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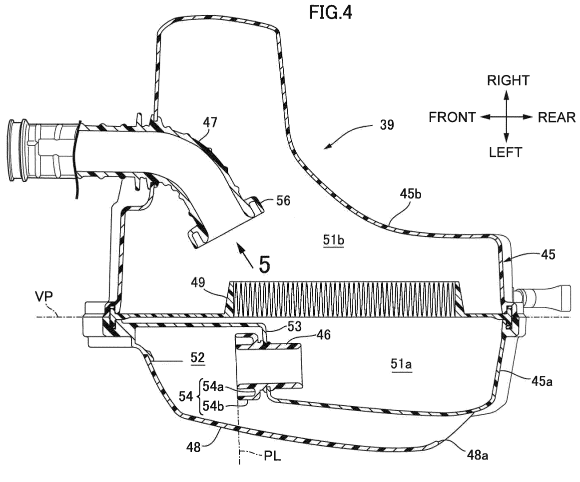
(54) **AIR CLEANER**

(57) An air cleaner (39) is provided with a cleaner container (45) that forms a dirty chamber (51a) communicating with outside air and a clean chamber (51b) communicating with a supply destination for cleaned air, a cleaner element (49) that is disposed within the cleaner container (45) between the dirty chamber (51a) and the clean chamber (51b), and a connecting tube (47) that is fixed to the cleaner container (45), opens in a space of the clean chamber (51b) via an upstream end within the clean chamber (51b), and provides communication between the clean chamber (51b) and the supply destination. A double pipe part (56) is provided at the upstream end of the connecting tube (47) along an outer periphery of the connecting tube (47). Accordingly, it is possible to provide an air cleaner that realizes flow alignment effectively in a small space.

FIG.4



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Description

TECHNICAL FIELD

[0001] The present invention relates to an air cleaner for supplying outside air to an internal combustion engine and, in particular, to an air cleaner that includes a cleaner container that forms a dirty chamber communicating with outside air and a clean chamber communicating with an internal combustion engine, which is a supply destination for cleaned air, a cleaner element that is disposed within the cleaner container between the dirty chamber and the clean chamber, and a connecting tube that is fixed to the cleaner container, opens in a space of the clean chamber at an upstream end of the clean chamber, and provides communication between the clean chamber and the supply destination.

BACKGROUND ART

[0002] Patent Document 1 discloses an intake duct that guides air to a carburetor in a two-wheeled motor vehicle. The intake duct includes a tubular part connected to the carburetor, a chamber part provided on the intake upstream side of the tubular part and having an internal diameter larger than that of the tubular part, and an extending inner wall part protruding into an interior space of the chamber part while being continuous from the tubular part and forming an extended flow path communicating with a flow path of the tubular part. Due to the flow path of the tubular part being extended, turbulence of the flow of air introduced from the tubular part is suppressed, thus realizing flow alignment for the flow of air.

RELATED ART DOCUMENTS

PATENT DOCUMENTS

[0003] Patent Document 1: Japanese Patent Application Laid-open No. 2011-43165

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004] However, in the arrangement of Patent Document 1, extra space is required for extending the intake path, the structure also becomes complicated, and there is a desire for a technique that will realize flow alignment effectively in a small space.

[0005] The present invention has been accomplished in light of the above circumstances, and it is an object thereof to provide an air cleaner that realizes flow alignment effectively in a small space.

MEANS FOR SOLVING THE PROBLEMS

[0006] According to a first aspect of the present invention, there is provided an air cleaner for supplying outside air to an internal combustion engine, comprising a cleaner container that forms a dirty chamber communicating with outside air and a clean chamber communicating with a supply destination for cleaned air, a cleaner element that is disposed within the cleaner container between the dirty chamber and the clean chamber, and a connecting tube that is fixed to the cleaner container, opens in a space of the clean chamber via an upstream end within the clean chamber, and provides communication between the clean chamber and the supply destination, characterized in that a double pipe part is provided at the upstream end of the connecting tube along an outer periphery of the connecting tube.

[0007] According to a second aspect of the present invention, in addition to the first aspect, the double pipe part comprises a flange portion that spreads outward from an outer wall face of the connecting tube, and an outer ring portion that extends from the flange portion toward the upstream end of the connecting tube along the outer wall face while maintaining an interval from the outer wall face.

[0008] According to a third aspect of the present invention, in addition to the second aspect, the upstream end of the outer ring portion is in contact with a virtual plane including the upstream end of the connecting tube, or the outer ring portion intersects the virtual plane.

[0009] According to a fourth aspect of the present invention, in addition to the second or third aspect, the distance between the outer wall face of the connecting tube and the double pipe part in a direction orthogonal to the axis of the connecting tube is set to be 10% to 30% of the distance of an inner wall of the connecting tube.

[0010] According to a fifth aspect of the present invention, in addition to any one of the second to fourth aspects, a gap that is larger than the interval is formed between the double pipe part and an inner wall face of the cleaner container within the clean chamber.

[0011] According to a sixth aspect of the present invention, in addition to the first aspect, the upstream end of the connecting tube is disposed along an inner wall face of the cleaner container and the double pipe part is biased toward a direction going away from the inner wall face.

[0012] According to a seventh aspect of the present invention, in addition to any one of the first to sixth aspects, the connecting tube is curved at least in part and is formed from two components separated by a virtual plane extending in a direction orthogonal to the air intake axis.

EFFECTS OF THE INVENTION

[0013] In accordance with the first aspect, due to the double pipe part being provided at the upstream end of the connecting tube, the flow rate within the connecting tube is made uniform, and the air intake efficiency improves. Flow alignment of the flow of air within the connecting tube is realized effectively in a small space without making the connecting tube unnecessarily long.

[0014] In accordance with the second aspect, the double pipe portion can be integrated with the upstream end of the connecting tube, and flow alignment of the flow of air within the connecting tube is realized with a simple arrangement.

[0015] In accordance with the third aspect, since the outer ring portion surrounds the upstream end of the connecting tube, flow alignment of the flow of air within the connecting tube is efficiently realized.

[0016] In accordance with the fourth aspect, due to an appropriate distance being set between the outer wall face of the connecting tube and the double pipe part with respect to the size of the flow path for the flow of air, flow alignment of the flow of air within the connecting tube is efficiently realized.

[0017] In accordance with the fifth aspect, even when the upstream end of the connecting tube is distant from the inner wall face of the cleaner container, flow alignment of the flow of air within the connecting tube is realized by the action of the double pipe part.

[0018] In accordance with the sixth aspect, since the inner wall face of the cleaner container serves as the double pipe part, flow alignment of the flow of air within the connecting tube is realized while putting the connecting tube close to the inner wall face of the cleaner container.

[0019] In accordance with the seventh aspect, even when the connecting tube having the double pipe part at the upstream end is curved, each component can be molded using a simple mold.

BRIEF DESCRIPTION OF DRAWINGS

[0020]

[FIG. 1] FIG. 1 is a side view schematically showing an overall picture of a saddle-ridden vehicle (two-wheeled motor vehicle) related to one embodiment of the present invention.

[FIG. 2] FIG. 2 is an enlarged plan view of an intake device incorporated into the two-wheeled motor vehicle.

[FIG. 3] FIG. 3 is an enlarged side view of an air cleaner related to a first embodiment when observed in the same direction as in FIG. 1.

[FIG. 4] FIG. 4 is an enlarged sectional view along line 4-4 in FIG. 3 when observed in a horizontal cross section.

[FIG. 5] FIG. 5 is (a) an enlarged front view and (b) an enlarged sectional view schematically showing the upstream end and a double pipe part of a connecting tube.

[FIG. 6] FIG. 6 is a flow rate distribution showing the flow rate of air within a connecting tube at a position close to a throttle body: (a) a connecting tube having a double pipe part and (b) a connecting tube having no double pipe part.

[FIG. 7] FIG. 7 is an enlarged plan view of an air cleaner related to a second embodiment.

[FIG. 8] FIG. 8 is an enlarged side view of the air cleaner when observed from the same direction as in FIG. 1.

[FIG. 9] FIG. 9 is an enlarged sectional view along line 9-9 in FIG. 8 when observed in a horizontal cross section.

[FIG. 10] FIG. 10 is (a) an enlarged front view and (b) an enlarged sectional view schematically showing the upstream end and a double pipe part of a connecting tube.

[FIG. 11] FIG. 11 is a side view schematically showing an overall picture of a saddle-ridden vehicle (two-wheeled motor vehicle) related to another embodiment of the present invention.

[FIG. 12] FIG. 12 is an enlarged side view of an air cleaner related to a third embodiment when observed from the same direction as in FIG. 11.

[FIG. 13] FIG. 13 is an enlarged sectional view of the air cleaner when observed in a vertical cross section.

[FIG. 14] FIG. 14 is (a) an enlarged plan view and (b) an enlarged sectional view of a partial selection of a connecting tube.

[FIG. 15] FIG. 15 is an enlarged plan view of an air cleaner related to a fourth embodiment.

[FIG. 16] FIG. 16 is an enlarged sectional view of the air cleaner when observed in a horizontal cross section.

[FIG. 17] FIG. 17 is an enlarged side view of a connecting tube disposed within a clean chamber.

[FIG. 18] FIG. 18 is an enlarged sectional view of the connecting tube.

[FIG. 19] FIG. 19 is (a) an enlarged front view and (b) an enlarged sectional view schematically showing the upstream end and a double pipe part of the connecting tube.

[FIG. 20] FIG. 20 is an enlarged plan view of an air cleaner related to a fifth embodiment.

[FIG. 21] FIG. 21 is an enlarged sectional view of the air cleaner when observed in a horizontal cross section.

[FIG. 22] FIG. 22 is (a) an enlarged front view and (b) an enlarged sectional view schematically showing the upstream end and a double pipe part of a connecting tube.

[FIG. 23] FIG. 23 is an enlarged plan view of an air cleaner related to a sixth embodiment.

[FIG. 24] FIG. 24 is an enlarged side view of the air cleaner when observed from the same direction as in FIG. 1.

[FIG. 25] FIG. 25 is an enlarged sectional view of the air cleaner in a horizontal cross section.

[FIG. 26] FIG. 26 is (a) an enlarged perspective view of a connecting tube, and (b) an enlarged front view and (c) an enlarged sectional view schematically showing the upstream end of the connecting tube and a double pipe part.

EXPLANATION OF REFERENCE NUMERALS AND SYMBOLS

[0021]

39	Air cleaner
45	Cleaner container
47	Connecting tube
49	Cleaner element
51a	Dirty chamber
51b	Clean chamber
56	Double pipe part
56a	Flange portion
56b	Outer ring portion
57	Air cleaner
58	Cleaner container
61	Connecting tube
63	Cleaner element
65a	Dirty chamber
65b	Clean chamber
71	Double pipe part
71a	Flange portion
71b	Outer ring portion
96	Air cleaner
102	Cleaner container
104	Connecting tube
104a	One component
104b	One component
105	Cleaner element
107a	Dirty chamber
107b	Clean chamber
108	Double pipe part
108a	Flange portion
108b	Outer ring portion
111	Air cleaner
112	Cleaner container
114	Connecting tube
115	Cleaner element
117a	Dirty chamber
117b	Clean chamber
127	Double pipe part
127a	Flange portion
127b	Outer ring portion
131	Air cleaner
132	Cleaner container
134	Connecting tube
136	Cleaner element
138a	Dirty chamber
138b	Clean chamber
149	Double pipe part
149a	Flange portion
149b	Outer ring portion
151	Air cleaner
152	Cleaner container
154	Connecting tube
158	Cleaner element
161a	Dirty chamber
161b	Clean chamber
172	Double pipe part
172a	Flange portion
172b	Outer ring portion
PN	Virtual plane

MODES FOR CARRYING OUT THE INVENTION

[0022] One embodiment of the present invention is explained below by reference to the attached drawings. In the explanation below, the fore-and-aft, up-and-down, and left-and-right directions are directions as viewed by a person riding a two-wheeled motor vehicle.

(1) Air cleaner related to first embodiment

[0023] FIG. 1 schematically shows a scooter type two-wheeled motor vehicle related to one embodiment of a saddle-ridden vehicle. The two-wheeled motor vehicle 11 includes a vehicle body frame 12 and a vehicle body cover 13 fitted on the vehicle body frame 12. Steerably supported on a head pipe of the vehicle body frame 12 are rod-shaped handlebars 16 and a front fork 15 supporting a front wheel WF so that it can rotate around an axle 14.

[0024] A rider's seat 17 is mounted on the vehicle body cover 13 above a rear frame. The vehicle body cover 13 includes a front cover 21 that covers the head pipe from the front, a leg shield 22 that is continuous from the front cover 21, a step floor 23 that is continuous from the lower end of the leg shield 22 and is disposed above a main frame between the rider's seat 17 and the front wheel WF, and a rear cover 24 that supports the rider's seat 17 above the rear frame.

[0025] A unit-swing type drive unit 25 is disposed in a space beneath the rear cover 24. The drive unit 25 is linked via a link 27 to a bracket 26 joined to the front end of the rear frame so that it can swing vertically. A rear wheel WR is supported at the rear end of the drive unit 25 so that it can rotate around a horizontal axis. A rear cushion unit 28 is disposed between the rear frame and the drive unit 25 at a position spaced from the link 27 and the bracket 26. The drive unit 25 includes an air cooled single cylinder engine 29 and a transmission case 31 that is joined to an engine main body 29a of the engine 29 and houses a transmission device transmitting the output of the engine 29 to the rear wheel WR.

[0026] The engine main body 29a of the engine 29 includes a crankcase 33 that supports a crankshaft so that it can rotate around a rotational axis, a cylinder block 34 that is joined to the crankcase 33, a cylinder head 35 that is joined to the cylinder block 34, and a head cover 36 that is joined to the cylinder head 35. A cylinder is formed in the cylinder block, the cylinder guiding back and forth linear movement of a piston. A combustion chamber is formed between the piston and the cylinder head 35. An intake stroke, compression stroke, combustion stroke, and exhaust stroke of the engine 29 are repeated in association with back and forth linear movement of the piston.

[0027] Joined to the cylinder head 35 are an intake device 37 that is connected to an intake path communicating with the combustion chamber, and an exhaust device 38 that is connected to an exhaust path communicating with the combustion chamber. The intake device 37 includes an air cleaner 39 supported on the transmission case 31, and a throttle body 41 disposed between the air cleaner 39 and the cylinder head 35. In the throttle body 41 the flow rate of cleaned air supplied from the air cleaner 39 is adjusted by the action of a throttle. A fuel injection valve 42 is mounted on an upper side wall of the cylinder head 35. An air-fuel mixture is formed by fuel being injected into the cleaned air from the fuel injection valve 42. The air-fuel mixture is introduced into the combustion chamber via the action of an intake valve. The exhaust device 38 includes an exhaust pipe 43 that extends rearward from a lower side wall of the cylinder head 35 while passing beneath the engine main body 29a, and an exhaust muffler (not illustrated) that is connected to the downstream end of the exhaust pipe 43 and linked to the crankcase 33. Air after combustion is discharged from the combustion chamber via the action of an exhaust valve.

[0028] As shown in FIG. 2, the air cleaner 39 related to the first embodiment includes a cleaner container 45 that has a first container body 45a and a second container body 45b joined to each other via mating faces along a vertical plane VP parallel to a virtual plane orthogonal to the rotational axis of the crankshaft and that forms an interior space communicating with outside air and a supply destination (engine 29) for cleaned air, an intake duct 46 that is fixed to the first container body 45a, opens outside the cleaner container 45 via the upstream end exposed to outside air, and provides communication between the interior space of the cleaner container 45 and the outside air space, and a connecting tube 47 that is fixed to the second container body 45b, opens in the interior space of the cleaner container 45 via the upstream end positioned in the interior space of the cleaner container 45, and is linked to the throttle body 41 via the downstream end outside the cleaner container 45. The intake duct 46 and the connecting tube 47 are molded from an elastic body such as for example rubber.

[0029] A duct cover 48 is mounted outside the first container body 45a, the duct cover 48 forming an auxiliary space between itself and an outer face of the first container body 45a, and the upstream end of the intake duct 46 opening in the auxiliary space. The duct cover 48 is hermetically joined to for example the first container body 45a by means of a screw. As shown in FIG. 3, the intake duct 46 forms a cylindrical passage having an axis extending horizontally in the vehicle body fore-and-aft direction. The upstream end of the intake duct 46 is disposed at a position in front of the mid position in the fore-and-aft direction of the cleaner container 45. The duct cover 48 has an edge 48a forming an opening between itself and the outer face of the cleaner container 45 further rearward than the mid position in the fore-and-aft direction of the cleaner container 45. Moreover, the edge 48a of the duct cover 48 extends rearward in going upward in the direction of gravity to thus prevent raindrops, etc. from entering as much as possible.

[0030] As shown in FIG. 4, a partition wall 50 retaining a cleaner element 49 is sandwiched between the first container body 45a and the second container body 45b. The partition wall 50 forms between itself and the first container body 45a a dirty chamber 51a communicating with the outside air space through the intake duct 46 and forms between itself and the second container body 45b a clean chamber 51b communicating with the throttle body 41 via the connecting tube 47. In this way, the interior space of the cleaner container 45 is partitioned into the dirty chamber 51a and the clean chamber 51b. The cleaner element 49 is disposed between the dirty chamber 51a and the clean chamber 51b. The outside air is cleaned while passing through the cleaner element 49 and is introduced into the clean chamber 51b. The downstream end of the intake duct 46 opens at a position facing the cleaner element 49.

[0031] The upstream end of the intake duct 46 opens forward in an air reservoir 52 formed between the duct cover 48 and the outer face of the first container body 45a. The intake duct 46 is supported on a vertical wall 53 that spreads along a vertical plane parallel to the rotational axis of the crankshaft. The air reservoir 52, which has sufficient volume, is established between the vertical wall 53 and the duct cover 48, which faces the vertical wall 53 and is in front thereof. A passage stretching from the opening partitioned by the edge 48a to the air reservoir 52 is formed so as to be narrower than the intake duct 46. A labyrinth structure stretching from the opening to the intake duct 46 is thus formed, thereby preventing raindrops, etc. from entering as much as possible.

[0032] A double pipe part 54 is provided at the upstream end of the intake duct 46 along the outer periphery of the intake duct 46. The double pipe part 54 has a flange portion 54a that spreads outward from an outer wall face of the intake duct 46, and an outer ring portion 54b that extends from the flange portion 54a toward the upstream end of the intake duct 46 along the outer wall face while maintaining an interval between itself and the outer wall face. Here, the upstream end of the outer ring portion 54b makes contact with a virtual plane PL including the upstream end of the intake duct 46. However, the upstream end of the outer ring portion 54b may extend further forward than the virtual plane PL including the upstream end of the intake duct 46 and the outer ring portion 54b may intersect the virtual plane PL.

[0033] A double pipe part 56 is provided at the upstream end of the connecting tube 47 along the outer periphery of the connecting tube 47. As shown in FIG. 5, the double pipe part 56 has a flange portion 56a that spreads outward from an outer wall face of the connecting tube 47, and an outer ring portion 56b that extends toward the upstream end of the connecting tube 47 along an outer wall face of the flange portion 56a while maintaining an interval between itself and the outer wall face. The outer ring portion 56b is formed from a cylindrical body that is coaxial with a cylindrical body forming the upstream end of the connecting tube 47 and has a larger diameter than that of the cylindrical body. However, the outer ring portion 56b is not necessarily a cylindrical body and may be another cross-sectional shape such as a polygon. Furthermore, the upstream end of the connecting tube 47 and the outer ring portion 56b are not necessarily coaxial and may be eccentric. A rib, other than the flange portion 56a, that links the outer ring portion 56b to the outer wall face of the connecting tube 47 may be formed on the outer ring portion 56b. The flange portion 56a may be omitted, and the outer ring portion 56b may be fixed to the outer wall face of the connecting tube 47 by means of a plurality of ribs separated in the peripheral direction. Here, the upstream end of the outer ring portion 56b is in contact with a virtual plane PN including the upstream end of the connecting tube 47. However, the upstream end of the outer ring portion 56b may extend further forward than the virtual plane PN including the upstream end of the connecting tube 47, and the outer ring portion 56b may intersect the virtual plane PN.

[0034] A distance DS between the outer wall face of the connecting tube 47 and the double pipe part 56 is set to be 10% to 30% of a distance DC of an inner wall of the connecting tube 47. Here, since the upstream end of the connecting tube 47 and the outer ring portion 56b are formed into coaxial cylindrical shapes, the distance DS corresponds to the difference in the radial direction between the outer wall face of the connecting tube 47 and the outer ring portion 56b, and the distance DC corresponds to the internal diameter of the connecting tube 47. As shown in FIG. 4, a gap is formed between the double pipe part 56 and the inner wall face of the cleaner container 45 within the clean chamber 51b.

[0035] The operation of the present embodiment is now explained. When the intake stroke, compression stroke, combustion stroke and exhaust stroke of the engine 29 are repeated in association with back and forth linear movement of the piston, the outside air is introduced into the dirty chamber 51a within the cleaner container 45 via the intake duct 46. The outside air is cleaned while passing through the cleaner element 49 and introduced into the clean chamber 51b. The cleaned air within the clean chamber 51b flows into the connecting tube 47 and is supplied to the throttle body 41. In the throttle body 41 the flow rate of cleaned air supplied from the air cleaner 39 is adjusted by the action of the throttle. An air-fuel mixture is formed by injecting fuel from the fuel injection valve 42 into the cleaned air flowing out of the throttle body 41. The air-fuel mixture is introduced into the combustion chamber via the action of the intake valve.

[0036] In the present embodiment, due to the double pipe part 56 being provided at the upstream end of the connecting tube 47 the flow rate within the connecting tube 47 is made uniform, and the air intake efficiency improves. It is unnecessary to extend the connecting tube 47, and flow alignment of the flow of air within the connecting tube 47 is realized effectively in a small space. As shown in FIG. 6, in accordance with the double pipe part 56, compared with an arrangement in which no double pipe part is added, it becomes possible to carry out flow alignment within the connecting tube 47 without changing the length of the connecting tube 47 or another arrangement, and to improve the amount of air taken into the throttle body 41.

[0037] In the air cleaner 39 related to the present embodiment, the double pipe part 56 has the flange portion 56a, which spreads outward from the outer wall face of the connecting tube 47, and the outer ring portion 56b, which extends from the flange portion 56a toward the upstream end of the connecting tube 47 along the outer wall face while maintaining, at least in part, a fixed interval between itself and the outer wall face. The double pipe portion 56b may be integrated with the upstream end of the connecting tube 47, and flow alignment of the flow of air within the connecting tube 47 is realized with a simple arrangement.

[0038] In the double pipe part 56, the upstream end of the outer ring portion 56b is in contact with a virtual plane including the upstream end of the connecting tube 47. Since the outer ring portion 56b surrounds the upstream end of the connecting tube 47, flow alignment of the flow of air within the connecting tube 47 is reliably realized. The outer ring portion 56b may extend further forward than the virtual plane including the upstream end of the connecting tube 47 and intersect the virtual plane. The inner wall end part of the connecting tube 47 is formed as a tapered part that is inclined outward from the axis and toward the extremity, and a groove part is formed from the tapered part and the double pipe part 56. The flow path of the inner wall in a portion downstream of the tapered part is defined as the distance DC for comparison with the groove part.

[0039] In the air cleaner 39, the distance DS between the outer wall face of the connecting tube 47 and the double pipe part 56 is set to be 10% to 30% of the distance DC of the inner wall of the connecting tube 47. Due to an appropriate distance being set between the outer wall face of the connecting tube 47 and the double pipe part 56 with respect to the size of the flow path for the flow of air, flow alignment of the flow of air within the connecting tube 47 is reliably realized.

[0040] A gap is formed between the double pipe part 56 and the inner wall face of the cleaner container 45 within the clean chamber 51b. Even when the upstream end of the connecting tube 47 is distant from the inner wall face of the cleaner container 45, flow alignment of the flow of air within the connecting tube 47 is realized by the action of the double pipe part 56.

(2) Air cleaner related to second embodiment

[0041] FIG. 7 schematically shows an air cleaner 57 related to a second embodiment. The air cleaner 57 related to the second embodiment can be fitted on the two-wheeled motor vehicle 11 instead of the air cleaner 39 related to the first embodiment. The air cleaner 57 related to the second embodiment includes a cleaner container 58 that has a first container body 58a and a second container body 58b joined to each other via mating faces along a vertical plane VP and forms an interior space communicating with outside air and a supply destination (engine 29) for cleaned air, an intake duct 59 that is fixed to the first container body 58a, opens outside the cleaner container 58 via its upstream end exposed to outside air, and provides communication between the interior space of the cleaner container 58 and the outside air space, and a connecting tube 61 that is fixed to the second container body 58b, opens in the interior space of the cleaner container 58 via its upstream end positioned within the interior space of the cleaner container 58, and is linked to the throttle body 41 via the downstream end outside the cleaner container 58. The intake duct 59 and the connecting tube 61 are molded from an elastic body such as for example rubber.

[0042] A duct cover 62 is mounted outside the first container body 58a, the duct cover 62 forming an auxiliary space between itself and an outer face of the first container body 58a, and the upstream end of the intake duct 59 opening in the auxiliary space. The duct cover 62 is hermetically joined to for example the first container body 58a by means of a screw. As shown in FIG. 8, the intake duct 59 forms a cylindrical passage having an axis extending horizontally in the vehicle body fore-and-aft direction. The upstream end of the intake duct 59 is disposed at a position further forward than the mid position in the fore-and-aft direction of the cleaner container 58. The duct cover 62 has an edge 62a forming an opening between itself and an outer face of the cleaner container 58 further rearward than the mid position in the fore-and-aft direction of the cleaner container 58. Moreover, the edge 62a of the duct cover 62 extends rearward in going upward in the direction of gravity, thus preventing raindrops, etc. from entering as much as possible.

[0043] As shown in FIG. 9, a partition wall 64 retaining a cleaner element 63 is sandwiched between the first container body 58a and the second container body 58b. The partition wall 64 forms between itself and the first container body 58a a dirty chamber 65a communicating with the outside air space through the intake duct 59, and forms between itself and the second container body 58b a clean chamber 65b communicating with the throttle body 41 through the connecting tube 61. In this way the interior space of the cleaner container 58 is partitioned into the dirty chamber 65a and the clean chamber 65b. The cleaner element 63 is disposed between the dirty chamber 65a and the clean chamber 65b. The outside air is cleaned while passing through the cleaner element 63 and introduced into the clean chamber 65b. The downstream end of the intake duct 59 opens at a position facing the cleaner element 63.

[0044] The upstream end of the intake duct 59 opens forward in an air reservoir 66 formed between the duct cover 62 and the outer face of the first container body 58a. The intake duct 59 is supported on a vertical wall 67 that spreads along a virtual face intersecting the vertical plane VP of the mating faces. A sufficient volume is established for the air reservoir 66 between the vertical wall 67 and the duct cover 62 facing the vertical wall 67 in front thereof. A passage extending from the opening partitioned by the edge 62a to the air reservoir 66 is formed so as to be narrower than the intake duct 59. In this way a labyrinth structure extending from the opening to the intake duct 59 is formed, thus preventing raindrops, etc. from entering as much as possible.

[0045] A double pipe part 68 is partially provided at the upstream end of the intake duct 59 in the peripheral direction along the outer periphery of the intake duct 59. The double pipe part 68 has a flange portion 68a that spreads outward from an outer wall face of the intake duct 59 partially in the peripheral direction, and an outer ring portion 68b that extends from the flange portion 68a toward the upstream end of the intake duct 59 along the outer wall face while maintaining an interval between itself and the outer wall face. The upstream end of the intake duct 59 is disposed along the outer wall face of the first container body 58a, and the double pipe part 68 is biased toward a direction that goes away from the outer wall face of the first container body 58a. An interval is formed between the upstream end of the intake duct 59 and the outer wall face of the first container body 58a, the interval corresponding to the distance between the outer face of the intake duct 59 and the outer ring portion 68b. Here, the upstream end of the outer ring portion 68b is in contact with a virtual plane PL including the upstream end of the intake duct 59. However, the upstream end of the outer ring portion 68b may extend further forward than the virtual plane PL including the upstream end of the intake duct 59 and the outer ring portion 68b may intersect the virtual plane PL.

[0046] A double pipe part 71 is partially provided at the upstream end of the connecting tube 61 in the peripheral direction along the outer periphery of the connecting tube 61. As shown in FIG. 10, the double pipe part 71 has a flange portion 71a that spreads outward partially in the peripheral direction from an outer wall face of the connecting tube 61, and an outer ring portion 71b that extends from the flange portion 71a toward the upstream end of the connecting tube 61 along the outer wall face while maintaining an interval between itself and the outer wall face. The upstream end of the connecting tube 61 is disposed along an inner wall face of the second container body 58b and the double pipe part 71 is biased toward a direction that goes away from the inner wall face of the second container body 58b. The outer ring portion 71b is formed from a cylindrical body that is eccentric with respect to the cylindrical body forming the upstream end of the connecting tube 61 and has a larger diameter than that of the cylindrical body. However, the outer ring portion 71b is not necessarily a cylindrical body and may be another cross-sectional shape such as a polygon. The upstream end of the connecting tube 61 and the outer ring portion 71b may be coaxial as long as an interval is partially formed in the peripheral direction between the two. A rib, other than the flange portion 71a, that links the outer ring portion 71b to the outer wall face of the connecting tube 61 may be formed on the outer ring portion 71b. Here, the upstream end of the outer ring portion 71b is in contact with a virtual plane PN including the upstream end of the connecting tube 61. However, the upstream end of the outer ring portion 71b may extend further forward than the virtual plane PN including the upstream end of the connecting tube 61, and the outer ring portion 71b may intersect the virtual plane PN. As described above, since the upstream end of the connecting tube 61 is disposed along the inner wall face of the second container body 58b, and the double pipe part 71 is biased toward the direction going away from the inner wall face of the second container body 58b, as shown in FIG. 10 the groove part is formed into a crescent shape when viewed in the axial direction of the air intake. An inner wall of the second container body 58b is disposed so as to be adjacent to a side opposite to the crescent-shaped groove part.

[0047] A distance DS between the outer wall face of the connecting tube 61 and the double pipe part 71 is set to be 10% to 30% of a distance DC of the inner wall of the connecting tube 61. Here, since the upstream end of the connecting tube 61 and the outer ring portion 71b are formed into a cylindrical shape, the distance DS corresponds to the maximum distance in the radial direction between the outer wall face of the connecting tube 61 and the outer ring portion 71b, and the distance DC corresponds to the internal diameter of the connecting tube 61. An interval SP is formed between the upstream end of the connecting tube 61 and the inner wall face of the second container body 58b, the interval SP corresponding to the distance DS between the outer face of the connecting tube 61 and the outer ring portion 71b. As shown in FIG. 9, a gap is formed between the double pipe part 71 and the inner wall face of the cleaner container 58 within the clean chamber 65b. The interval SP is also formed so as to be 10% to 30% of the distance DC of the inner wall of the connecting tube 61 in a direction orthogonal to the air intake axis.

[0048] The air cleaner 57 related to the second embodiment realizes the same effects as those of the air cleaner 39 related to the first embodiment, with the upstream end of the connecting tube 61 being disposed along the inner wall face of the cleaner container 58, and the double pipe part 71 being biased toward the direction going away from the inner wall face of the cleaner container 58. Since the inner wall face of the cleaner container 58 serves as the double pipe part 71, flow alignment of the flow of air within the connecting tube 61 is realized while putting the connecting tube 61 close to the inner wall face of the cleaner container 58. It is possible to contribute to a small size for the clean chamber 68b and a large diameter for the connecting tube 61.

(3) Air cleaner related to third embodiment

[0049] FIG. 11 schematically shows a two-wheeled motor vehicle related to one embodiment of a saddle-ridden vehicle. A two-wheeled motor vehicle 72 includes a vehicle body frame 73 and a vehicle body cover 74 that is at least partially fitted on the vehicle body frame 73. The vehicle body frame 73 includes a head pipe 75 at the front end, a single main frame 76 extending downward to the rear from the head pipe 75, a pair of left and right pivot plates 77 extending downward from the rear end of the main frame 76, and a pair of left and right seat rails 78 extending upward to the rear from the rear end of the main frame 76. A front fork 79 is steerably supported on the head pipe 75. A front wheel WF is supported on the front fork 79 so that it can rotate around an axle 81. Handlebars 82 are joined to the upper end of the front fork 79.

[0050] A swing arm 84 is linked to the pivot plate 77 so that it can swing vertically around a pivot 83. A rear wheel WR is supported on the swing arm 84 so that it can rotate around an axle 85. A rear cushion unit 86 is disposed between the seat rail 78 and the swing arm 84 at a position spaced from the pivot 83. A rider's seat 87 is mounted on the seat rail 78 above the rear wheel WR.

[0051] An engine 88 is supported on the vehicle body frame 73. An engine main body 88a of the engine 88 includes a crankcase 89 that supports a crankshaft so that it can rotate around a rotational axis X, a cylinder block 91 that is joined to the crankcase 89, a cylinder head 92 that is joined to the cylinder block 91, and a head cover 93 that is joined to the cylinder head 92. Formed in the cylinder block 91 is a cylinder that guides back and forth linear movement of a piston. A combustion chamber is formed between the piston and the cylinder head 92. An intake stroke, compression stroke, combustion stroke, and exhaust stroke of the engine 88 are repeated in association with back and forth linear movement of the piston. The engine main body 88a is joined to the main frame 76 and the pivot plate 77 in a forwardly inclined attitude in which a cylinder axis C is inclined forward at an angle close to 90 degrees around the rotational axis X of the crankshaft.

[0052] Joined to the cylinder head 92 are an intake device 94 that is connected to an intake path communicating with the combustion chamber and an exhaust device 95 that is connected to an exhaust path communicating with the combustion chamber. The intake device 94 includes an air cleaner 96 that is supported in front of the main frame 76 beneath the head pipe 75 and a throttle body 97 that is disposed between the air cleaner 96 and the cylinder head 92. In the throttle body 97 the flow rate of cleaned air supplied from the air cleaner 96 is adjusted by the action of a throttle. A fuel injection valve 98 is mounted on an upper side wall of the cylinder head 92. Fuel is injected into cleaned air from the fuel injection valve 98 to thus form an air-fuel mixture. The air-fuel mixture is introduced into the combustion chamber via the action of an intake valve. The exhaust device 95 includes an exhaust pipe 99 extending rearward from a lower side wall of the cylinder head 92 while passing beneath the engine main body 88a, and an exhaust muffler 101 connected to the downstream end of the exhaust pipe 99 and linked to the crankcase 89. Air after combustion is discharged from the combustion chamber via the action of an exhaust valve.

[0053] As shown in FIG. 12, the air cleaner 96 related to the third embodiment includes a cleaner container 102 that has a first container body 102a and a second container body 102b that are joined to each other via mating faces along a vertical plane VP parallel to the rotational axis of the crankshaft and that forms an interior space communicating with outside air and a supply destination (engine 88) for cleaned air, an intake duct 103 that is integrated with the cleaner container 102, opens outside the cleaner container 102 via the upstream end exposed to outside air, and provides communication between the interior space of the cleaner container 102 and an outside air space, and a connecting tube 104 that is fixed to the second container body 102b, opens in the interior space of the cleaner container 102 via the upstream end positioned within the interior space of the cleaner container 102, and is linked to the throttle body 97 via the downstream end outside the cleaner container 102. The connecting tube 104 is molded from an elastic body such as for example rubber.

[0054] As shown in FIG. 13, a partition wall 106 retaining a cleaner element 105 is sandwiched between the first container body 102a and the second container body 102b. The partition wall 106 forms between itself and the first container body 102a a dirty chamber 107a communicating with the outside air space through an intake duct 103 and forms between itself and the second container body 102b a clean chamber 107b communicating with the throttle body 97 though the connecting tube 104. In this way the interior space of the cleaner container 102 is partitioned into the dirty chamber 107a and the clean chamber 107b. The cleaner element 105 is disposed between the dirty chamber 107a and the clean chamber 107b. The outside air is cleaned by passing through the cleaner element 105 and introduced into the clean chamber 107b.

[0055] The intake duct 103 opens from the vertical plane VP toward the rear of the vehicle body. The flow of air entering from the opening of the intake duct 103 flows in forward from a first region of the vertical plane VP, is guided downward, crosses from the front side to the rear side a second region that is adjacent to the first region within the vertical plane VP, and is guided to a guide pipe of the second container body 102b. The flow of air is guided along the horizontal direction along the vertical plane VP by means of the guide pipe, crosses from the rear side to the front side a third region that is adjacent to the second region within the vertical plane VP, and flows into the dirty chamber 107a within the first container body 102a. In this way a labyrinth structure is formed between the intake duct 103 and the dirty chamber 107a, thus preventing raindrops, etc. from entering as much as possible.

[0056] As shown in FIG. 14, the connecting tube 104 is curved within the clean chamber 107b. The connecting tube 104 is formed from for example two components 104a and 104b that are separated by a virtual plane orthogonal to the centroid axis. A double pipe part 108 is provided at the upstream end of the connecting tube 104 along the outer periphery of the connecting tube 104. The double pipe part 108 has a flange portion 108a that spreads outward from an outer wall face of the connecting tube 104, and an outer ring portion 108b that extends from the flange portion 108a toward the upstream end of the connecting tube 104 along the outer wall face while maintaining an interval between itself and the outer wall face. The outer ring portion 108b is formed from a cylindrical body that is coaxial with the cylindrical body forming the upstream end of the connecting tube 104 and has a larger diameter than that of the cylindrical body. However, the outer ring portion 108b is not necessary a cylindrical body and may be another cross-sectional shape such as a polygon. The upstream end of the connecting tube 104 and the outer ring portion 108b are not necessarily coaxial and may be eccentric. A rib, other than the flange portion 108a, that links the outer ring portion 108b to the outer wall face of the connecting tube 104 may be formed on the outer ring portion 108b. The flange portion 108a may be omitted, and the outer ring portion 108b may be fixed to the outer wall face of the connecting tube 104 by means of a plurality of ribs separated in the peripheral direction. Here, the upstream end of the outer ring portion 108b is in contact with a virtual plane PN including the upstream end of the connecting tube 104. However, the upstream end of the outer ring portion 108b may extend further forward than the virtual plane PN including the upstream end of the connecting tube 104, and the outer ring portion 108b may intersect the virtual plane PN.

[0057] A distance DS between the outer wall face of the connecting tube 104 and the double pipe part 108 is set to be 10% to 30% of a distance DC of an inner wall of the connecting tube 104. Here, since the upstream end of the connecting tube 104 and the outer ring portion 108b are formed into a coaxial cylindrical shape, the distance DS corresponds to the difference in the radial direction between the outer wall face of the connecting tube 104 and the outer ring portion 108b, and the distance DC corresponds to the internal diameter of the connecting tube 104. As shown in FIG. 13, a gap is formed between the double pipe part 108 and the inner wall face of the cleaner container 102 within the clean chamber

107b.

[0058] The air cleaner 96 related to the third embodiment realizes the same effects as those of the air cleaner 39 related to the first embodiment, with the connecting tube 104 being formed from two components that are at least partially curved and are separated by the virtual plane. Even when the connecting tube 104 having the double pipe part 108 at the upstream end is curved, each component can be molded using a simple mold.

(4) Air cleaner related to fourth embodiment

[0059] FIG. 15 schematically shows an air cleaner 111 related to a fourth embodiment. The air cleaner 111 related to the fourth embodiment may be fitted on the two-wheeled motor vehicle 11 instead of the air cleaner 39 related to the first embodiment. The air cleaner 111 related to the fourth embodiment includes a cleaner container 112 that has a first container body 112a and a second container body 112b that are joined to each other via mating faces along a vertical plane VP parallel to a virtual plane orthogonal to the rotational axis of the crankshaft, and forms an interior space communicating with outside air and a supply destination (engine 29) for cleaned air, an intake duct 113 that is integrated with the first container body 112a, opens outside the cleaner container 112 via the upstream end exposed to outside air, and provides communication between an outside air space and the interior space of the cleaner container 112, and a connecting tube 114 that is fixed to the second container body 112b, opens in the interior space of the cleaner container 112 via the upstream end positioned within the interior space of the cleaner container 112, and is linked to the throttle body 41 via the downstream end outside the cleaner container 112.

[0060] As shown in FIG. 16, a partition wall 116 retaining a cleaner element 115 is sandwiched between the first container body 112a and the second container body 112b. The partition wall 116 forms between itself and the first container body 112a a dirty chamber 117a communicating with the outside air space through the intake duct 113 and forms between itself and the second container body 112b a clean chamber 117b communicating with the throttle body 41 through the connecting tube 114. In this way the interior space of the cleaner container 112 is partitioned into the dirty chamber 117a and the clean chamber 117b. The cleaner element 115 is disposed between the dirty chamber 117a and the clean chamber 117b. The outside air is cleaned by passing through the cleaner element 115 and is introduced into the clean chamber 117b. The downstream end of the intake duct 113 opens at a position facing the cleaner element 115.

[0061] A double pipe part 118 is provided at the upstream end of the intake duct 113 along the outer periphery of the intake duct 113. The double pipe part 118 has a flange portion 118a that spreads outward from an outer wall face of the intake duct 113, and an outer ring portion 118b that extends from the flange portion 118a toward the upstream end of the intake duct 113 along the outer wall face while maintaining an interval between itself and the outer wall face. Here, the upstream end of the outer ring portion 118b is in contact with a virtual plane PL including the upstream end of the intake duct 113. However, the upstream end of the outer ring portion 118b may extend further forward than the virtual plane PL including the upstream end of the intake duct 113 and the outer ring portion 118b may intersect the virtual plane PL. The double pipe part 118 is molded integrally with the first container body 112a. The intake duct 113 is continuous from a wall face of the dirty chamber 117a.

[0062] The connecting tube 114 has an interior member 119 that is disposed within the clean chamber 117b and is molded from a hard resin material, and a linking member 121 that links the cleaner container 112 and the throttle body 41, extends through a wall of the second container body 112b, faces the interior of the clean chamber 117b via the upstream end, and is directly linked to the interior member 119. The linking member 121 is molded from an elastic body such as a rubber material. The interior member 119 has a tab 123 that is superimposed on the extremity of each of a plurality of bosses 122 rising perpendicularly from an inner wall of the clean chamber 117b. Due to the tab 123 being held on the extremity of the boss 122 by means of a screw 124 the interior member 119 is supported in a floating state within the clean chamber 117b. As shown in FIG. 17, three screws 124 have screw axes that extend in parallel with each other, and the screw axes and the connecting tube 114 do not intersect. Here, the interior member 119 is formed from an upper member 119a and a lower member 119b formed from semi-cylindrical bodies that are superimposed on each other. The upper member 119a and the lower member 119b are hermetically joined to each other by means of for example melt-bonding. The tab 123 are each formed integrally with the upper member 119a and the lower member 119b.

[0063] As shown in FIG. 18, the linking member 121 has a first annular body 126a that makes contact with an inner wall face of the second container body 112b from the inside of the second container body 112b when it is inserted into an insertion opening 125 of the second container body 112b, and a second annular body 126b that faces the first annular body 126a in the axial direction and is in contact with an outer wall face of the second container body 112b from the outside of the second container body 112b. The first annular body 126a is in intimate contact with the inner wall face of the second container body 112b via a vertical plane orthogonal to the axis of the insertion opening 125. The second annular body 126b is in intimate contact with the outer wall face of the second container body 112b via a vertical plane orthogonal to the axis of the insertion opening 125. In this way the wall body of the second container body 112b is sandwiched between the first annular body 126a and the second annular body 126b. The external diameter of the first annular body 126a is of a size that allows the entire first annular body 126a to enter the insertion opening 125 in response to deformation of the first annular body 126a when the linking member 121 is inserted into the insertion opening 125 via the upstream end. The external diameter of the second annular body 126b is larger than that of the first annular body 126a and is of a size such that it remains outside the insertion opening 125 even when the first annular body 126a is deformed at the time of entering the insertion opening 125. The first annular body 126a has a tapered face that gradually increases in diameter from the upstream side and is continuous with the vertical plane via the largest diameter. The interior member 119 is inserted into the upstream end of the linking member 121. The internal diameter of the connecting tube 114 is maintained constant from the interior member 119 throughout the linking member 121.

[0064] A double pipe part 127 is provided at the upstream end of the connecting tube 114 along the outer periphery of the connecting tube 114. As shown in FIG. 19, the double pipe part 127 has a flange portion 127a that spreads outward from an outer wall face of the connecting tube 114, and an outer ring portion 127b that extends toward the upstream end of the connecting tube 114 along the outer wall face from the flange portion 127a while maintaining an interval between itself and the outer wall face. The outer ring portion 127b is formed from a cylindrical body that is coaxial with a cylindrical body forming the upstream end of the connecting tube 114 and has a larger diameter than that of the cylindrical body. However, the outer ring portion 117b is not necessarily a cylindrical body and may be another cross-sectional shape such as a polygon. The upstream end of the connecting tube 114 and the outer ring portion 127b are not necessarily coaxial and may be eccentric. A rib, other than the flange portion 127a, that links the outer ring portion 127b to the outer wall face of the connecting tube 114 may be formed on the outer ring portion 127b. The flange portion 127a may be omitted, and the outer ring portion 127b may be fixed to the outer wall face of the connecting tube 114 by means of a plurality of ribs separated in the peripheral direction. Here, the upstream end of the outer ring portion 127b is in contact with a virtual plane PN including the upstream end of the connecting tube 114. However, the upstream end of the outer ring portion 127b may extend further forward than the virtual plane PN including the upstream end of the connecting tube 114 and the outer ring portion 127b may intersect the virtual plane PN.

[0065] A distance DS between the outer wall face of the connecting tube 114 and the double pipe part 127 is set to be 10% to 30% of a distance DC of the inner wall of the connecting tube 114. Here, since the upstream end of the connecting tube 114 and the outer ring portion 127b are formed into a coaxial cylindrical shape, the distance DS corresponds to the difference in the radial direction between the outer wall face of the connecting tube 114 and the outer ring portion 127b, and the distance DC corresponds to the internal diameter of the connecting tube 114. As shown in FIG. 16, a gap is formed between the double pipe part 127 and the inner wall face of the cleaner container 112 within the clean chamber 117b.

[0066] The air cleaner 96 related to the fourth embodiment realizes the same operational effects as those of the air cleaner 39 related to the first embodiment, with the connecting tube 114 being at least partially curved and being formed from two components separated by the virtual plane. Even when the connecting tube 114 having the double pipe part 127 at the upstream end is curved, each component can be molded using a simple mold. Moreover, since the interior member 119 of the connecting tube 114 is fixed to a boss 122 within the clean chamber 117b, even when the interior member 119 has a long form, the interior member 119 can be reliably positioned within the clean chamber 117b.

(5) Air cleaner related to fifth embodiment

[0067] FIG. 20 schematically shows an air cleaner 131 related to a fifth embodiment. The air cleaner 131 related to the fifth embodiment includes a cleaner container 132 that has a small container body 132a and a large container body 132b that are joined to each other via mating faces along a first vertical plane VP1 parallel to a virtual plane orthogonal to the rotational axis of the crankshaft, and forms an interior space communicating with outside air and a supply destination (engine) for cleaned air, an intake duct 133 that is fixed to the small container body 132a, opens outside the cleaner container 132 via the upstream end exposed to the outside air, and provides communication between an outside air space and the interior space of the cleaner container 132, and a connecting tube 134 that is fixed to the large container body 132b, opens in the interior space of the cleaner container 132 via the upstream end positioned within the interior space of the cleaner container 132, and is linked to a throttle body via the downstream end outside the cleaner container 132. The large container body 132b is divided into a main body 135a and a cover body 135b that are joined to each other via mating faces along a second vertical plane VP2 parallel to the first vertical plane VP1.

[0068] As shown in FIG. 21, a partition wall 137 retaining a cleaner element 136 is sandwiched between the small container body 132a and the large container body 132b. The partition wall 137 forms between itself and the small container body 132a a dirty chamber 138a communicating with the outside air space through the intake duct 133 and forms between itself and the large container body 132b a clean chamber 138b communicating with a throttle body through the connecting tube 134. In this way the interior space of the cleaner container 132 is partitioned into the dirty chamber 138a and the clean chamber 138b. The cleaner element 136 is disposed between the dirty chamber 138a and the clean chamber 138b. The outside air is cleaned by passing through the cleaner element 136 and introduced into the clean chamber

138b. The downstream end of the intake duct 133 opens at a position facing the cleaner element 136.

[0069] A double pipe part 139 is provided partially in the peripheral direction at the upstream end of the intake duct 133 along the outer periphery of the intake duct 133. The double pipe part 139 has a flange portion 139a that spreads partially in the peripheral direction outward from an outer wall face of the intake duct 133, and an outer ring portion 139b that extends toward the upstream end of the intake duct 133 along the outer wall face of the flange portion 139a while maintaining an interval between itself and the outer wall face. Here, the upstream end of the outer ring portion 139b is in contact with a virtual plane PL including the upstream end of the intake duct 133. However, the upstream end of the outer ring portion 139b may extend further forward than the virtual plane PL including the upstream end of the intake duct 133 and the outer ring portion 139b may intersect the virtual plane PL. The intake duct 133 is molded from an elastic body such as for example a rubber material. The outer ring portion 139b is formed from a cylindrical body that is coaxial with a cylindrical body forming the upstream end of the intake duct 133 and has a larger diameter than that of the cylindrical body.

[0070] The connecting tube 134 has an interior member 141 that is disposed within the clean chamber 138b and is molded from a hard resin material, and a linking member 142 that links the cleaner container 132 and the throttle body, extends through a wall of the large container body 132b, faces the interior of the clean chamber 138b via the upstream end, and is directly linked to the interior member 141. The linking member 142 is molded from an elastic body such as a rubber material. The interior member 141 has a tab 144 that is superimposed on the extremity of each of a plurality of bosses 143 rising perpendicularly from an inner wall of the clean chamber 138b. Due to the tab 144 being held on the extremity of the boss 143 by means of a screw 145 the interior member 141 is supported in a floating state within the clean chamber 138b. Two screws 145 have screw axes that extend in parallel with each other, and the screw axes and the connecting tube 134 do not intersect. Here, the interior member 141 is formed from a first half body 146a and a second half body 146b that are semi-cylindrical bodies joined via a virtual plane parallel to the vertical planes VP1 and VP2. The first half body 146a and the second half body 146b are hermetically joined to each other by means of for example melt-bonding. The tab 144 may be formed integrally with either one of the first half body 146a and the second half body 146b.

[0071] The linking member 142 has a first annular body 148a that makes contact with an inner wall face of the large container body 132b from the inside of the large container body 132b when it is inserted into an insertion opening 147 of the large container body 132b, and a second annular body 148b that faces the first annular body 148a in the axial direction and is in contact with an outer wall face of the large container body 132b from the outside of the large container body 132b. The first annular body 148a is in intimate contact with the inner wall face of the large container body 132b via a vertical plane orthogonal to the axis of the insertion opening 147. The second annular body 148b is in intimate contact with the outer wall face of the large container body 132b via a vertical plane orthogonal to the axis of the insertion opening 147. In this way the wall body of the large container body 132b is sandwiched between the first annular body 148a and the second annular body 148b. The external diameter of the first annular body 148a is of a size that allows the entire first annular body 148a to enter the insertion opening 147 in response to deformation of the first annular body 148a when the linking member 142 is inserted into the insertion opening 147 via the upstream end. The external diameter of the second annular body 148b is larger than the first annular body 148a and is of a size such that it remains outside the insertion opening 147 even when the first annular body 148a is deformed at the time of entering the insertion opening 147. The first annular body 148a has a tapered face that gradually increases in diameter from the upstream side and is continuous with the vertical plane via the largest diameter. The interior member 141 is inserted into the upstream end of the linking member 142. The internal diameter of the connecting tube 134 is maintained constant from the interior member 141 throughout the linking member 142.

[0072] A double pipe part 149 is provided at the upstream end of the connecting tube 134 along the outer periphery of the connecting tube 134. As shown in FIG. 22, the double pipe part 149 has a flange portion 149a that spreads outward from an outer wall face of the connecting tube 134, and an outer ring portion 149b that extends from the flange portion 149a toward the upstream end of the connecting tube 134 along the outer wall face while maintaining an interval between itself and the outer wall face. The outer ring portion 149b is formed from a cylindrical body that is coaxial with a cylindrical body forming the upstream end of the connecting tube 134 and has a larger diameter than that of the cylindrical body. However, the outer ring portion 138b is not necessarily a cylindrical body and may be another cross-sectional shape such as a polygon. The upstream end of the connecting tube 134 and the outer ring portion 149b are not necessarily coaxial and may be eccentric. A rib, other than the flange portion 149a, that links the outer ring portion 149b to the outer wall face of the connecting tube 134 may be formed on the outer ring portion 149b. The flange portion 149a may be omitted, and the outer ring portion 149b may be fixed to the outer wall face of the connecting tube 134 by means of a plurality of ribs separated in the peripheral direction. Here, the upstream end of the outer ring portion 149b is in contact with a virtual plane PN includingning the upstream end of the connecting tube 134. However, the upstream end of the outer ring portion 149b may extend further forward than the virtual plane PN including the upstream end of the connecting tube 134 and the outer ring portion 149b may intersect the virtual plane PN.

[0073] A distance DS between the outer wall face of the connecting tube 134 and the double pipe part 149 is set to be 10% to 30% of a distance DC of the inner wall of the connecting tube 134. Here, since the upstream end of the connecting tube 134 and the outer ring portion 149b are formed into a coaxial cylindrical shape, the distance DS corresponds to the difference in the radial direction between the outer wall face of the connecting tube 134 and the outer ring portion 149b, and the distance DC corresponds to the internal diameter of the connecting tube 134. As shown in FIG. 21, a gap is formed between the double pipe part 149 and the inner wall face of the cleaner container 132 within the clean chamber 138b.

[0074] The air cleaner 131 related to the fifth embodiment realizes the same operational effects as those of the air cleaner 39 related to the first embodiment, with the connecting tube 134 being at least partially curved and being formed from two components separated by the virtual plane. Even when the connecting tube 134 having the double pipe part 149 at the upstream end is curved, each component can be molded using a simple mold. Moreover, since the interior member 141 of the connecting tube 134 is fixed to the boss 143 within the clean chamber 138b, even when the interior member 141 has a long form, the interior member 141 can be reliably positioned within the clean chamber 138b.

(6) Air cleaner related to sixth embodiment

[0075] FIG. 23 schematically shows an air cleaner 151 related to a sixth embodiment. The air cleaner 151 related to the sixth embodiment may be fitted on the two-wheeled motor vehicle 11 instead of the air cleaner 39 related to the first embodiment. The air cleaner 151 related to the sixth embodiment includes a cleaner container 152 that has a first container body 152a and a second container body 152b that are joined to each other via mating faces along a vertical plane VP, and forms an interior space communicating with outside air and a supply destination (engine 29) for cleaned air, an intake duct 153 that is integrated with the first container body 152a, opens outside the cleaner container 152 via the upstream end exposed to the outside air, and provides communication between an outside air space and the interior space of the cleaner container 152, and a connecting tube 154 that is fixed to the second container body 152b, opens in the interior space of the cleaner container 152 via the upstream end positioned within the interior space of the cleaner container 152, and is linked to the throttle body 41 via the downstream end outside the cleaner container 152.

[0076] An air reservoir 156 is formed in the inside of the first container body 152a, the air reservoir 156 being partitioned by a vertical wall 155 that spreads along a virtual plane orthogonal to the vertical plane VP of the mating faces and supports the intake duct 153, and the upstream end of the intake duct 153 opens in the air reservoir 156. A sufficient volume is ensured for the air reservoir 156 between the vertical wall 155 and a wall body of the first container body 152a facing the vertical wall 155. As shown in FIG. 24, the intake duct 153 forms a cylindrical passage having an axis extending horizontally in the vehicle body fore-and-aft direction. The upstream end of the intake duct 153 is disposed at a position in front of the mid position in the fore-and-aft direction of the cleaner container 152. A lower face of the air reservoir 156 is covered by a duct cover 157. The duct cover 157 has an edge 157a forming an opening between itself and an outer face of the cleaner container 152 further rearward than the vertical wall 55. Since the edge 157a of the duct cover 157 forms the opening to the rear of the vehicle body beneath the vertical wall 155 in the direction of gravity, raindrops, etc. are prevented from entering as much as possible.

[0077] As shown in FIG. 25, a partition wall 159 retaining a cleaner element 158 is sandwiched between the first container body 152a and the second container body 152b. The partition wall 159 forms between itself and the first container body 152a a dirty chamber 161a communicating with the outside air space through the intake duct 153 and forms between itself and the second container body 152b a clean chamber 161b communicating with the throttle body 41 through the connecting tube 154. In this way the interior space of the cleaner container 152 is partitioned into the dirty chamber 161a and the clean chamber 161b. The cleaner element 158 is disposed between the dirty chamber 161a and the clean chamber 161b. The outside air is cleaned by passing through the cleaner element 158 and introduced into the clean chamber 161b. The downstream end of the intake duct 153 opens at a position facing the cleaner element 158.

[0078] A double pipe part 162 is provided at the upstream end of the intake duct 153 along the outer periphery of the intake duct 153. The double pipe part 162 has a flange portion 162a that spreads outward from an outer wall face of the intake duct 153, and an outer ring portion 162b that extends from the flange portion 162a toward the upstream end of the intake duct 153 along the outer wall face while maintaining an interval between itself and the outer wall face. Here, the upstream end of the outer ring portion 162b is in contact with a virtual plane PL including the upstream end of the intake duct 153. However, the upstream end of the outer ring portion 162b may extend further forward than the virtual plane PL including the upstream end of the intake duct 153 and the outer ring portion 162b may intersect the virtual plane PL. The double pipe part 162 is molded integrally with the vertical wall 155. The flange portion 162a and the outer ring portion 162b are continuous from the vertical wall 155. The vertical wall 155 is molded from for example a hard resin material. The vertical wall 155 is fitted onto the first container body 152a and the partition wall 159.

[0079] The connecting tube 154 has an interior member 163 that is disposed within the clean chamber 161b while bending and is molded from a hard resin material, and a linking member 164 that links the cleaner container 152 and the throttle body 41, extends through a wall of the second container body 152b, faces the interior of the clean chamber 161b via the upstream end, and is directly linked to the interior member 163. The linking member 164 is molded from an elastic body such as a rubber material. The interior member 163 has a tab 166 that is superimposed on the extremity of each of a plurality of bosses 165 rising perpendicularly from an inner wall of the clean chamber 161b. Due to the tab 166 being held on the extremity of the boss 165 by means of a screw 167 the interior member 163 is supported in a floating state within the clean chamber 161b. As shown in FIG. 26, three screws 167 have screw axes that extend in parallel with each other, and the screw axes and the connecting tube 154 do not intersect. Here, the interior member 163 is formed from a first half body 168a and a second half body 168b that are formed from semi-cylindrical bodies joined to each other via curved faces. The second half body 168a and the second half body 168b are hermetically joined to each other by means of for example melt-bonding. The tab 166 is formed integrally with either one of the first half body 168a and the second half body 168b.

[0080] The linking member 164 has a first annular body 171a that makes contact with an inner wall face of the second container body 152b from the inside of the second container body 152b when it is inserted into an insertion opening 169 of the second container body 152b, and a second annular body 171b that faces the first annular body 171a in the axial direction and is in contact with an outer wall face of the second container body 152b from the outside of the second container body 152b. The first annular body 171a is in intimate contact with the inner wall face of the second container body 152b via a vertical plane orthogonal to the axis of the insertion opening 169. The second annular body 171b is in intimate contact with the outer wall face of the second container body 152b via a vertical plane orthogonal to the axis of the insertion opening 169. In this way the wall body of the second container body 152b is sandwiched between the first annular body 171a and the second annular body 171b. The external diameter of the first annular body 171a is of a size that allows the entire first annular body 171a to enter the insertion opening 169 in response to deformation of the first annular body 171a when the linking member 154 is inserted into the insertion opening 169 via the upstream end. The external diameter of the second annular body 171b is larger than the first annular body 171a and is of a size such that it remains outside the insertion opening 169 even when the first annular body 171a is deformed at the time of entering the insertion opening 169. The first annular body 171a has a tapered face that gradually increases in diameter from the upstream side and is continuous with the vertical plane via the largest diameter. The interior member 163 is inserted into the upstream end of the linking member 164. The internal diameter of the connecting tube 154 is continuous from the interior member 163 throughout the linking member 164.

[0081] A double pipe part 172 is provided at the upstream end of the connecting tube 154 along the outer periphery of the connecting tube 154. As shown in FIG. 26, the double pipe part 172 has a flange portion 172a that spreads outward from an outer wall face of the connecting tube 154, and an outer ring portion 172b that extends from the flange portion 172a toward the upstream end of the connecting tube 154 along the outer wall face while maintaining an interval between itself and the outer wall face. The outer ring portion 172b is formed from a cylindrical body that is coaxial with a cylindrical body forming the upstream end of the connecting tube 154 and has a larger diameter than that of the cylindrical body. However, the outer ring portion 172b is not necessarily a cylindrical body and may be another cross-sectional shape such as a polygon. The upstream end of the connecting tube 154 and the outer ring portion 172b are not necessarily coaxial and may be eccentric. A rib, other than the flange portion 172a, that links the outer ring portion 172b to the outer wall face of the connecting tube 154 may be formed on the outer ring portion 172b. The flange portion 172a may be omitted, and the outer ring portion 172b may be fixed to the outer wall face of the connecting tube 154 by means of a plurality of ribs separated in the peripheral direction. Here, the upstream end of the outer ring portion 172b is in contact with a virtual plane PN including the upstream end of the connecting tube 154. However, the upstream end of the outer ring portion 172b may extend further forward than the virtual plane PN including the upstream end of the connecting tube 154 and the outer ring portion 172b may intersect the virtual plane PN.

[0082] A distance DS between the outer wall face of the connecting tube 154 and the double pipe part 172 is set to be 10% to 30% of a distance DC of the inner wall of the connecting tube 154. Here, since the upstream end of the connecting tube 154 and the outer ring portion 172b are formed into a coaxial cylindrical shape, the distance DS corresponds to the difference in the radial direction between the outer wall face of the connecting tube 154 and the outer ring portion 172b, and the distance DC corresponds to the internal diameter of the connecting tube 154. As shown in FIG. 25, a gap is formed between the double pipe part 172 and the inner wall face of the cleaner container 152 within the clean chamber 161b.

[0083] The air cleaner 151 related to the sixth embodiment realizes the same operational effects as those of the air cleaner 39 related to the first embodiment, with the connecting tube 154 being at least partially curved and being formed from two components separated by the virtual plane. Even when the connecting tube 154 having the double pipe part 171 at the upstream end is curved, each component can be molded using a simple mold. Moreover, since the interior member 163 of the connecting tube 154 is fixed to a boss 165 within the clean chamber 161b, even when the interior member 161 has a long form, the interior member 161 can be reliably positioned within the clean chamber 161b.

Claims

1. An air cleaner for supplying outside air to an internal combustion engine, comprising
a cleaner container that forms a dirty chamber communicating with outside air and a clean chamber communicating with a supply destination for cleaned air,
a cleaner element that is disposed within the cleaner container between the dirty chamber and the clean chamber, and
a connecting tube that is fixed to the cleaner container, opens in a space of the clean chamber via an upstream end within the clean chamber, and provides communication between the clean chamber and the supply destination,
characterized in that a double pipe part is provided at the upstream end of the connecting tube along an outer periphery of the connecting tube.

2. The air cleaner according to Claim 1, wherein the double pipe part comprises
a flange portion that spreads outward from an outer wall face of the connecting tube, and
an outer ring portion that extends from the flange portion toward the upstream end of the connecting tube along the outer wall face while maintaining an interval from the outer wall face.

3. The air cleaner according to Claim 2, wherein the upstream end of the outer ring portion is in contact with a virtual plane including the upstream end of the connecting tube, or the outer ring portion intersects the virtual plane.

4. The air cleaner according to Claim 2 or 3, wherein the distance between the outer wall face of the connecting tube and the double pipe part in a direction orthogonal to the axis of the connecting tube is set to be 10% to 30% of the distance of an inner wall of the connecting tube.

5. The air cleaner according to any one of Claims 2 to 4, wherein a gap that is larger than said interval is formed between the double pipe part and an inner wall face of the cleaner container within the clean chamber.

6. The air cleaner according to Claim 1, wherein the upstream end of the connecting tube is disposed along an inner wall face of the cleaner container and the double pipe part is biased toward a direction going away from the inner wall face.

7. The air cleaner according to any one of Claims 1 to 6, wherein the connecting tube is curved at least in part and is formed from two components separated by a virtual plane extending in a direction orthogonal to the air intake axis.

FIG.1

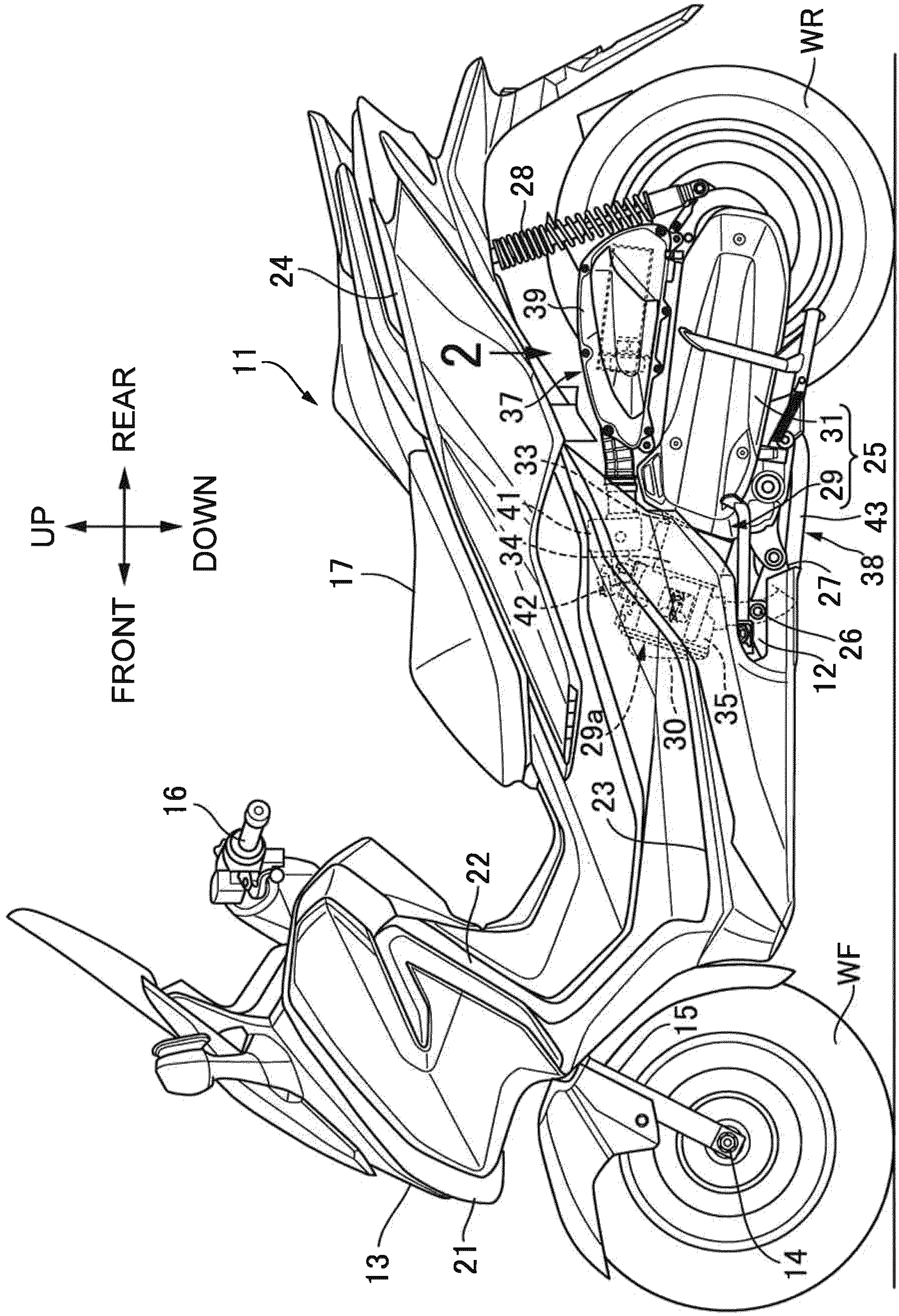
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FIG.2

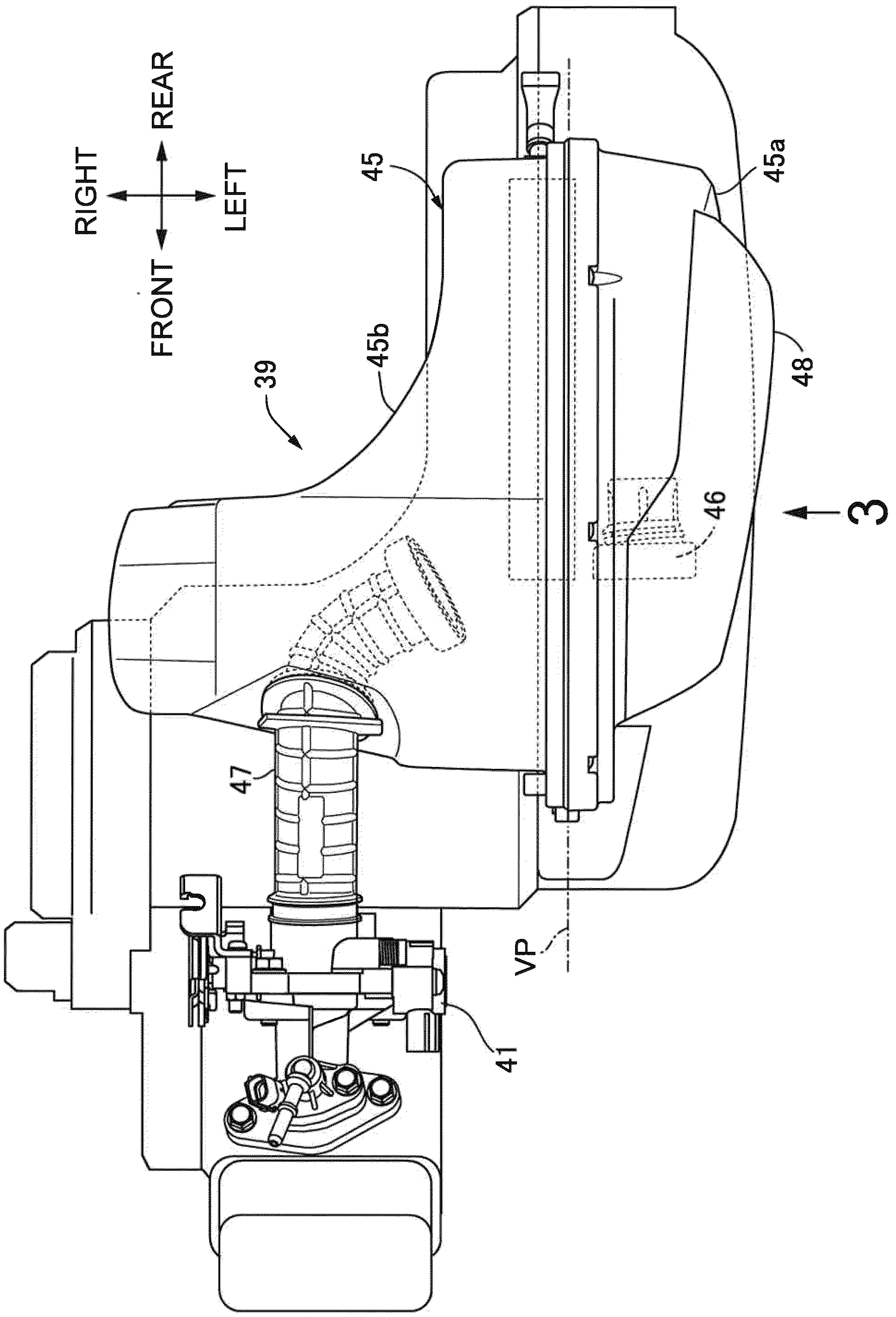

FIG.3

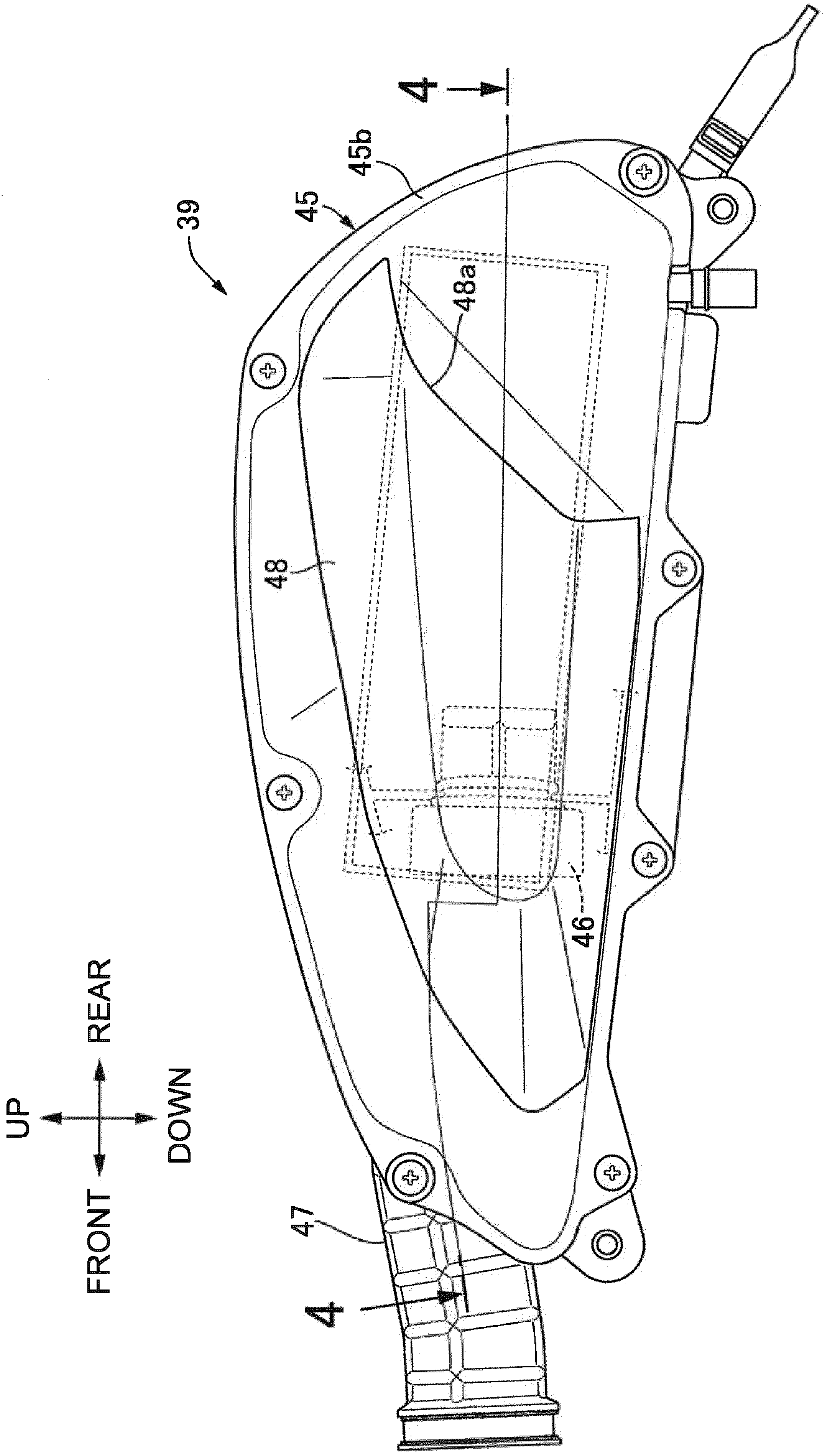

FIG.4

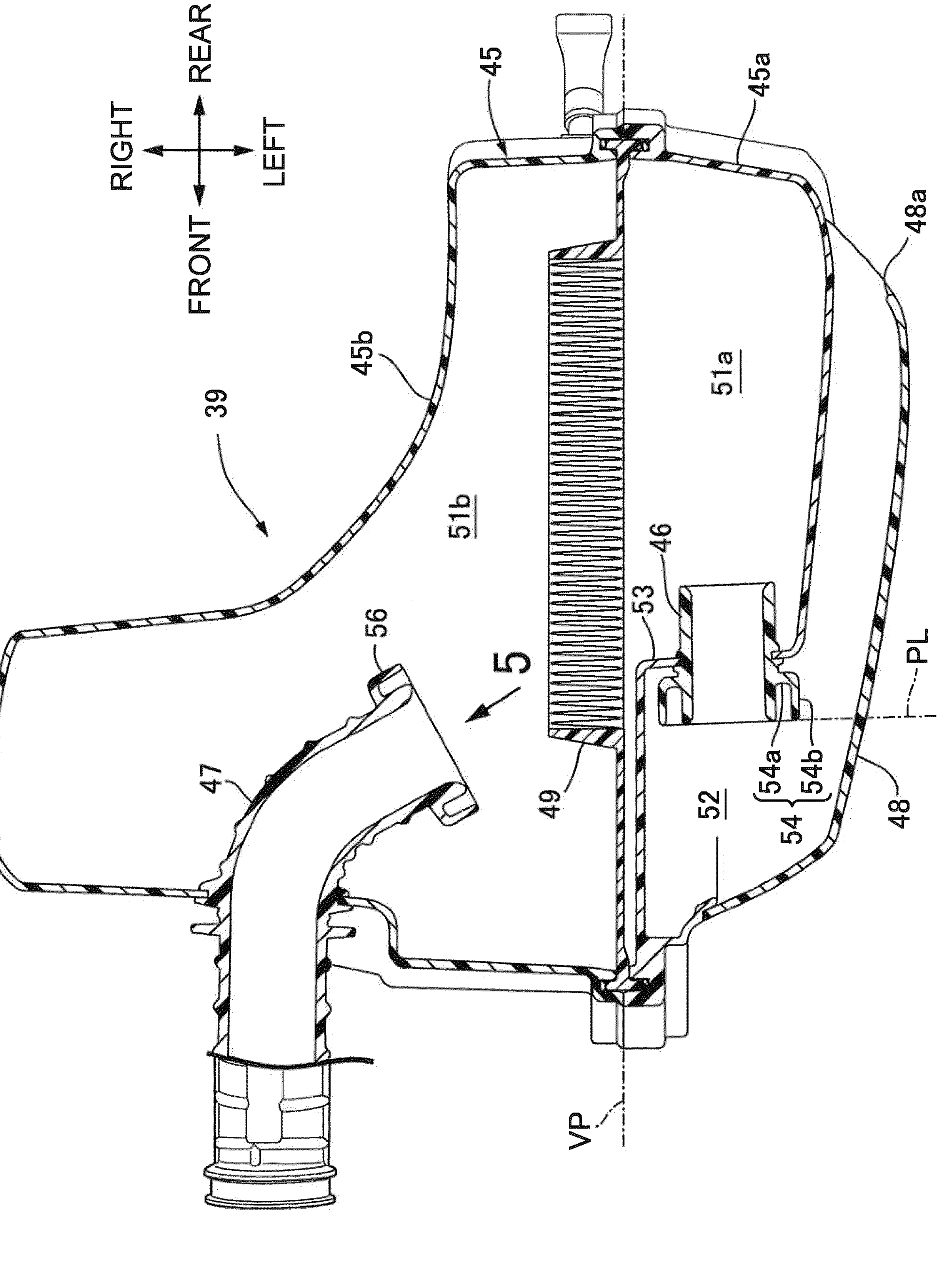
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FIG.5

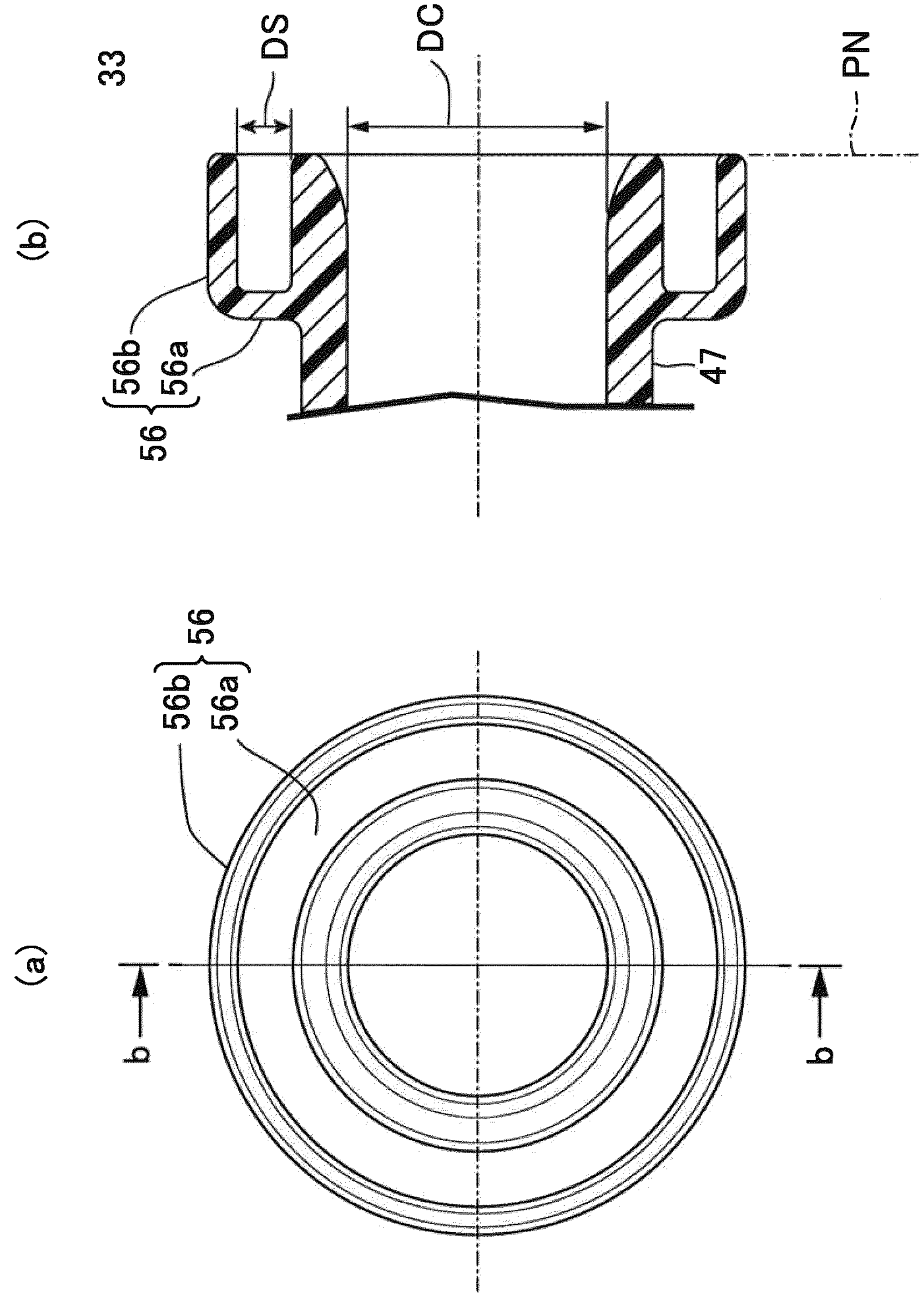
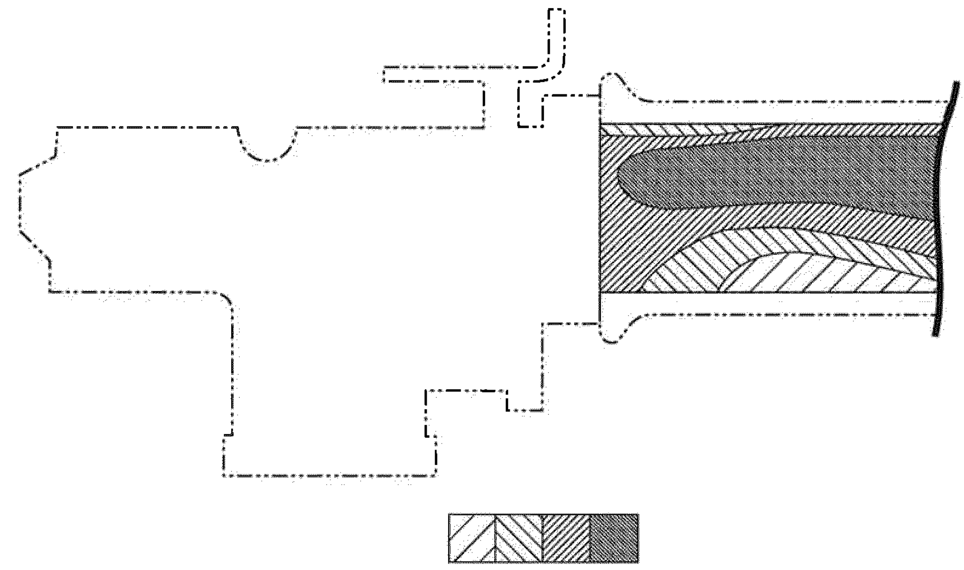


FIG.6

(a)PRESENT EMBODIMENT



(b)COMPARATIVE EXAMPLE

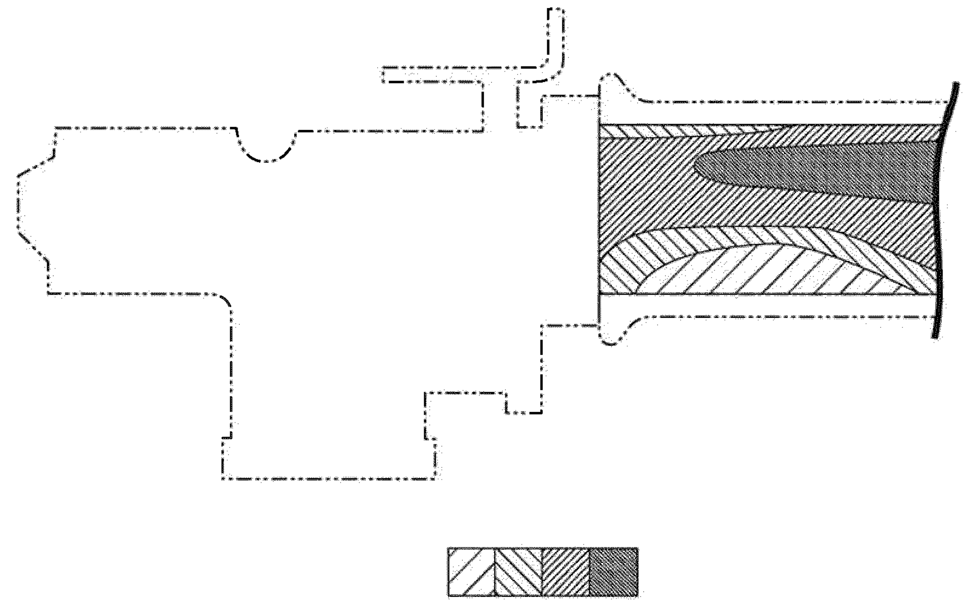


FIG.7

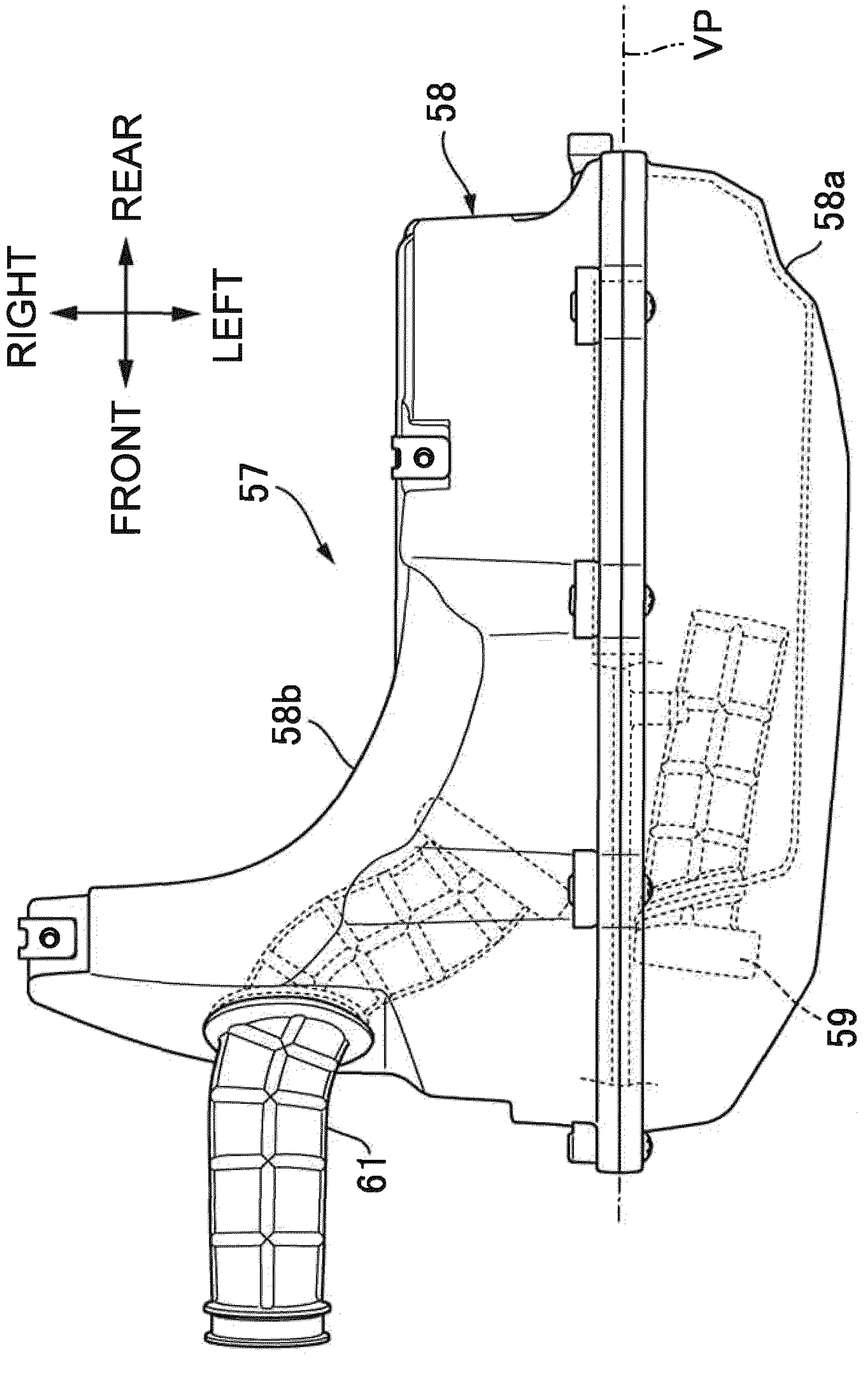


FIG.8

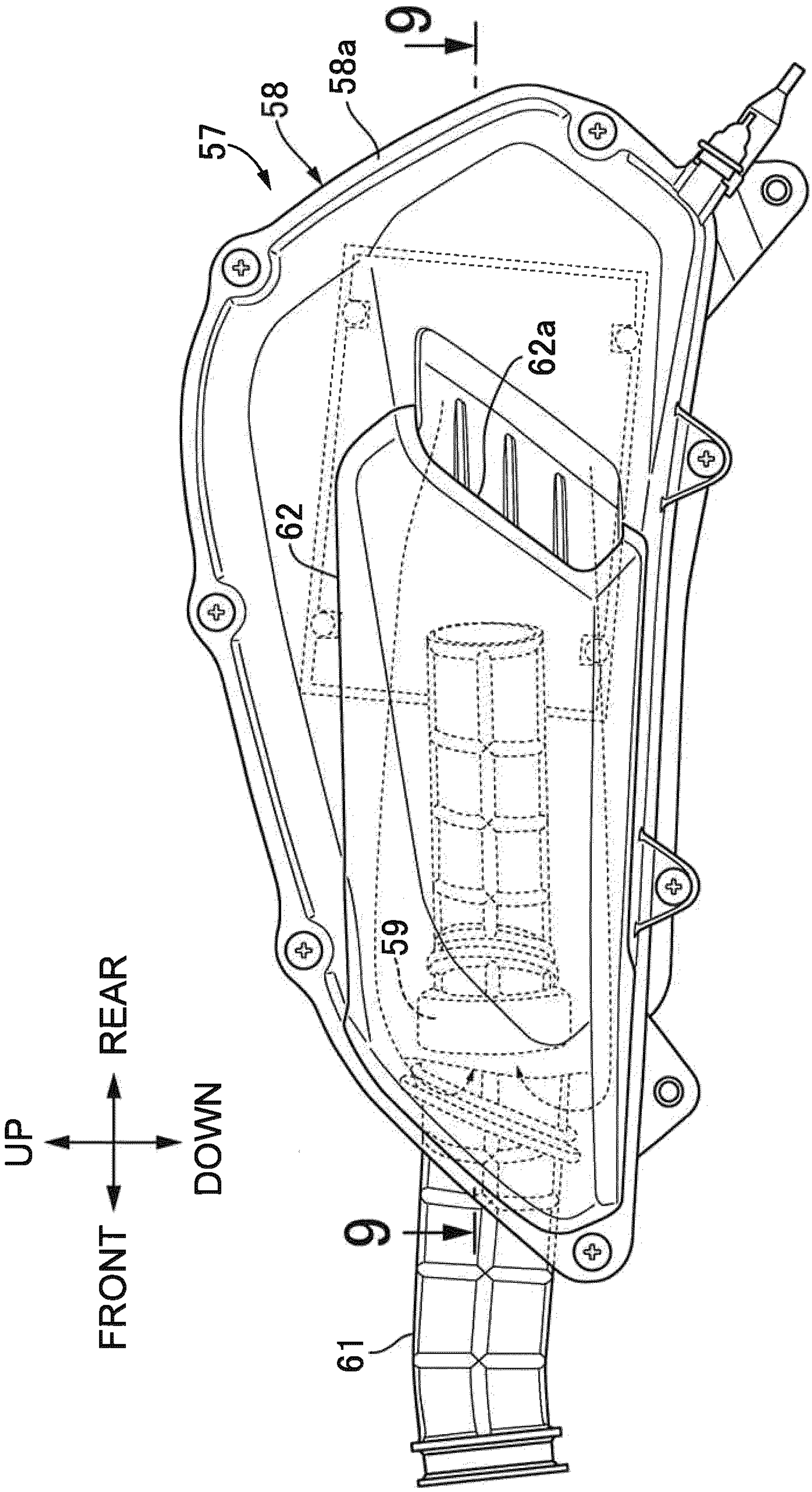


FIG.9

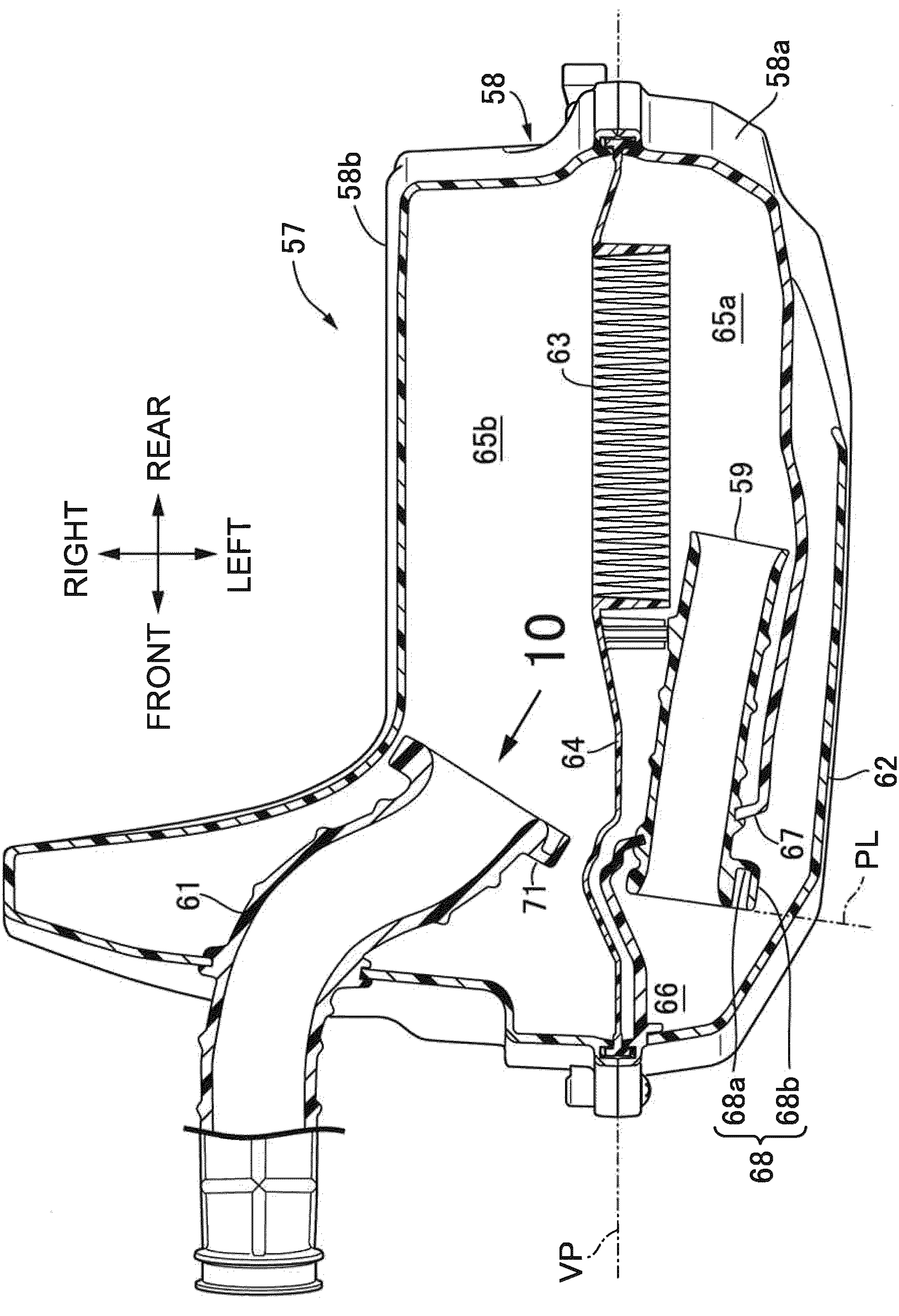

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FIG.10

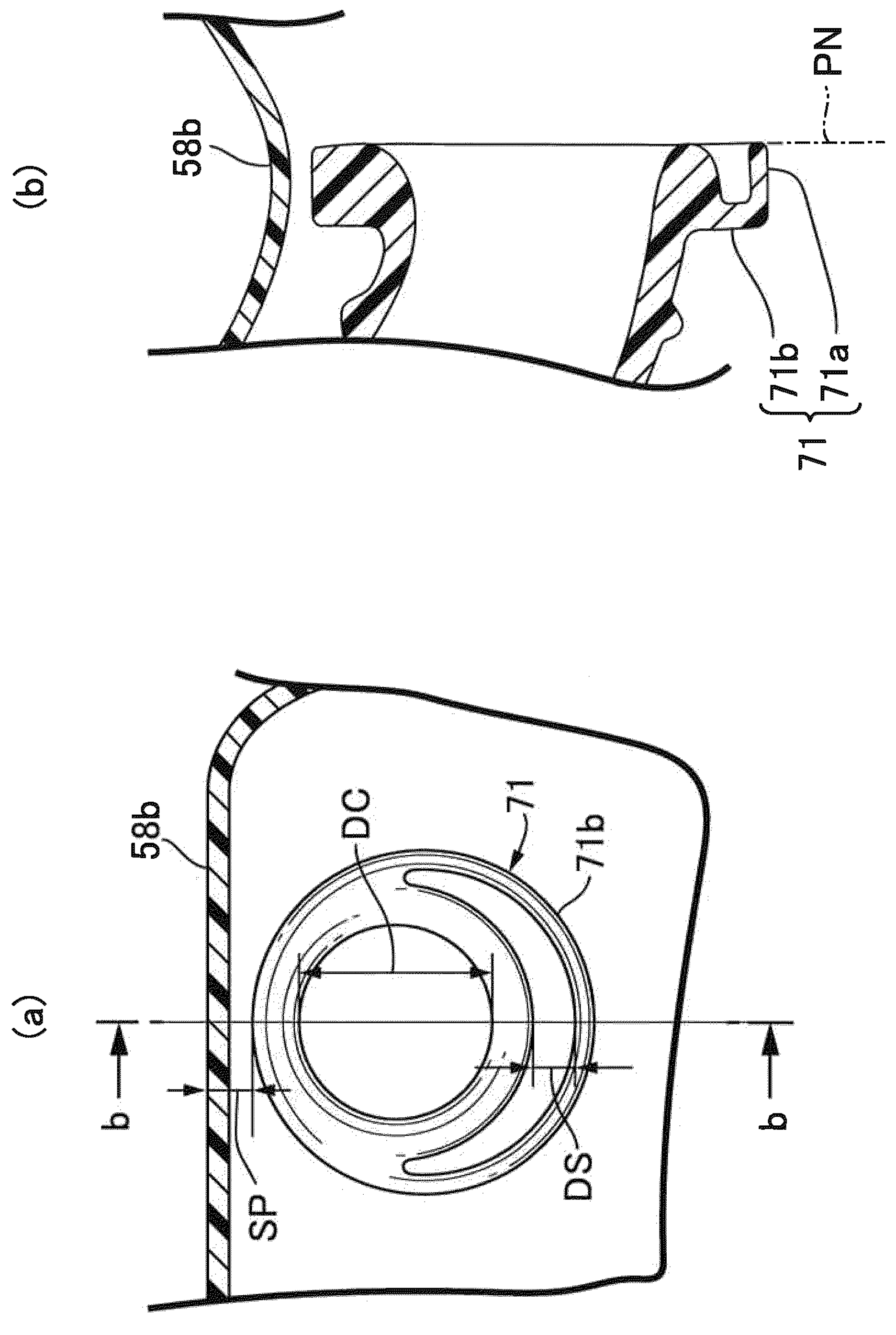

FIG.11

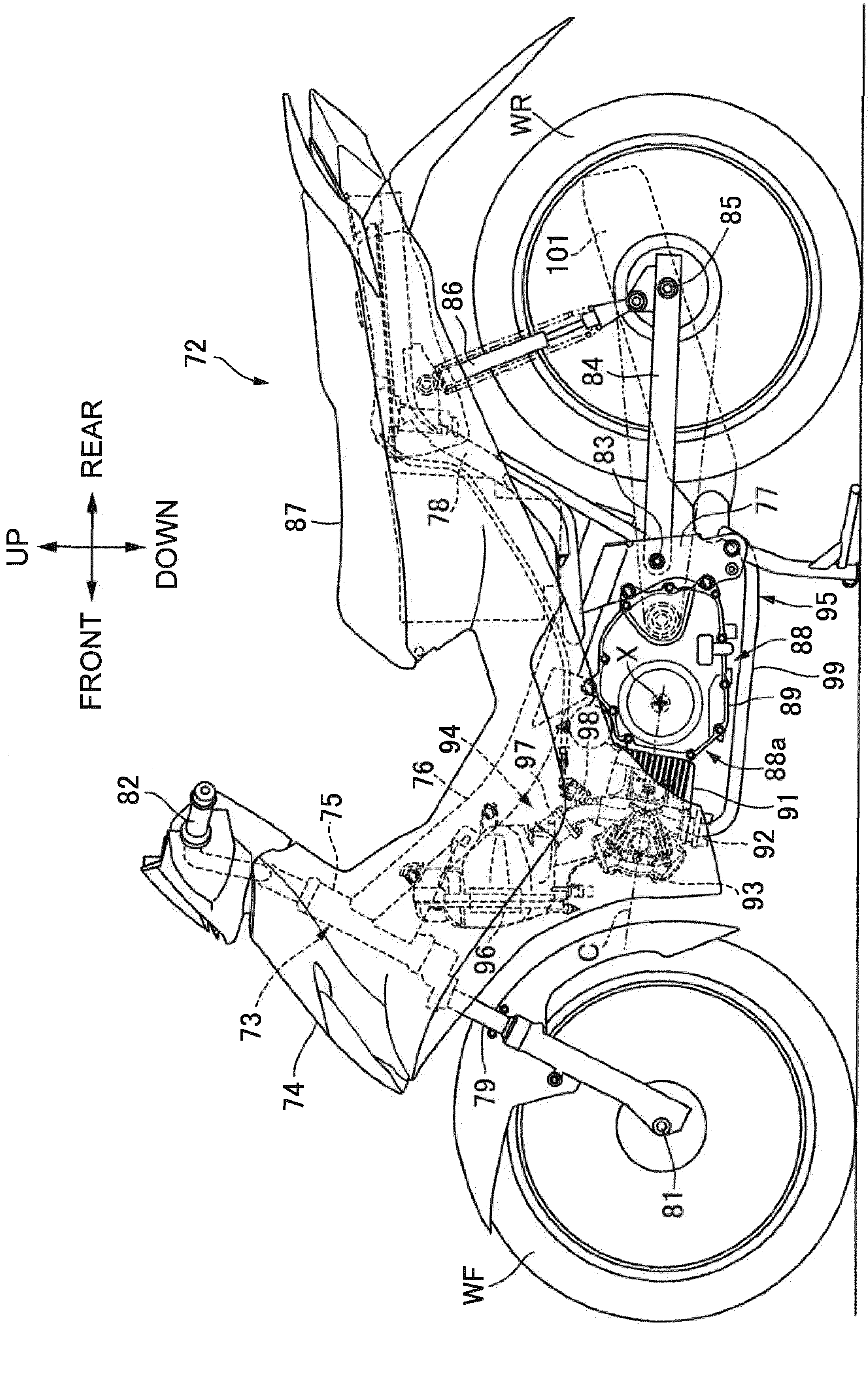
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FIG.12

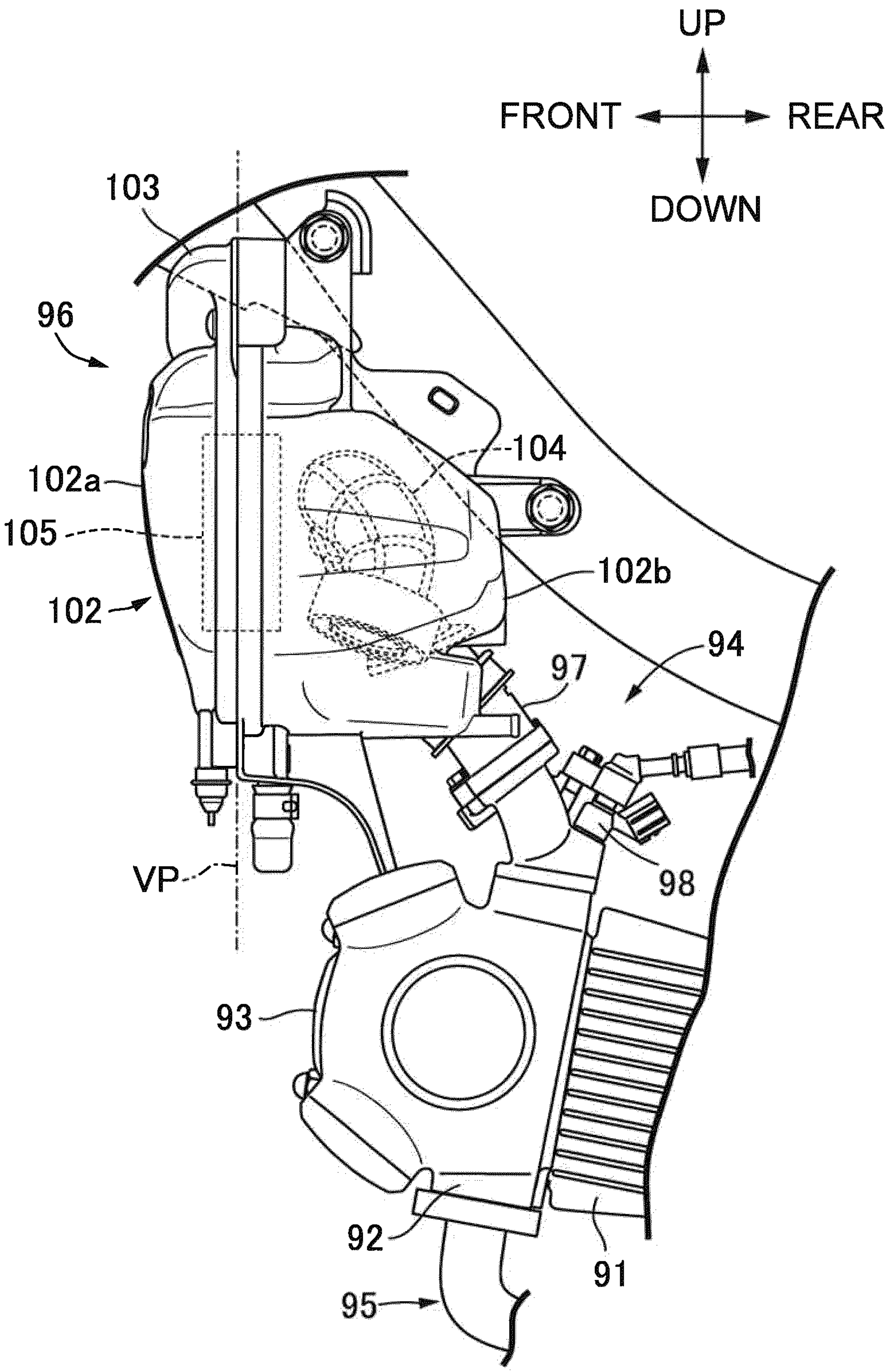
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FIG.13

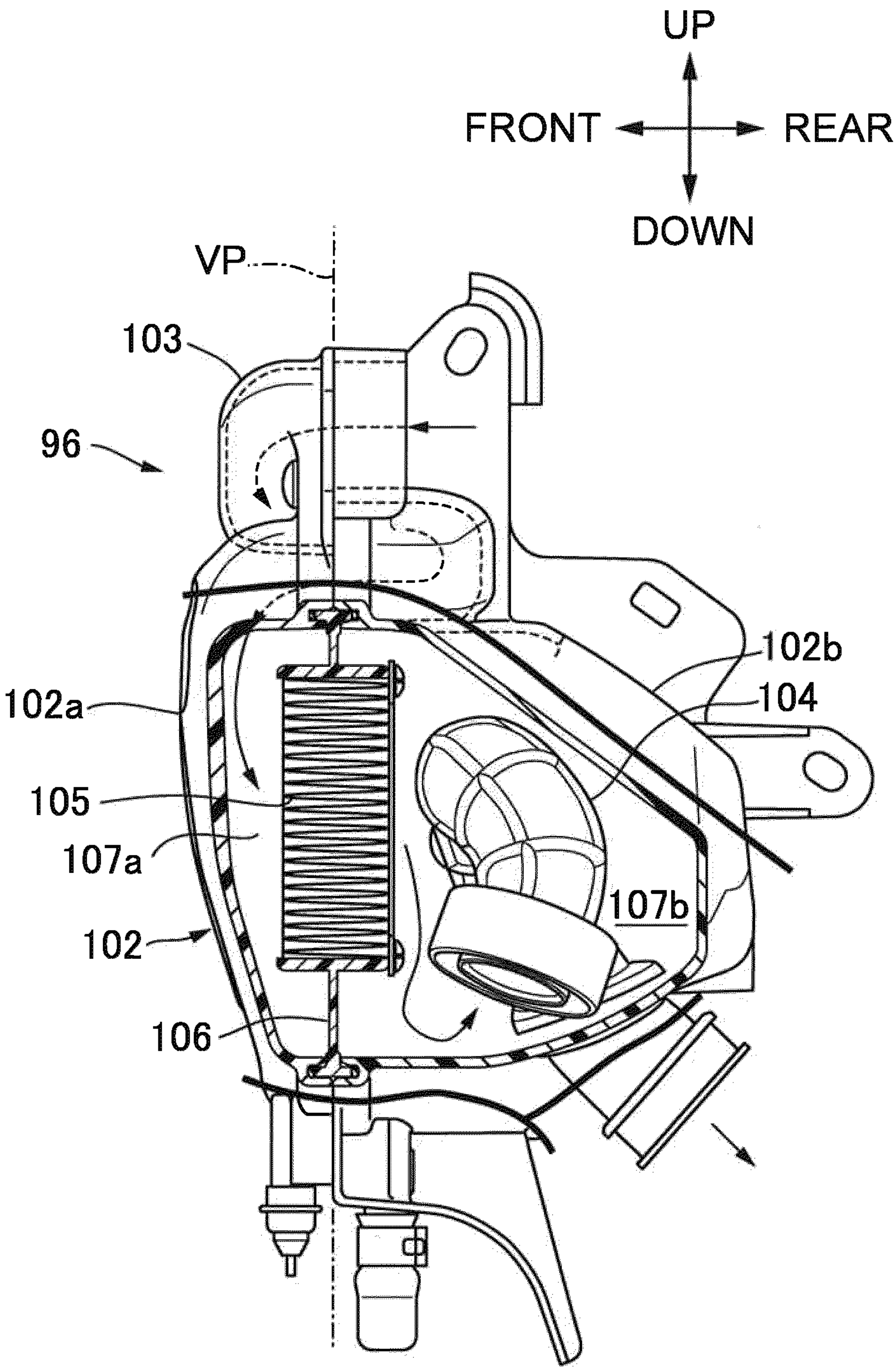
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FIG.14

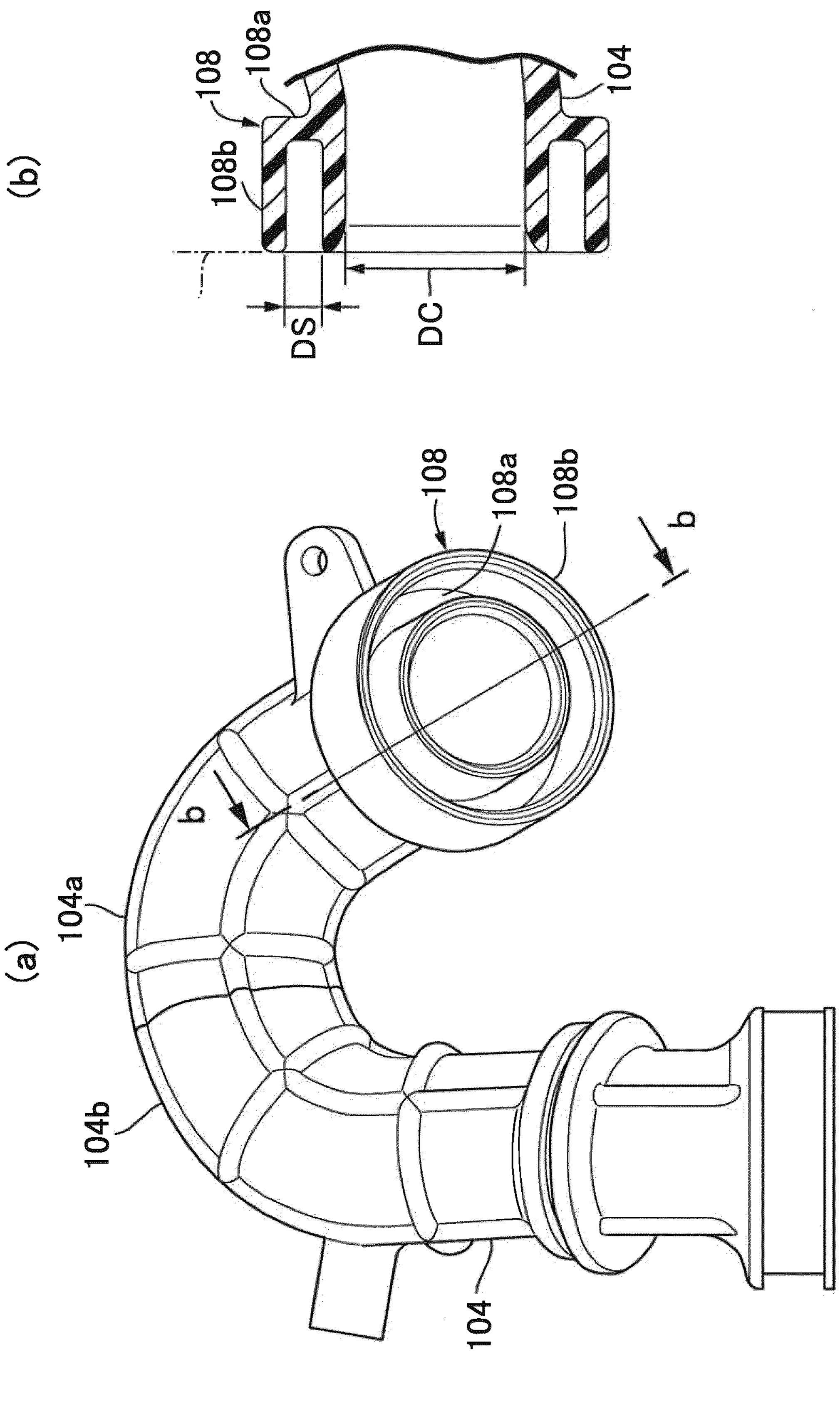

FIG.15

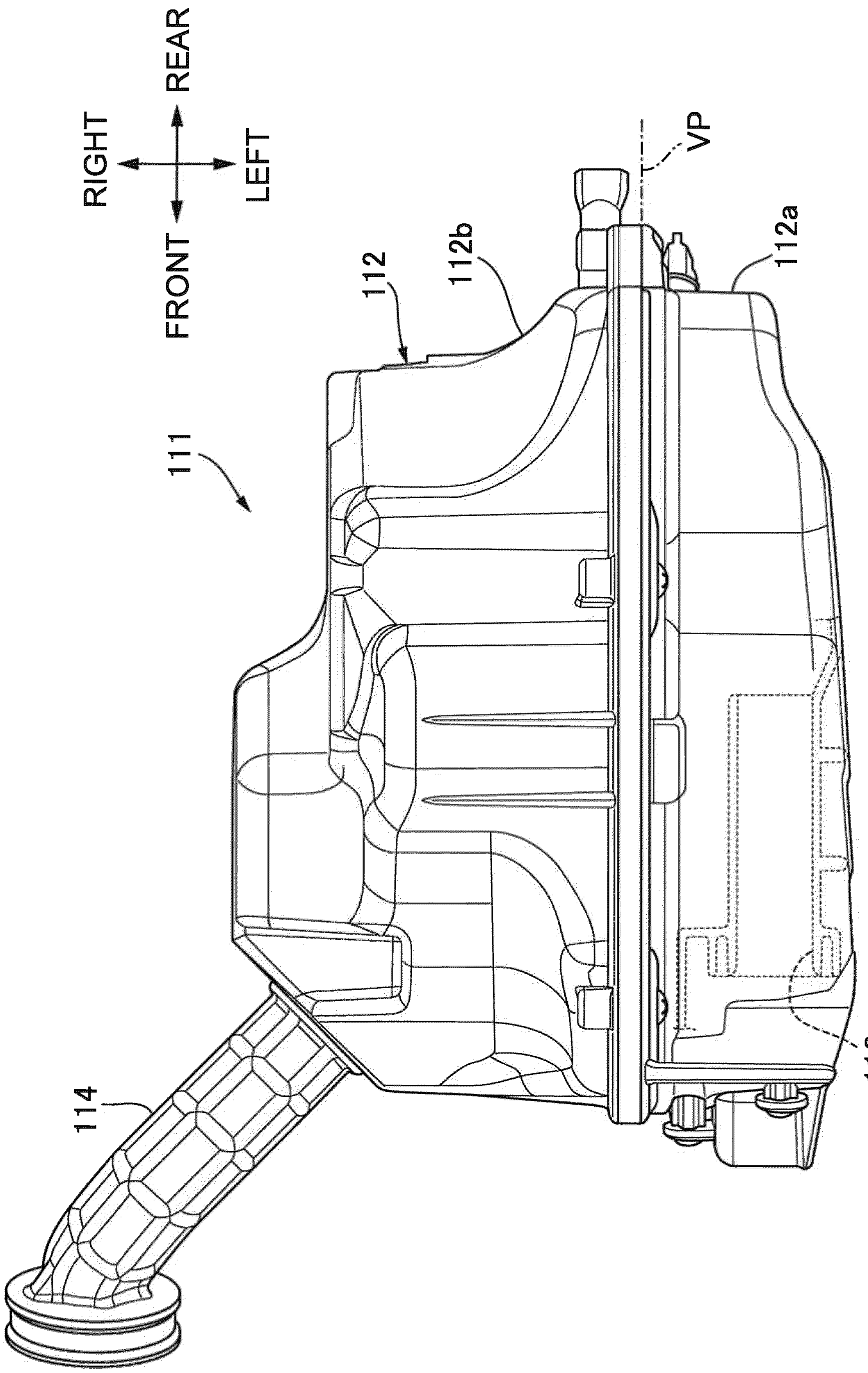

FIG.16

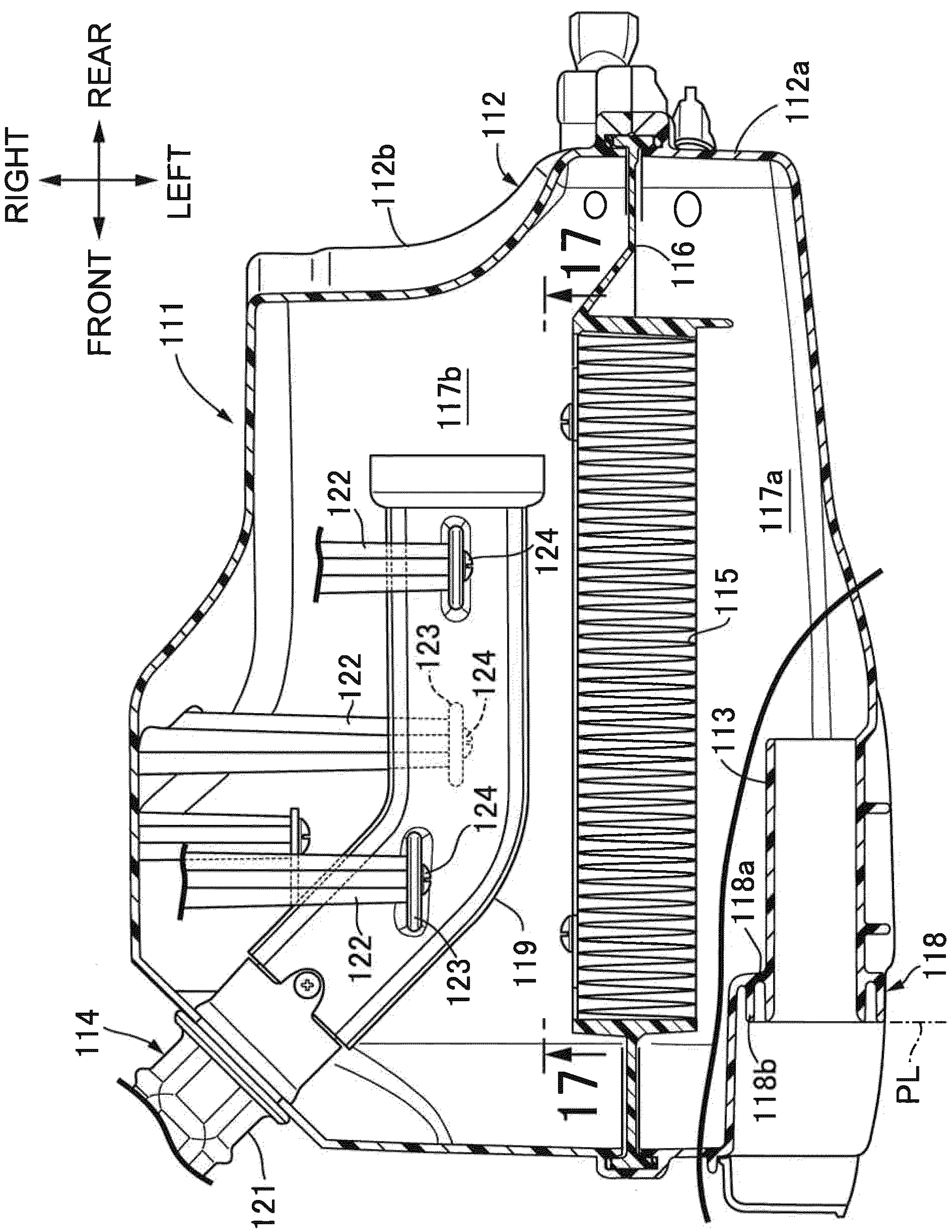
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FIG.17

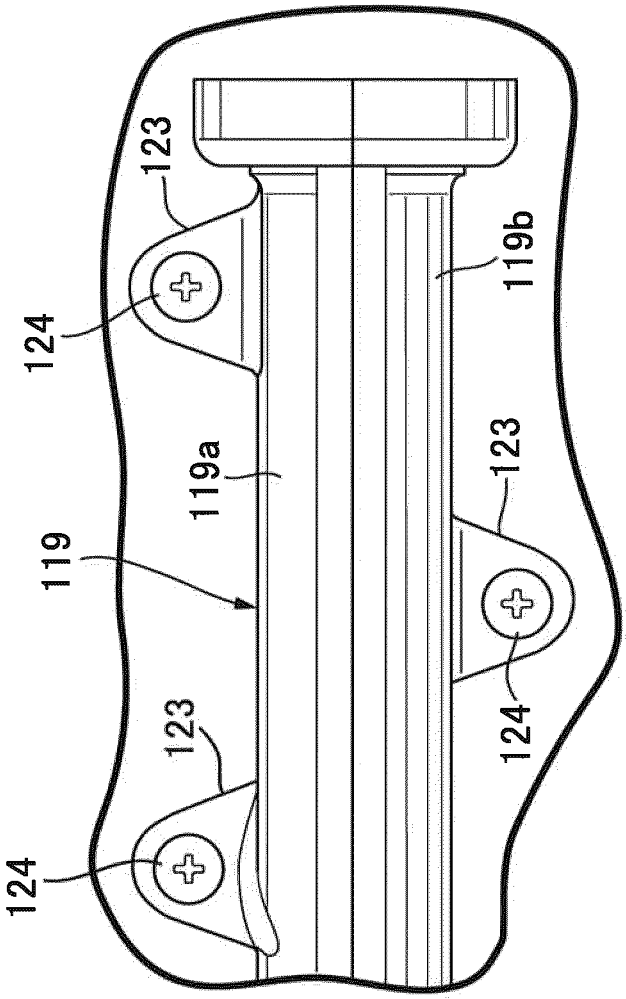
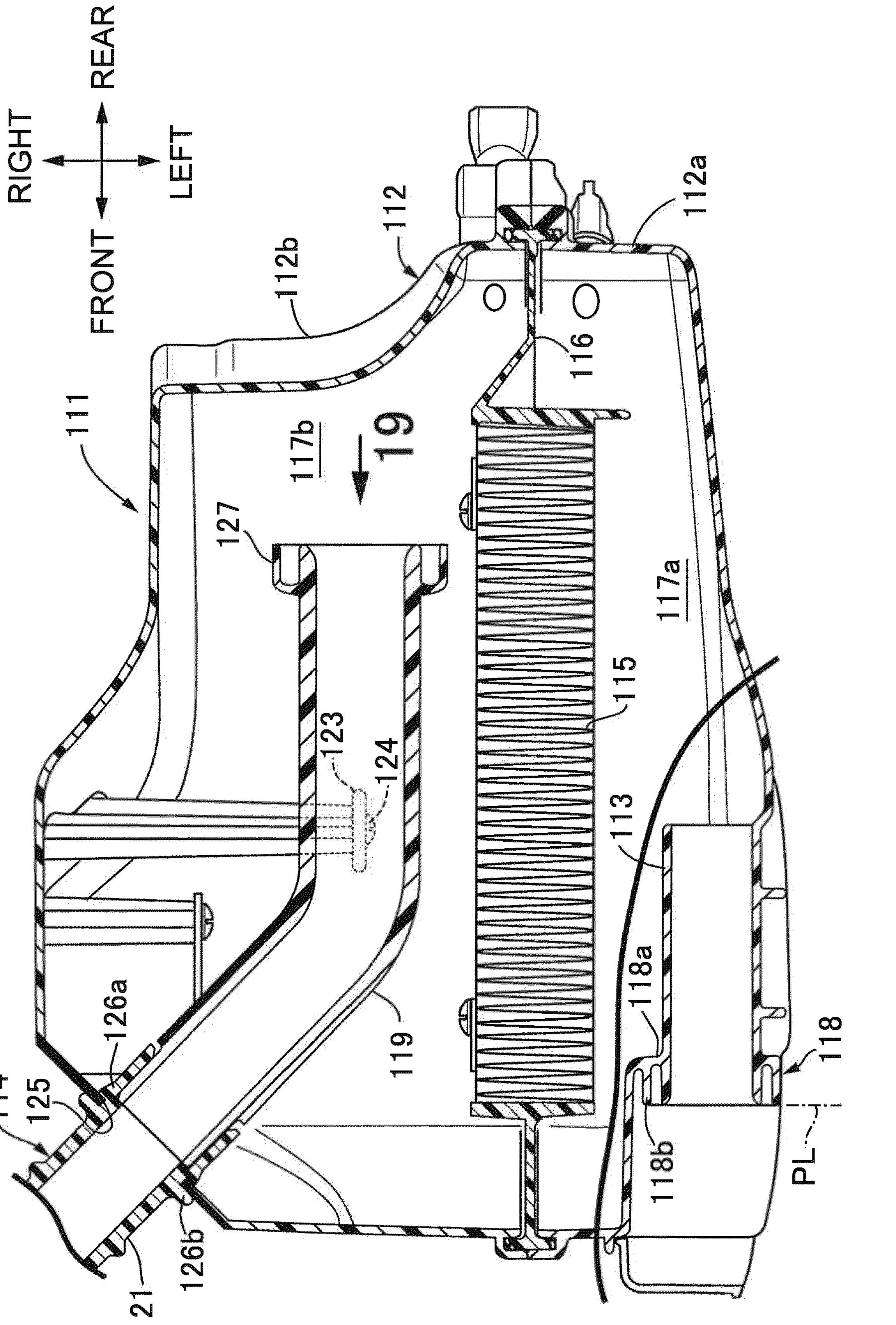


FIG.18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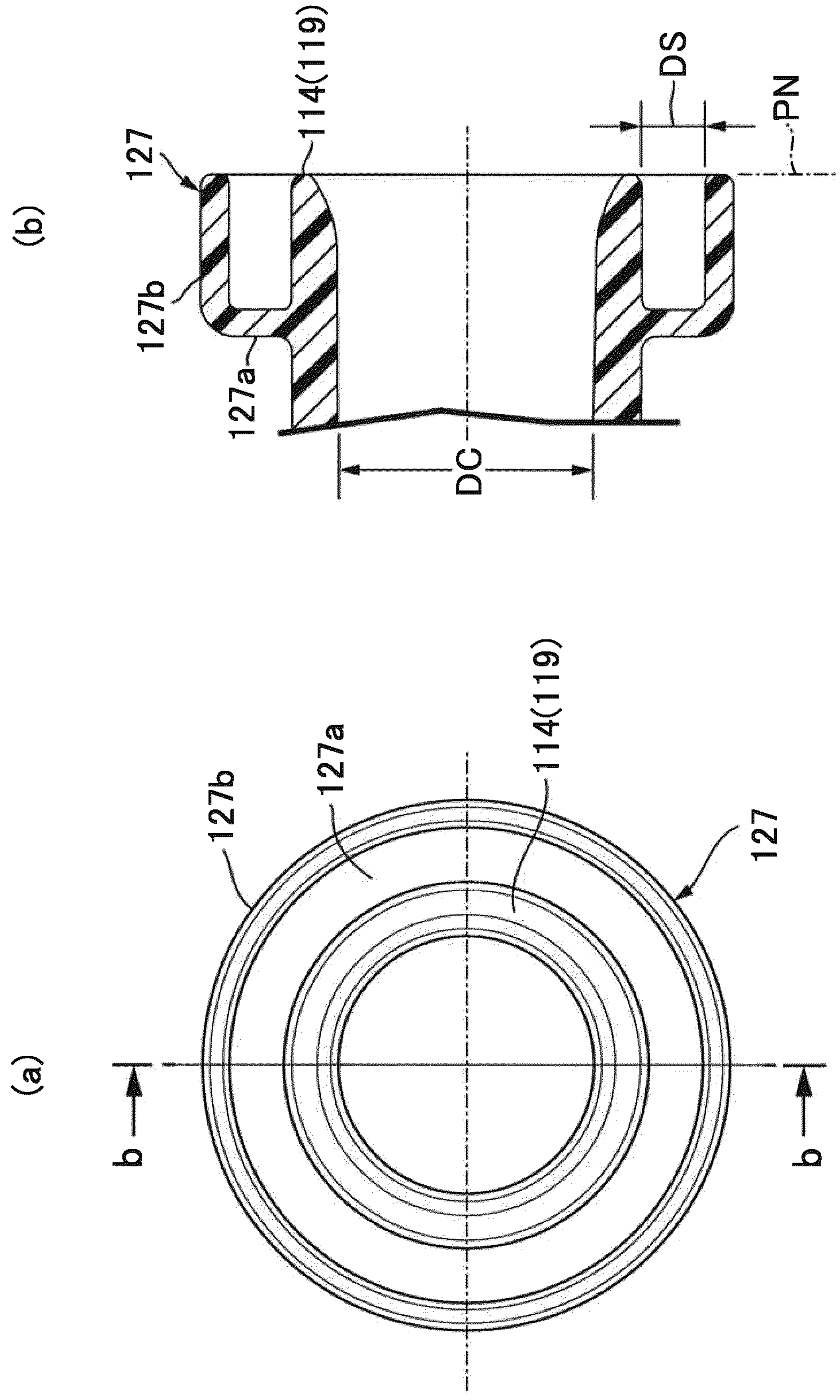

FIG.19

FIG.20

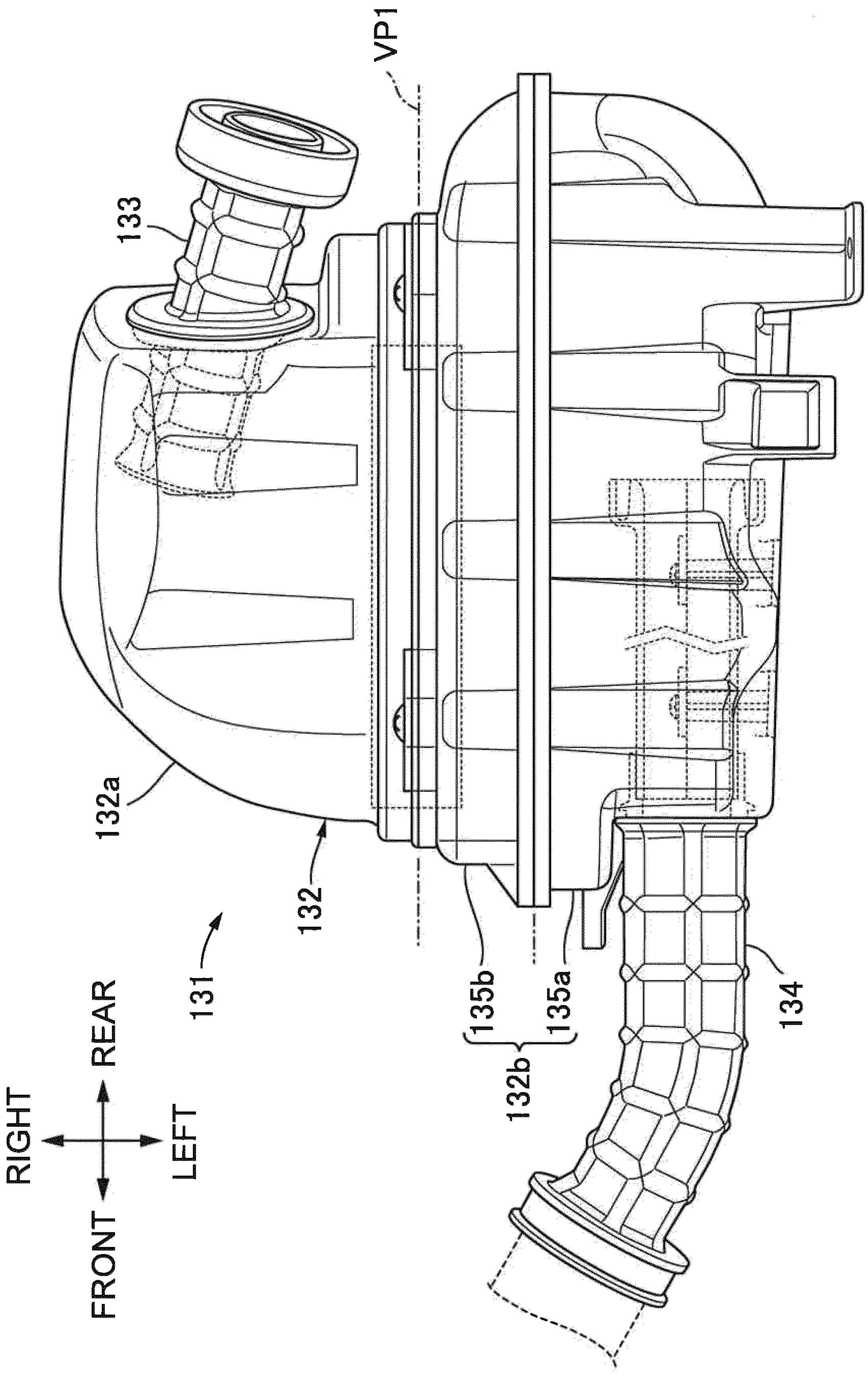

FIG.21

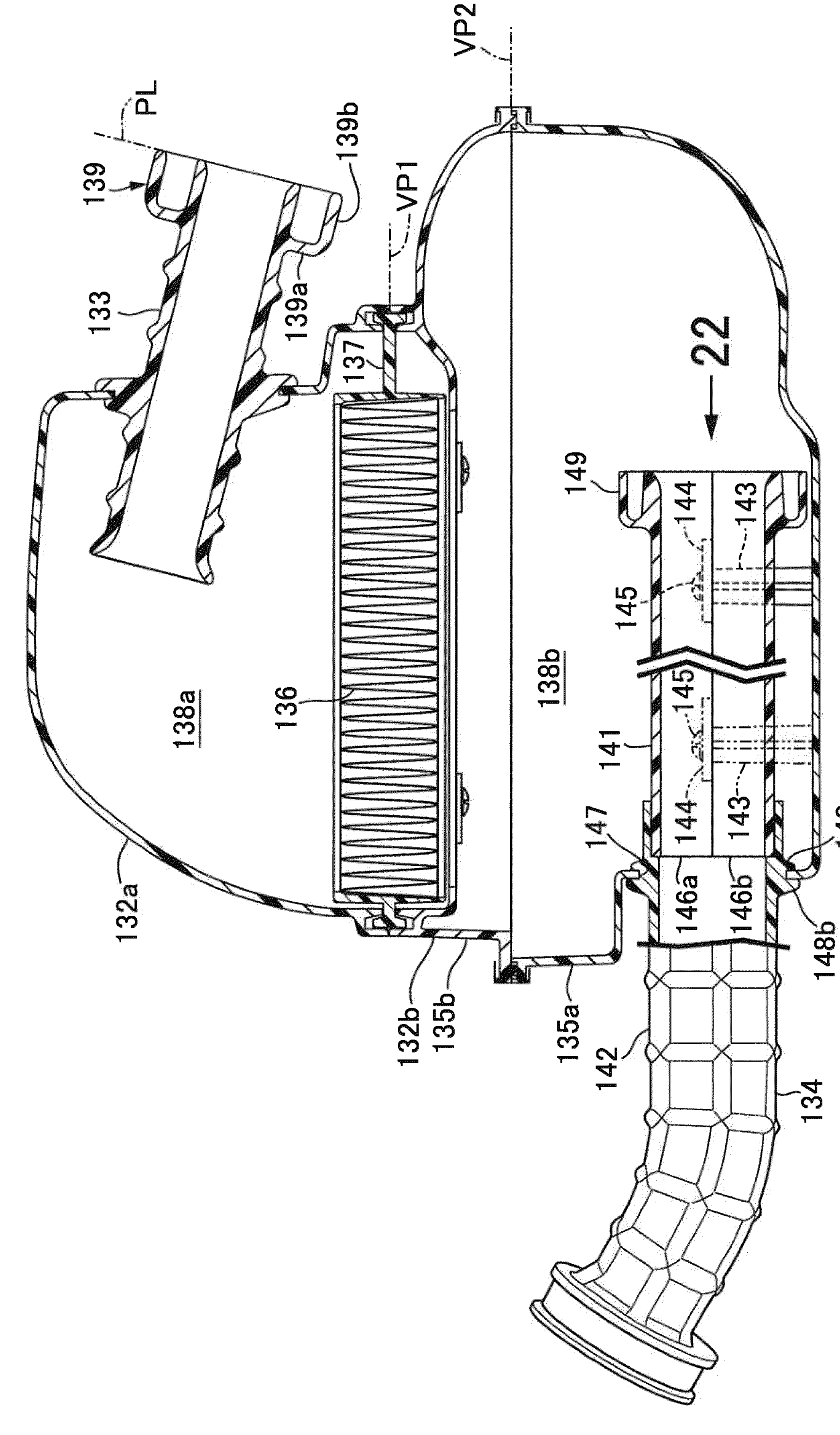
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FIG.22

(a)

(b)

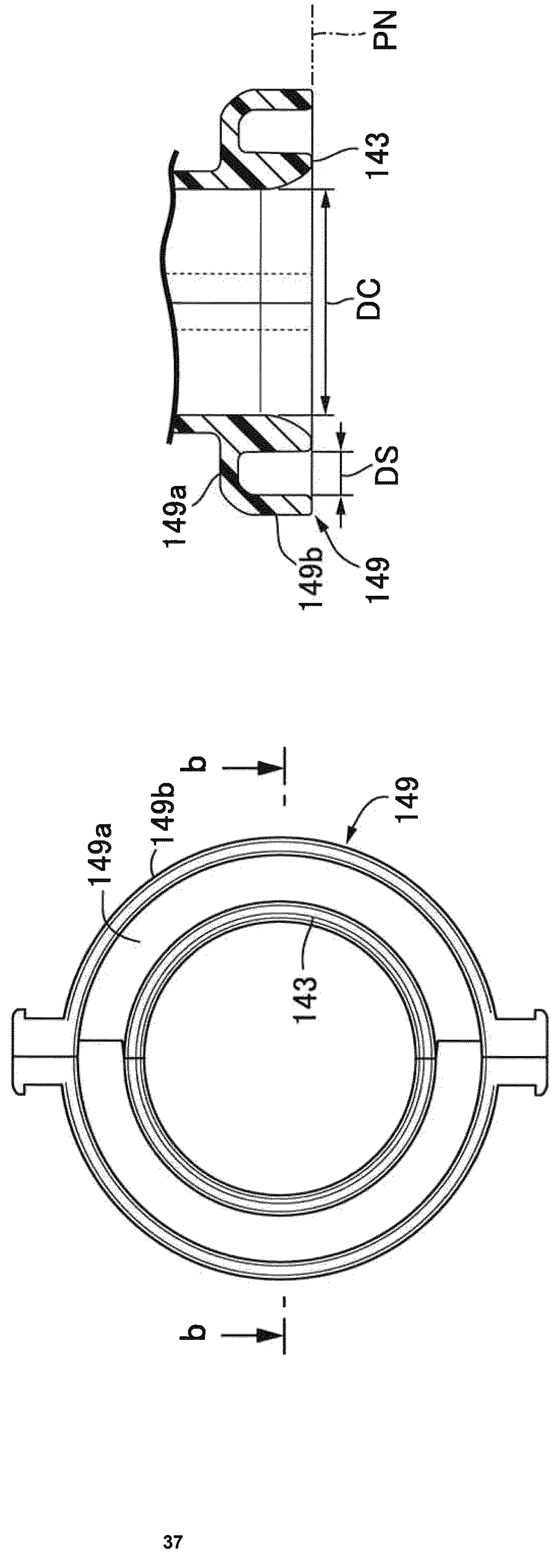

FIG.23

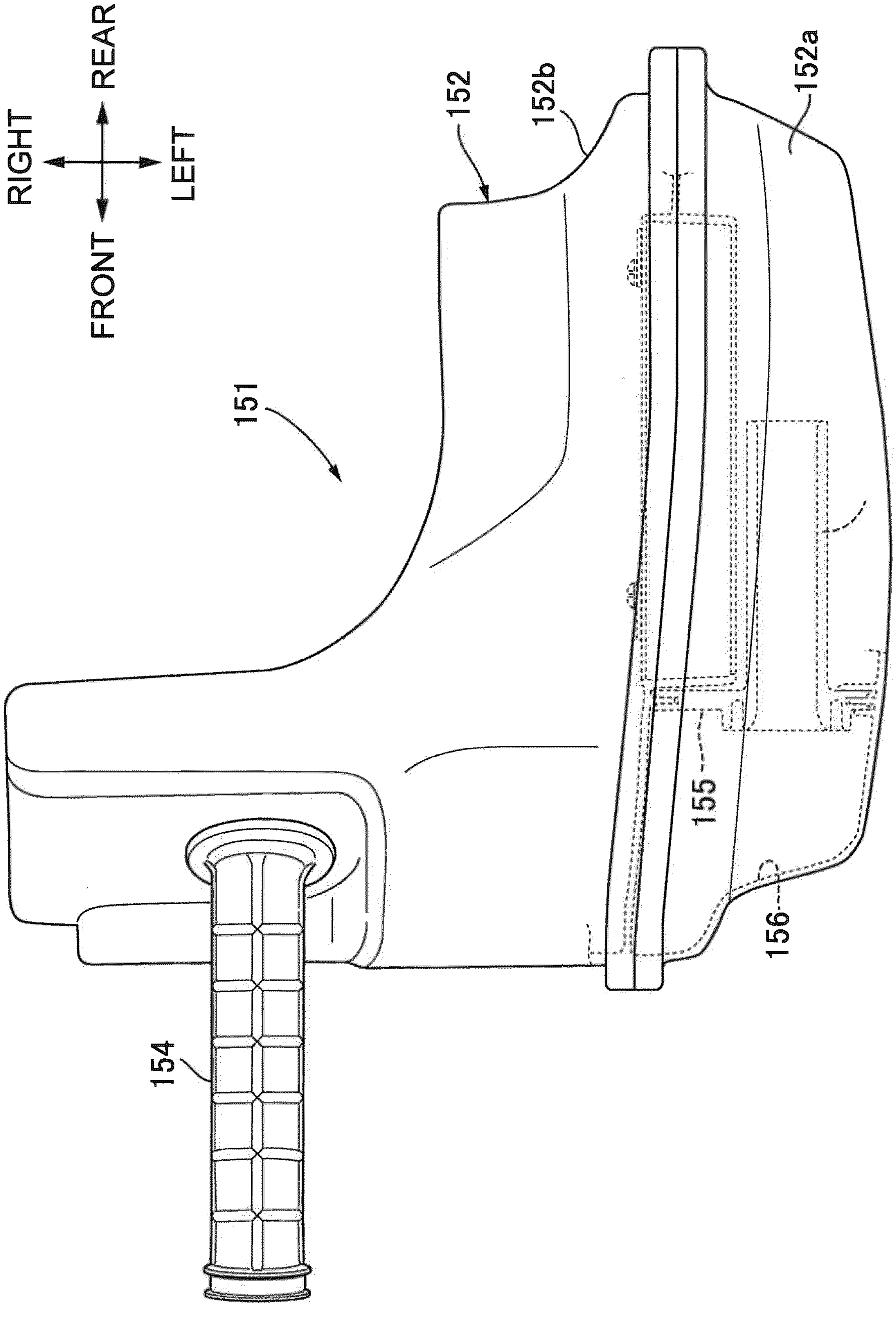

FIG.24

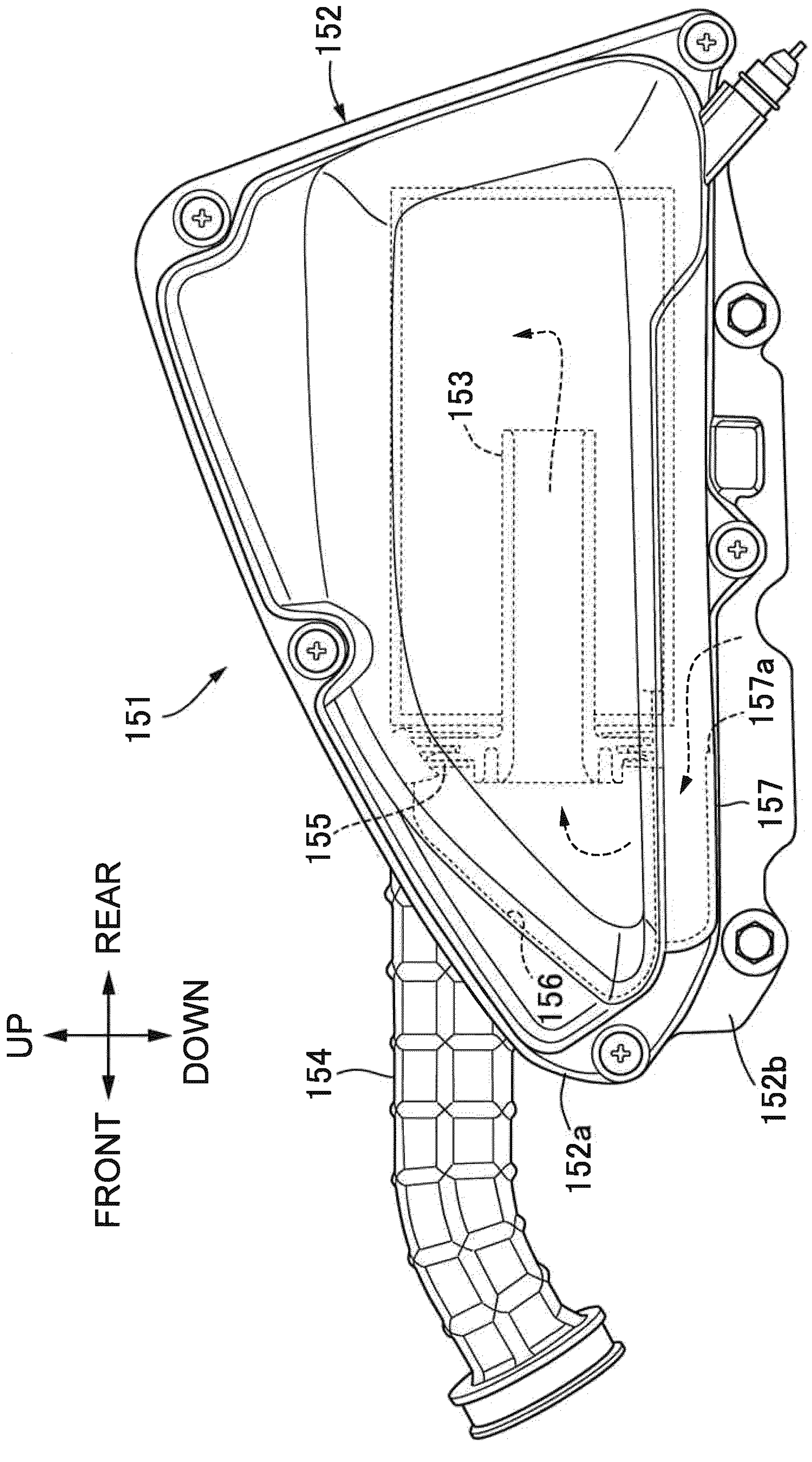

FIG.25

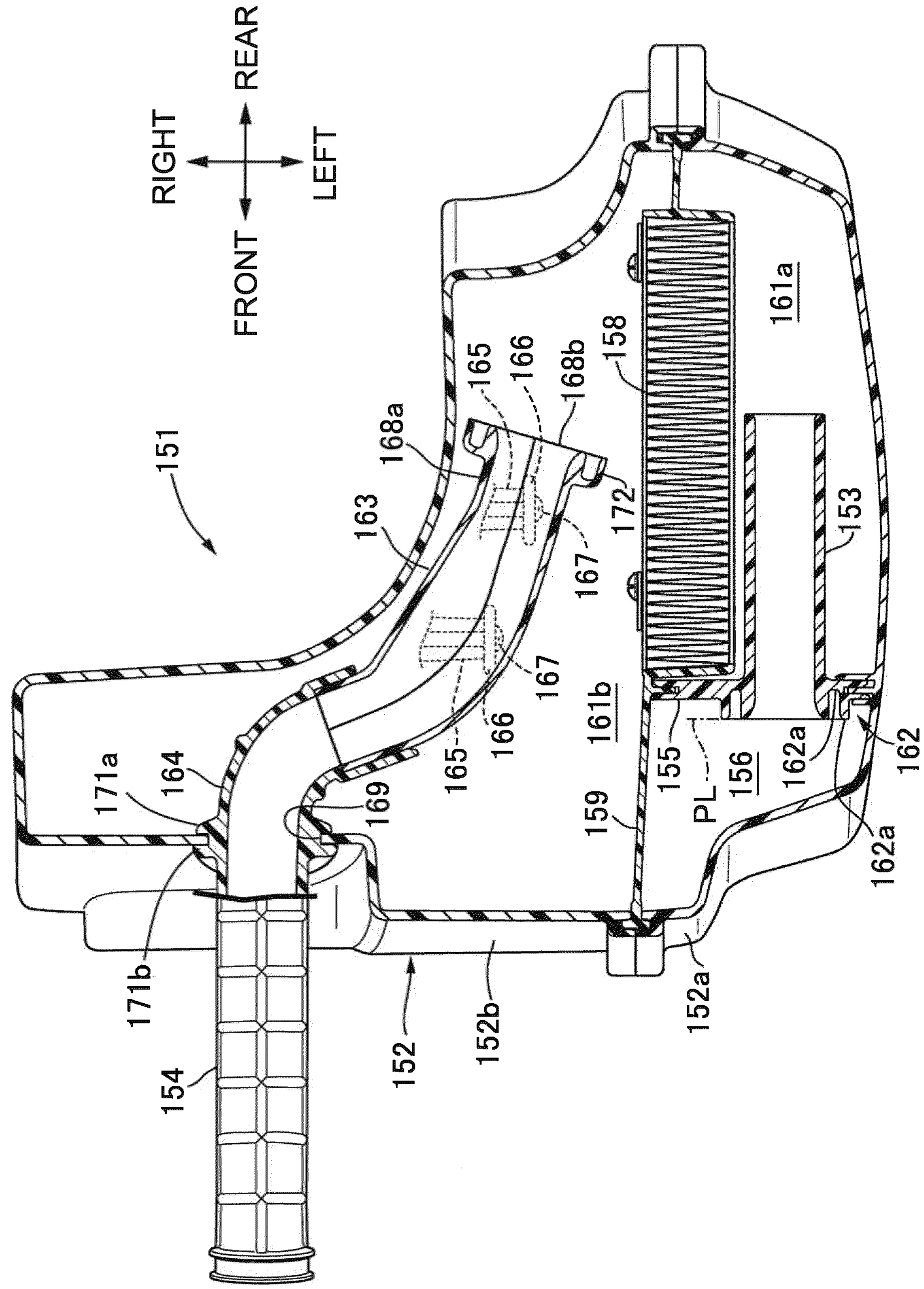
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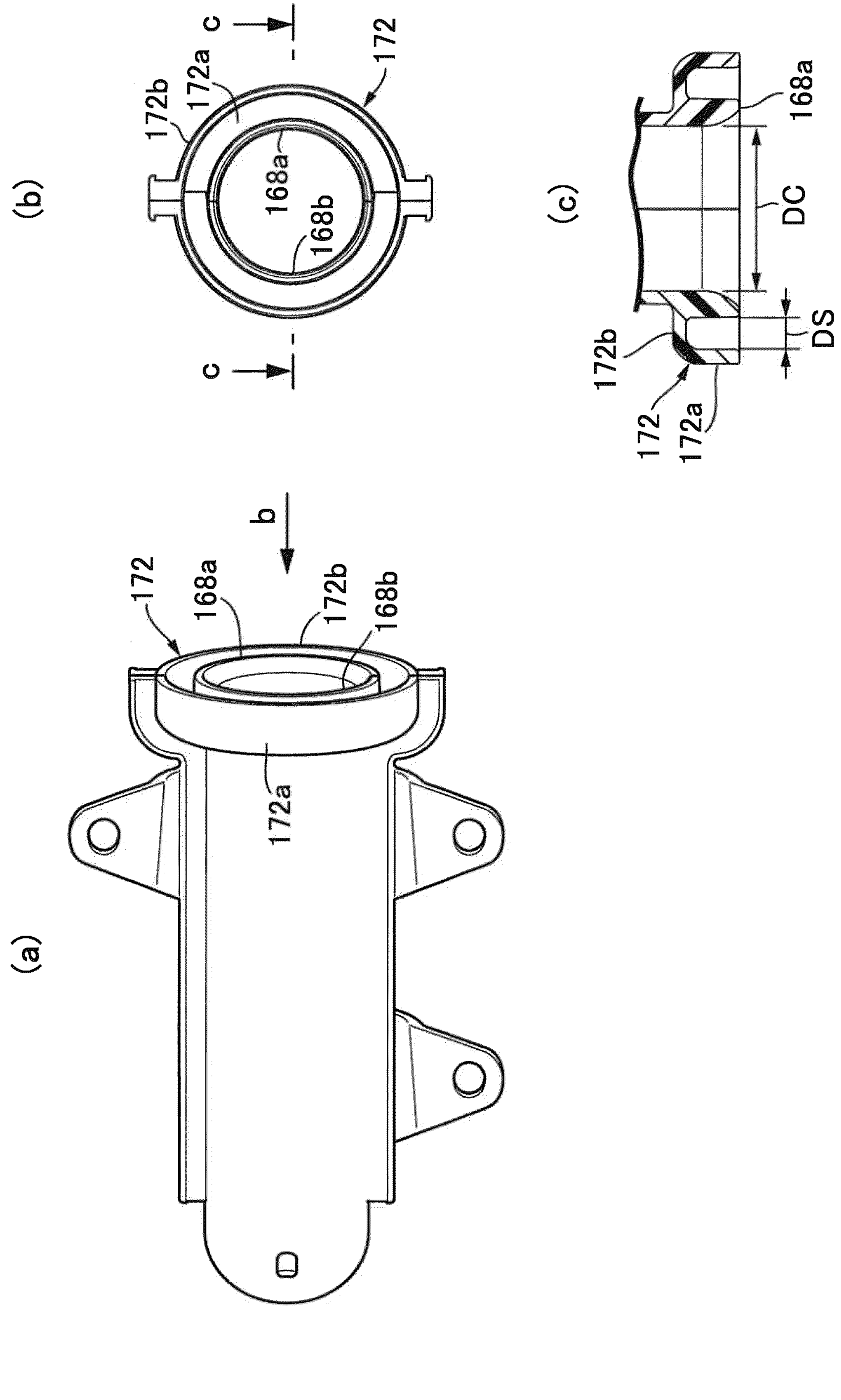
FIG.26



INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2018/001278

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. F02M35/10(2006.01)i, F02M35/16(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. F02M35/10, F02M35/16

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

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 A	JP 2010-71111 A (KAWASAKI HEAVY INDUSTRIES, LTD.) 02 April 2010, paragraphs [0021]-[0032], [0037]-[0040], fig. 2-4, 10-12 & US 2010/0108010 A1, fig. 2-6, 11-13	1-2, 4-6 7 3
Y	JP 2017-31851 A (MAHLE FILTER SYSTEMS JP CORP.) 09 February 2017, paragraph [0013], fig. 1, 2 (Family: none)	7
A	JP 2013-100731 A (TOYOTA BOSHOKU CORP.) 23 May 2013, claims, fig. 2 (Family: none)	1-7
A	JP 2013-238176 A (SUZUKI MOTOR CORP.) 28 November 2013, fig. 2 & US 2013/0306044 A1, fig. 2 & EP 2664776 A2 & CN 103422940 A	1-7

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

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"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06.02.2018	20.02.2018

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/001278

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-217156 A (HONDA MOTOR CO., LTD.) 05 August 2004, fig. 10, 12 & CN 1517242 A	1-7
A	JP 3172535 U (MURAKAMI, Yasunobu) 22 December 2011, paragraph [0025], fig. 3 (Family: none)	1-7

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- JP 2011043165 A **[0003]**