserted from outside the upper case 11b. In addition, fasteners such as the bolts 67, etc. are exemplary and fixation can be of course achieved by means of fasteners such as screws, etc.

[0065] Pipes 16a branching off a fuel supply pipe 16 are connected to upper ends of the respective fuel injectors 14. As shown in Figs. 9 and 10, an insertion port 75 is formed on the rear wall 11g of the upper case 11b. A sealing member 73 for waterproofing is fitted into the insertion port 75, and the fuel supply pipe 16 extends through the sealing member 73. With such arrangement, the fuel supply pipe 16 is arranged inside (strictly, an interior of the separate chamber 68) and outside the air cleaner 10 through the insertion port 75.

[0066] Also, the respective fuel injectors 14 are connected to electric power supply harnesses 14e within the separate chamber 68. As shown in Figs. 9 and 11, an insertion port 76 is formed on the rear wall 11g of the upper case 11b, and a sealing member 74 for waterproofing is also fitted into the insertion port 76. Four sets of electric power supplyharnesses 14e are bundled to make a group of harnesses 70 to extend through the sealing member 74 . With such arrangement, the harnesses 70 are arranged inside and outside the air cleaner 10 through the insertion port 76. In addition, a connection connector 71 is provided on edges of the harnesses 70 outside the air cleaner 10.

[0067] In addition, the fuel supply device according to the embodiment can be assembled in the same manner as the fuel supply device according to the second embodiment.

[0068] Also, it is possible in the embodiment to produce the same effect as those in the respective embodiments.

Industrial Applicability

[0069] As described above, the invention is useful in fuel supply devices for engines and vehicles provided with the same.

Claims

1. A fuel supply device comprising
an intake chamber having an introducing portion for introduction of an air,
an intake passage having an opening opened to the intake chamber and guiding an air in the intake chamber from the opening to an engine,
a compartment member to form a separate chamber inside the intake chamber, and
an injector having an injector body and a nozzle, at

least the injector body being accommodated within the separate chamber, the injector acting to inject a fuel between the introducing portion in the intake chamber and the opening.

2. The fuel supply device according to claim 1, further comprising a fuel supply pipe connected to the injector in the separate chamber.

3. The fuel supply device according to claim 1, further comprising an electric power supply harness connected to the injector in the separate chamber.

4. The fuel supply device according to claim 1, further comprising
a first case, and
a second case joined to the first case to cooperate therewith to compartment the intake chamber, and
wherein the compartment member is mounted to an inner surface of the first case.

5. The fuel supply device according to claim 1, further comprising
a fuel supplypipe connected to the injector in the separate chamber,
an electric power supply harness connected to the injector in the separate chamber, and
a connector connected to an edge of the harness, and
wherein the injector, the fuel supply pipe, and the electric power supply harness are made integral as an injector unit and arranged in the separate chamber, and
the connector is arranged outside the intake chamber.

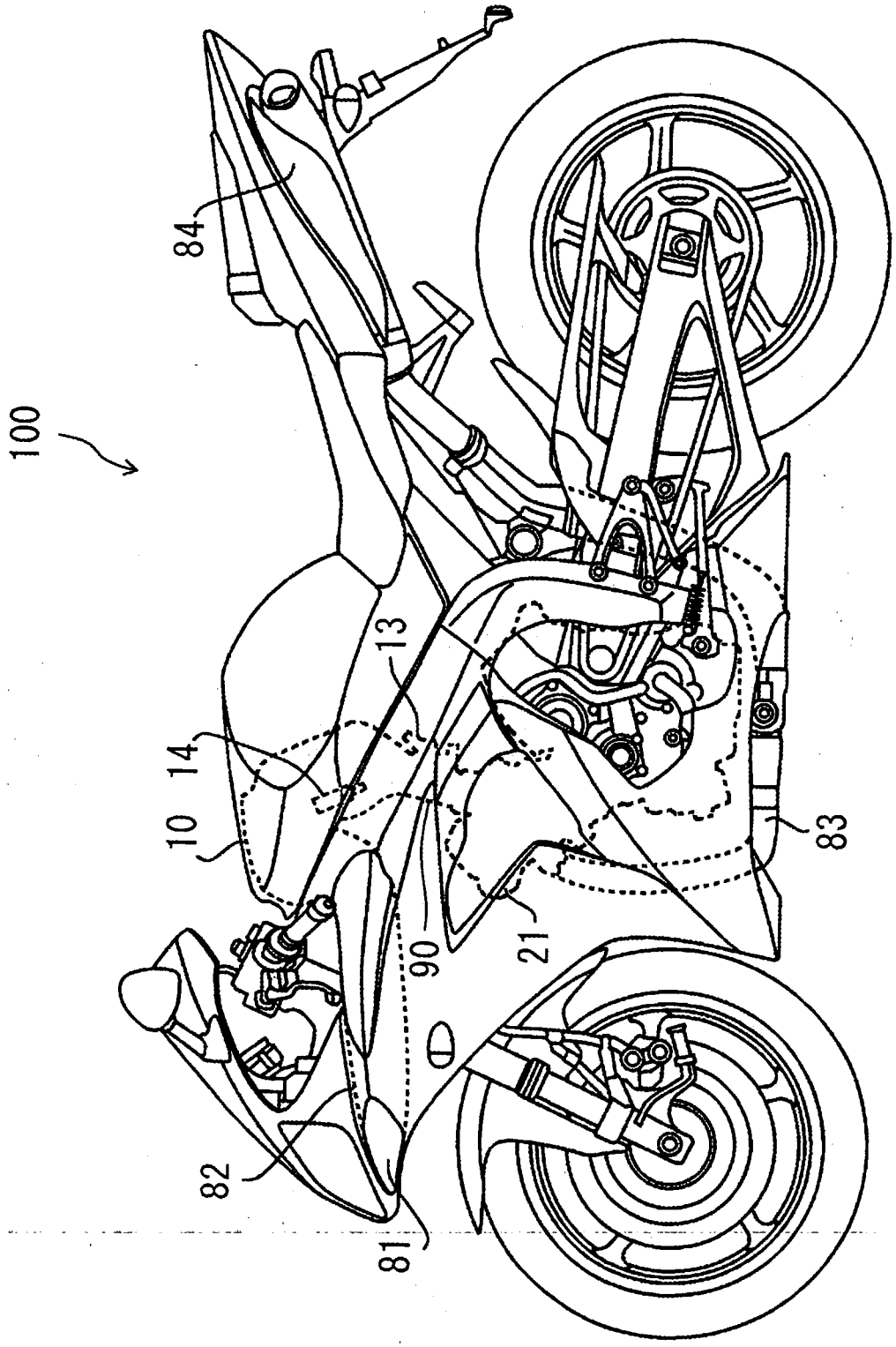
6. A fuel supply device comprising
an intake chamber having an introducing portion for introduction of an air,
a plurality of intake passages each having an opening opened to the intake chamber and guiding an air in the intake chamber from the opening to an engine,
a compartment member to form a separate chamber inside the intake chamber, and
a plurality of injectors each having an injector body and a nozzle, and acting to inject a fuel between the introducing portion in the intake chamber and the respective openings, and
wherein at least the injector bodies of the plurality of injectors are accommodated together within the separate chamber.

7. A vehicle provided with a fuel supply device according to any one of claims 1 to 6.

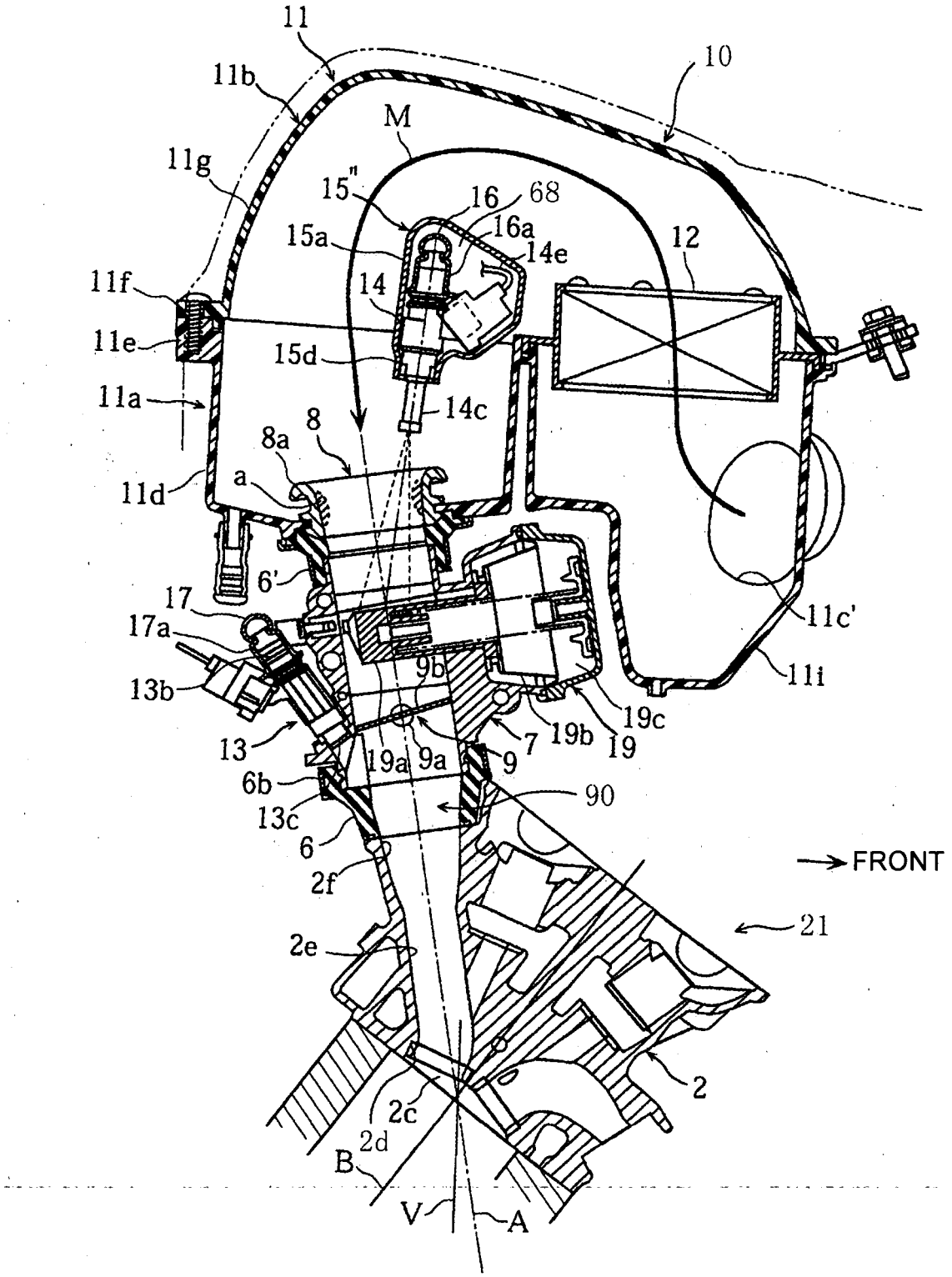
8. A method of assembling a fuel supply device, which comprises
an intake chamber box having a first case, and a second case joined to the first case to cooperate therewith to compartment an intake chamber,
an intake passage having an opening opened to the intake chamber and guiding an air in the intake chamber from the opening to an engine,
a compartment member to form a separate chamber inside the intake chamber, and
an injector having an injector body and a nozzle, at least the injector body being accommodated within the separate chamber, the injector acting to inject a fuel between the introducing portion in the intake chamber and the opening, the method comprising the steps of:

mounting the compartment member to an inner surface of the first case while arranging the injector between the inner surface of the first case and the compartment member, or arranging the injector inside the compartment member, and
assembling the first case, to which the compartment member is mounted, and the second case.

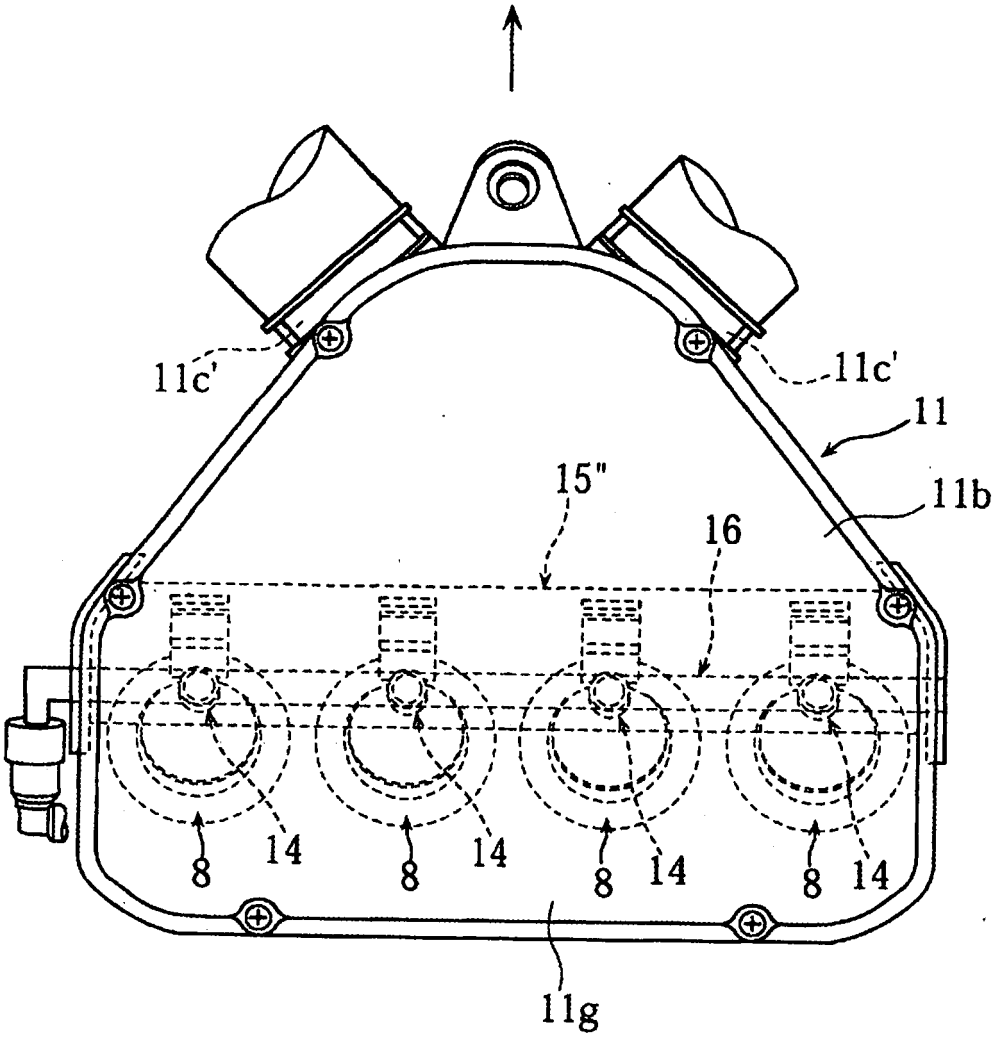
[Fig. 1]



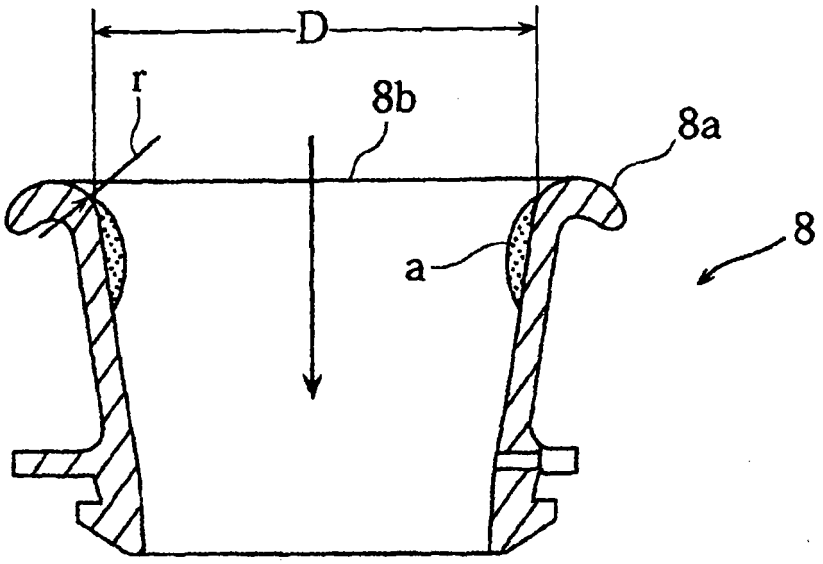
[Fig. 2]


11
11b
10
M
11g
15"
16
68
16a
15a
14e
12
14
11f
11e
15d
11a
14c
8
8a
a
11d
6'
17
17a
11c'
11i
13b
9b
19c
19b
19
7
13
19a
9a
9
6b
90
13c
6
2f
FRONT
21
2e
2
2c
2d
B
V
A

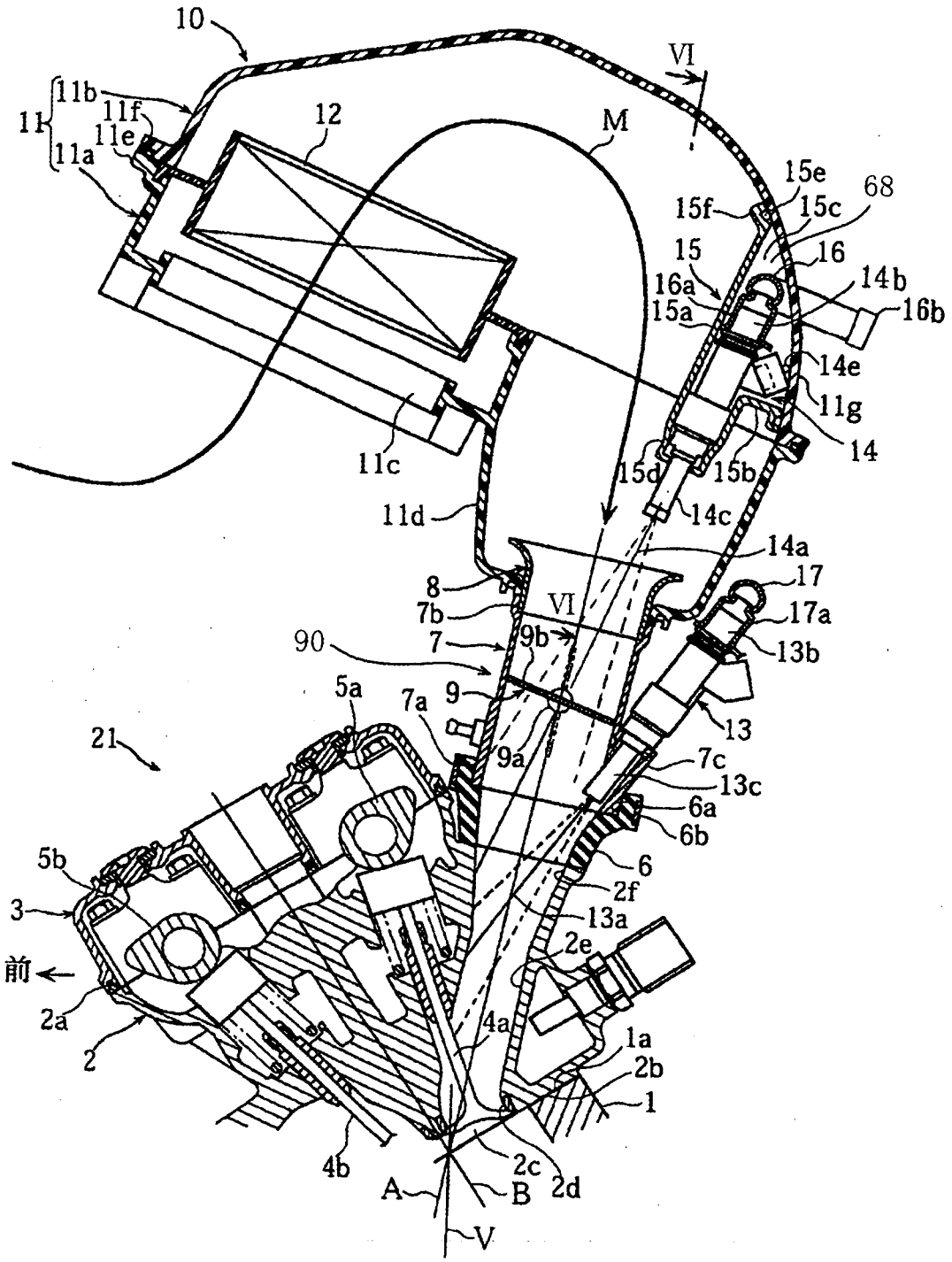
[Fig. 3]



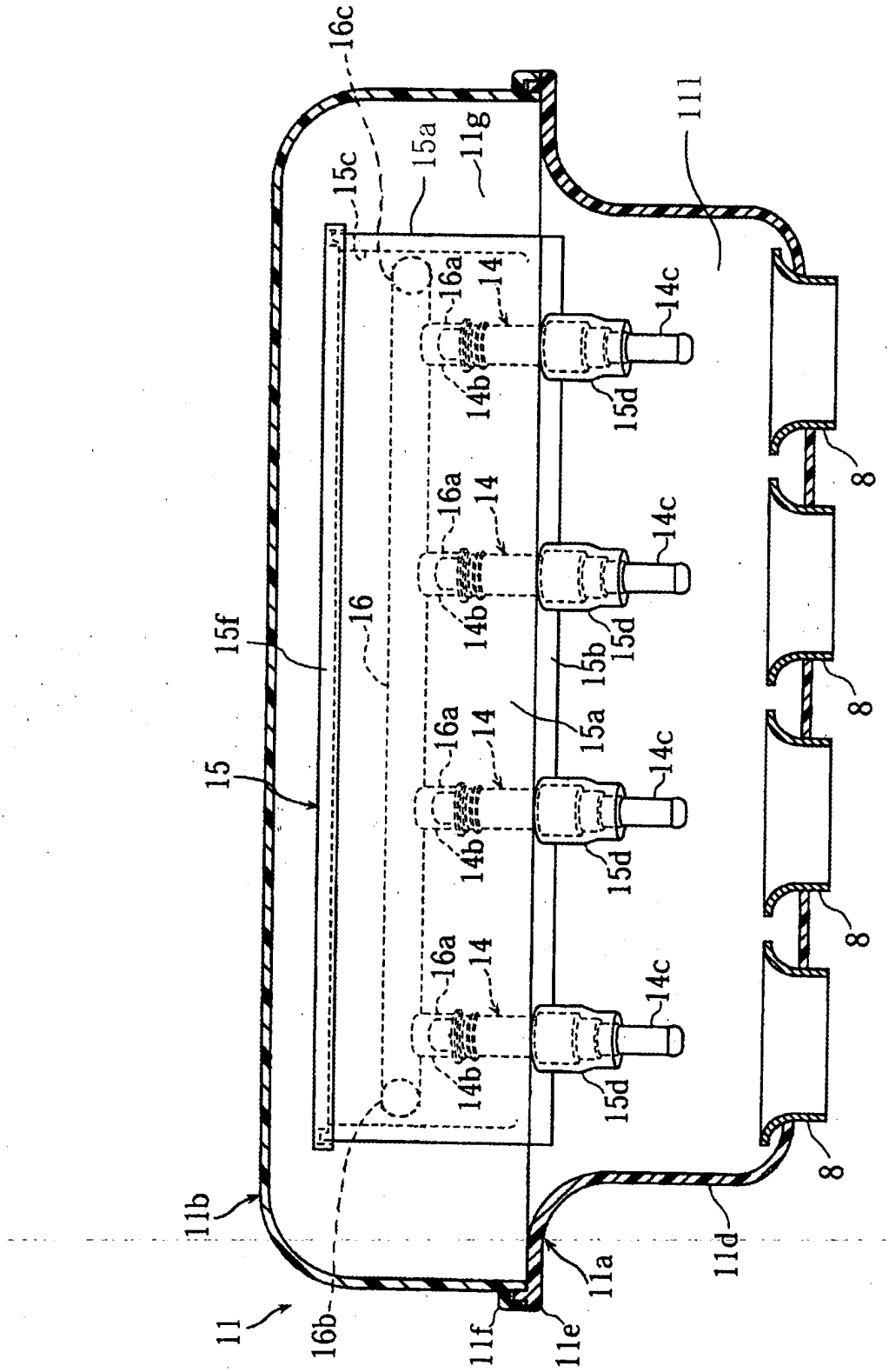
[Fig. 4]



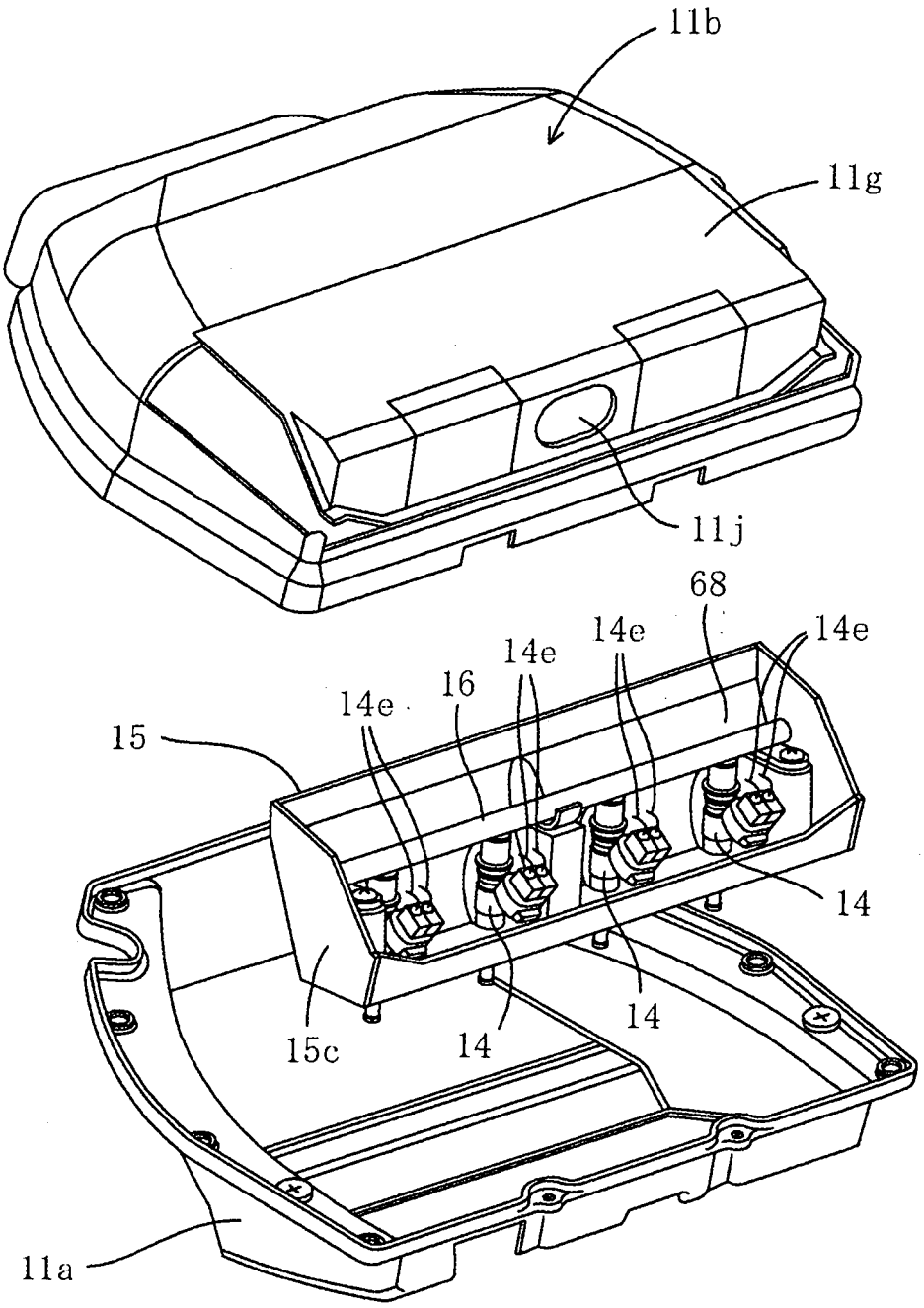
[Fig. 5]


10
11
11b
11f
11e
11a
12
M
VI
15e
68
15f
15c
15
16
16a
14b
15a
16b
14e
11g
14
11c
15d
15b
11d
14c
14a
17
8
7b
VI
17a
90
7
9b
13b
5a
7a
9
21
9a
13
7c
13c
6a
6b
5b
6
3
2f
13a
2e
前
2a
4a
1a
2b
2
1
4b
2c
2d
A
B
V

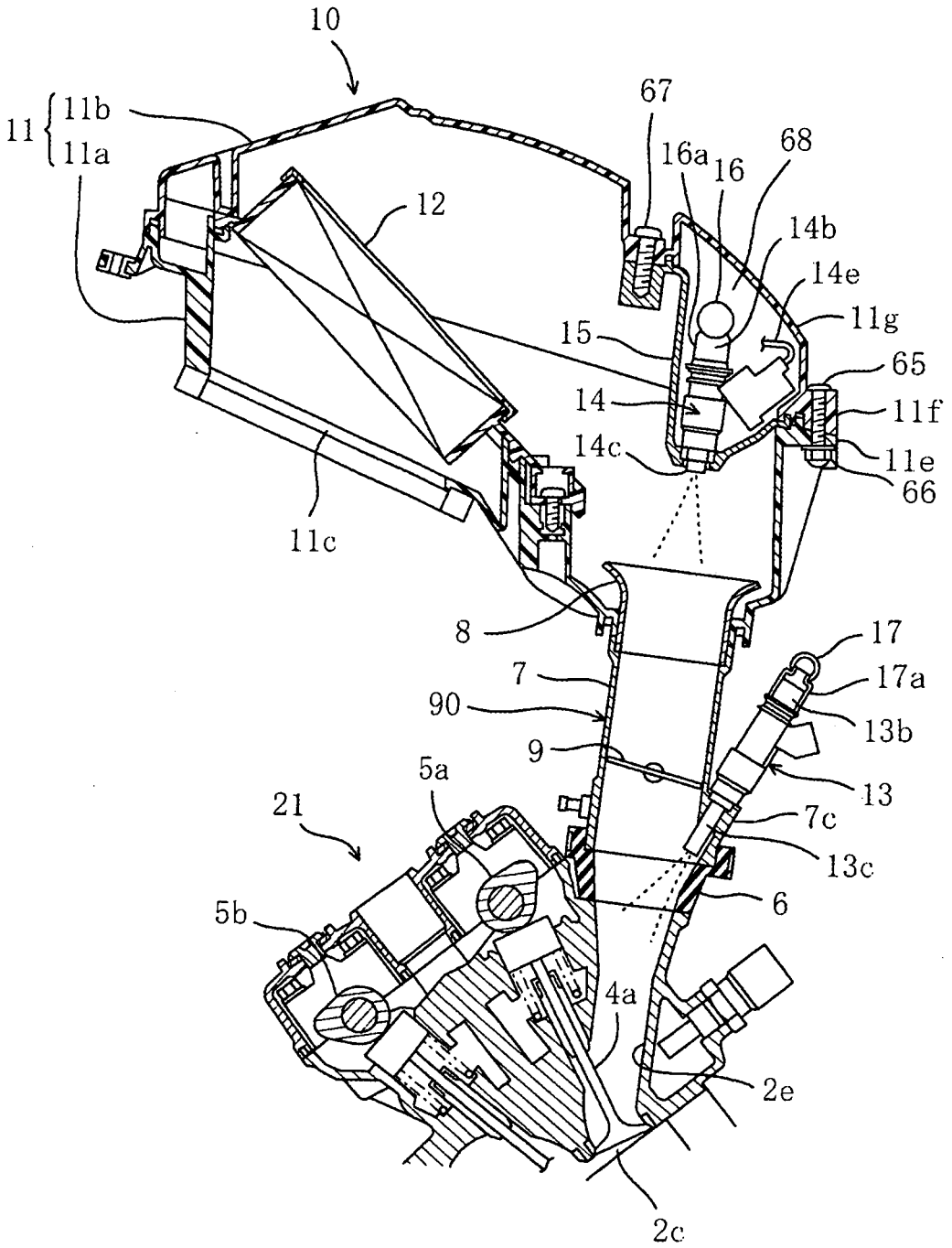
[Fig. 6]


16c
15c
15a
11g
111
16a
14
14c
14b
15d
8
16
15f
15
15b
11b
11
16b
11f
11e
11a
11d

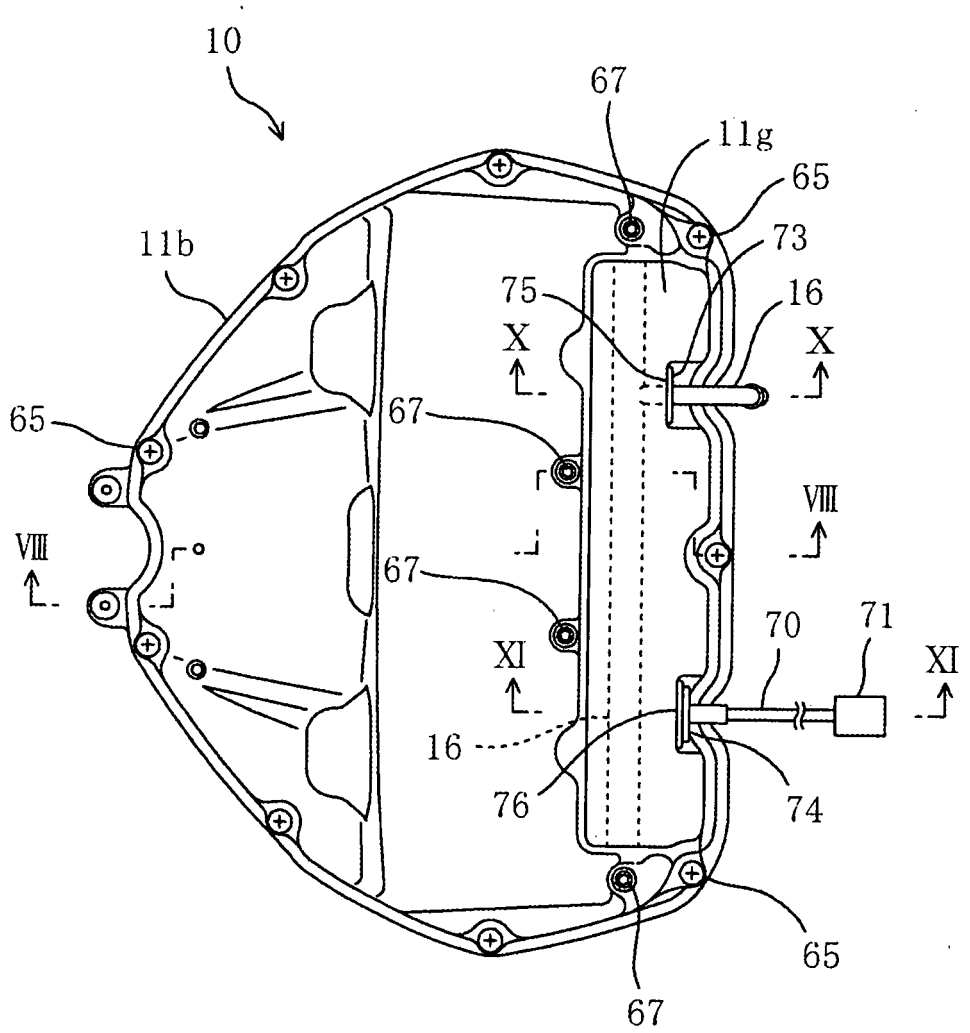
[Fig. 7]



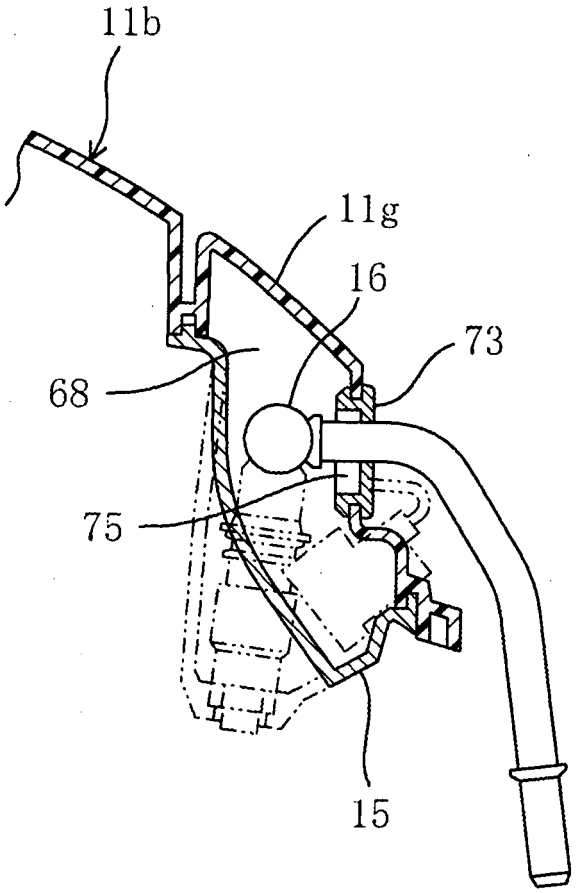
[Fig. 8]


10
11
11b
11a
67
16a
16
68
12
14b
14e
11g
15
65
14
11f
14c
11e
66
11c
8
17
7
17a
90
13b
9
13
5a
21
7c
13c
6
5b
4a
2e
2c

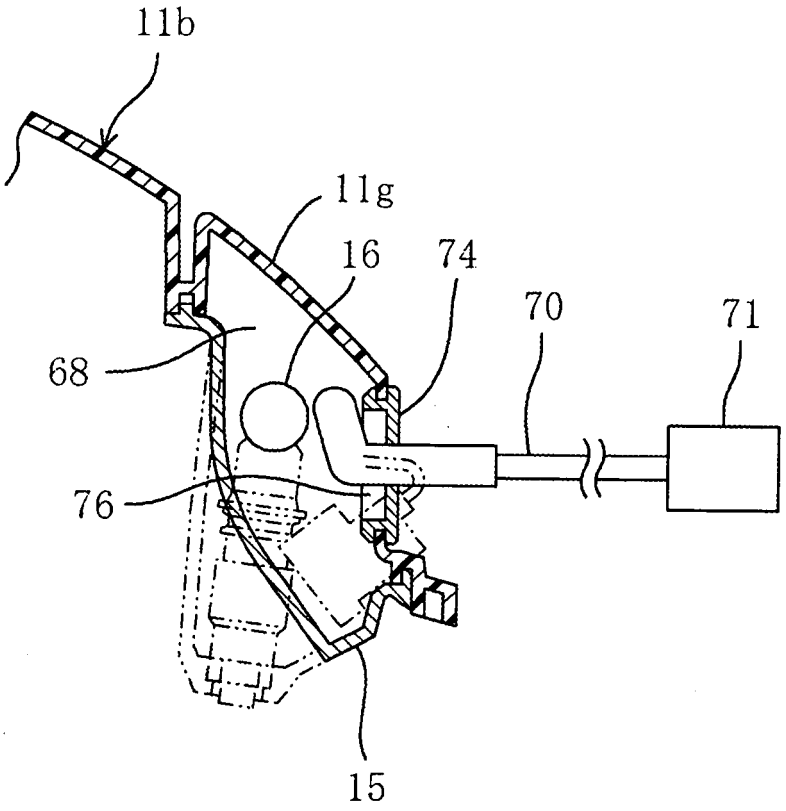
[Fig. 9]


10
67
11g
65
73
11b
75
16
X
X
65
67
VIII
VIII
67
70
71
XI
XI
16
76
74
65
67

[Fig. 10]



[Fig. 11]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/016301

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] F02M69/00, F02M69/04, F02M35/10, F02M35/16

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)
Int.Cl[7] F02M69/00, F02M69/04, F02M35/10, F02M35/16

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	1996-2005
Kokai Jitsuyo Shinan Koho	1971-2005	Toroku Jitsuyo Shinan Koho	1994-2005

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.
X Y	JP 58-35266 A (Mitsubishi Electric Corp.), 01 March, 1983 (01.03.83), Page 1, left column, line 19 to right column, line 11; Fig. 1 (Family: none)	1,2,4,7,8 3,5,6
Y	JP 2000-97131 A (Yamaha Motor Co., Ltd.), 04 April, 2000 (04.04.00), Par. Nos. [0013] to [0025], [0030], [0031]; Figs. 2, 3, 10 to 12 (Family: none)	1-8

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

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Date of the actual completion of the international search 01 February, 2005 (01.02.05)	Date of mailing of the international search report 08 March, 2005 (08.03.05)
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/JP2004/016301

C (Continuation). *DOCUMENTS CONSIDERED TO BE RELEVANT*

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 151682/1986(Laid-open No. 57370/1988) (Mitsubishi Electric Corp.), 16 April, 1988 (16.04.88), Full text; all drawings (Family: none)	1-8
Y	JP 10-205410 A (Toyota Motor Corp.), 04 August, 1998 (04.08.98), Par. Nos. [0025] to [0027]; Fig. 5 (Family: none)	1-8

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