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

(11) **EP 2 853 703 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.04.2015 Bulletin 2015/14

(51) Int Cl.:
F01N 1/08 *(2006.01)*

(21) Application number: **14177403.4**

(22) Date of filing: **17.07.2014**

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

(30) Priority: **27.09.2013 JP 2013201246**

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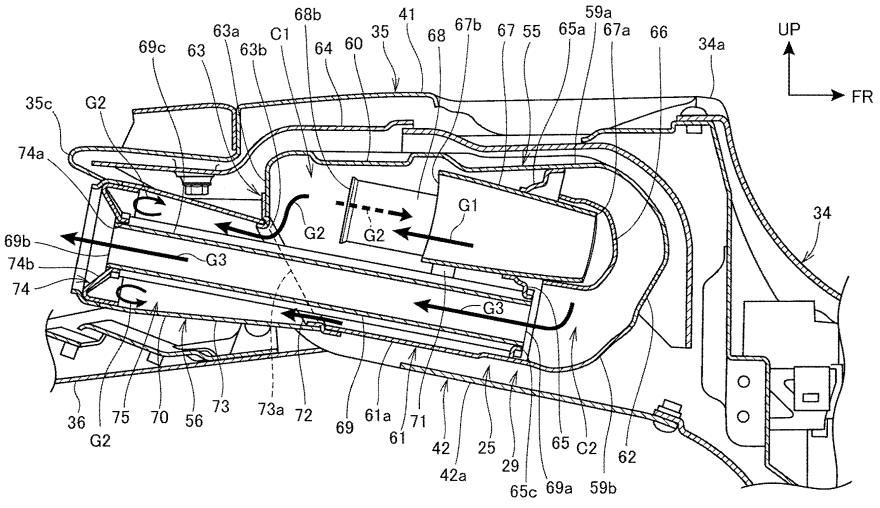
(54) Exhaust structure for a vehicle

(57) An exhaust structure for a vehicle including a rear cowl (35) covering a vehicle rear portion has a muffler (29) including a first expansion chamber (C1) and a second expansion chamber (C2) partitioned by a partition (65), first and second connecting pipes (67, 68) connecting the expansion chambers, and a tail pipe (69) configured to discharge exhaust gas from the muffler (29). The muffler (29) is covered by the rear cowl (35) such that outlines of the muffler (29) and the rear cowl (35) are each formed such that the width decreases toward the vehicle rear. The tail pipe (69) and the first and second connecting pipes (67, 68) are provided so as to penetrate the partition (65); and the position where the tail pipe (69) penetrates the partition (65) and the positions where the first and second connecting pipes (67, 68) penetrate the partition (65) are vertically offset. This allows the tail pipe to be elongated.

Fig.7



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Description

[0001] The present invention relates to an exhaust structure of a vehicle.

[0002] Japanese Patent Application Publication No. 2005-83286, for example, discloses an exhaust device installed in a vehicle, where a muffler in a rear portion of the exhaust device extending rearwardly from an engine is arranged inside a rear cowl that covers a vehicle rear portion. In Japanese Patent Application Publication No. 2005-83286, two tail pipes for discharging exhaust gas to the outside are provided.

[0003] When arranging a muffler inside a rear cowl (as in the aforementioned known exhaust structure), the muffler needs to be formed to correspond with the shape of the rear cowl, which limits the shape of the muffler. Even with such a limitation, it is desirable for the tail pipe to be formed so as to be as long as possible to increase the flow velocity of exhaust gas in the final stage, depending on the required output characteristic of an engine.

[0004] The present invention has been made in view of the circumstances mentioned above, and aims to elongate a tail pipe in an exhaust structure of a vehicle whose muffler is covered by a rear cowl.

[0005] According to a first aspect of the present invention, there is provided an exhaust structure of a vehicle comprising: an engine; an exhaust device of the engine; and a rear cowl covering a vehicle rear portion, said exhaust device including an exhaust pipe and a muffler connected to a rear portion of the exhaust pipe; the muffler including a plurality of expansion chambers partitioned by a partition, first and second connecting pipes connecting the plurality of expansion chambers and a tail pipe configured to discharge exhaust gas from said muffler; said muffler being covered by said rear cowl, wherein: outlines of said muffler and said rear cowl are each formed such that the lateral width decreases toward the vehicle rear; said tail pipe and said first and second connecting pipes are provided so as to penetrate said partition; and positions where said tail pipe and said first and second connecting pipes penetrate said partition are vertically offset from each other.

[0006] With this arrangement, the penetrating positions of the connecting pipes do not interfere with that of the tail pipe, and so the tail pipe can be elongated even when the muffler and rear cowl are formed such that their widths decrease toward the rear of the vehicle. Additionally, the width of the muffler can be reduced.

[0007] Preferably, one end of said tail pipe is arranged in a frontmost expansion chamber of the said expansion chambers of said muffler; and the other end of said tail pipe extends from a rear portion of said muffler and is open to outside air.

[0008] Thus, it is possible to elongate the tail pipe by having it extend from the frontmost expansion chamber.

[0009] Preferably, said muffler is partitioned into a first expansion chamber in a rear portion and a second expansion chamber in a front portion; exhaust gas introduced into said muffler from said exhaust pipe flows into said second expansion chamber through said first and second connecting pipes; the one end of said tail pipe is arranged in said second expansion chamber; and the other end of said tail pipe extends from a rear portion of said muffler and is open to outside air.

[0010] With this arrangement, it is possible to elongate the tail pipe by having it extending from the second expansion chamber in the front portion to the rear portion of the muffler.

[0011] Preferably, said first connecting pipe accommodated inside said muffler is supported by said partition; and said first and second connecting pipes are arranged at substantially the same vertical height.

[0012] The first connecting pipe can accommodate a catalyst. With this arrangement, although the catalyst is accommodated inside the muffler in this configuration, the catalyst can be prevented from interfering with the tail pipe, and thus the tail pipe can be elongated.

[0013] In a further preferred form, said first connecting pipe is formed into a flat shape.

[0014] Thus, the vertical size of the catalyst can be reduced while ensuring capacity of the catalyst. Consequently, the catalyst does not interfere with the tail pipe, so that the tail pipe can be elongated.

[0015] In a preferred form, an outline of said muffler is formed such that a width at a vertical position where said tail pipe is arranged is smaller than a width at a vertical position where said first and second connecting pipes are arranged.

[0016] With this arrangement, the width of the portion of the rear cowl covering the vicinity of the tail pipe can be reduced, whereby the muffler and rear cowl can be reduced in size.

[0017] Preferably, a tubular cover member covers a part of said tail pipe from outside in the radial direction; ends of said first and second connecting pipes face an inner wall of said muffler; and a space between said cover member and said tail pipe communicates with said first expansion chamber through a connecting portion between said cover member and said inner wall.

[0018] With this arrangement, the space between the tubular cover member and the tail pipe can be used as an expansion chamber, and so the size of the muffler can be reduced while capacity of the expansion chamber can be ensured.

[0019] In a preferred form, said cover member is connected to said muffler by welding; and a connecting portion thereof is tapered in side view.

[0020] Thus, an area of the welding portion of the cover member can be enlarged, and rigidity can be enhanced.

[0021] A preferred embodiment of the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

FIG. 1 is a right side view of a motorcycle including an exhaust structure according to the preferred embodiment of the present invention;

FIG. 2 is a right side view of the periphery of a rear cowl;
FIG. 3 is a plan view of the rear cowl as seen from above;
FIG. 4 is a view of the periphery of the rear cowl as seen from below;
FIG. 5 is a perspective view of a rear bank exhaust device;
FIG. 6 is a plan view of a rear bank muffler as seen from above;
FIG. 7 is a cross-sectional view taken along line VII-VII of FIG. 6;
FIG. 8 is a cross-sectional view of the rear bank muffler as seen from the left side;
FIG. 9 is a cross-sectional view of a rear portion of the rear bank muffler; and
FIG. 10 is a view of a partition as seen from the vehicle rear side.

[0022] Hereinafter, a presently preferred embodiment of the present invention will be described with reference to the drawings. Note that in the description, directions such as "front", "rear", "left", and "right" should be interpreted with regard to the vehicle in normal use, unless otherwise stated. Further, in the drawings, "FR" indicates the direction towards the front of the vehicle body, "UP" the direction upwards from the vehicle body, and "LE" the direction towards the left of the vehicle.

[0023] FIG. 1 is a right side view of a motorcycle 10 including an exhaust structure according to the preferred embodiment of the present invention.

[0024] The motorcycle 10 is a vehicle in which: an engine 11 is supported by a body frame F; a front fork 12 supporting a front wheel 2 is steerably supported at the front end of the body frame F; and a swing arm 13 supporting a rear wheel 3 is provided on the rear side of the body frame F. The motorcycle 10 is a straddle type vehicle, where a seat 14 on which a rider sits in a straddling manner is supported on a top portion of the body frame F.

[0025] The body frame F includes: a head pipe 15 supporting the front fork 12 at the front end; paired left and right main frames 16 extending obliquely downwardly and rearwardly from the head pipe 15; and paired left and right centre frames 17 extending downwardly from rear portions of the main frames 16. The body frame F also includes paired left and right seat frames (not shown) extending obliquely upwardly from rear portions of the main frames 16 toward a rear portion of the vehicle.

[0026] The swing arm 13 is supported in a vertically swingable manner by a pivot shaft 18 provided in vertically central portions of the left and right centre frames 17. The rear wheel 3 is axially supported by an axle 19 at a rear end portion of the swing arm 13.

[0027] A steering handlebar 20 is attached to a top end portion of the front fork 12, and the front wheel 2 is supported at a bottom end portion of the front fork 12 through an axle 21.

[0028] A fuel tank 22 is supported by the left and right centre frames 17 behind the head pipe 15. The seat 14 is positioned behind the fuel tank 22 and supported by the aforementioned seat frames.

[0029] The engine 11 is a V4 engine in which cylinders are arranged in a V shape in side view. The engine 11 includes: a crankcase 23 supporting a crankshaft extending in the lateral (width) direction of the vehicle; a front bank 47F configured of two cylinders extending upwardly and forwardly from the crankcase 23 in an inclined manner; and a rear bank 47R configured of two cylinders extending upwardly and rearwardly from the crankcase 23 in an inclined manner.

[0030] The engine 11 has a front bank exhaust device 24 connected to the front bank 47F, and a rear bank exhaust device 25 (exhaust device) connected to the rear bank 47R.

[0031] The front bank exhaust device 24 has: exhaust pipes 26 extending from the front faces of cylinder heads of the cylinders in the aforementioned front bank 47F, which are then collected into one exhaust pipe at their rear ends; and a front bank muffler 27 arranged outside the swing arm 13 and connected to the rear end of the exhaust pipe.

[0032] The rear bank exhaust device 25 has: exhaust pipes 28 extending from the rear faces of cylinder heads of the cylinders in the rear bank 47R, which are then collected into one exhaust pipe at their rear ends; and a rear bank muffler 29 arranged at a rear end portion of the motorcycle 10 and connected to the rear end of the exhaust pipe.

[0033] The motorcycle 10 includes a resin body cover 30 covering the vehicle body. The body cover 30 includes: a front side cover 31 covering a front portion of the engine 11, the head pipe 15, and the main frames 16; a front cowl 32 covering the head pipe 15 from the front; and an under cover 33 covering the engine 11 from below. The body cover 30 also includes a middle cover 34 covering the rear bank exhaust device 25 below the seat 14, and a rear cowl 35 covering the rear bank muffler 29 behind the seat 14.

[0034] A rear stay 36 extending obliquely downwardly and rearwardly is provided on a lower face of the rear cowl 35, and a pair of blinkers 37 projecting to the left and right are provided at the rear end of the rear stay 36. A plate-shaped license plate holder 38 extending downwardly and rearwardly is also provided at the rear end of the rear stay 36.

[0035] A rear wheel cover 39 covering the rear wheel 3 from above and the front is attached to a front portion of the swing arm 13. A front fender 40 is attached to the front fork 12.

[0036] FIG. 2 is a right side view of the periphery of the rear cowl 35. FIG. 3 is a plan view of the rear cowl 35 as seen from above. FIG. 4 is a view of the periphery of the rear cowl 35 as seen from below.

[0037] Referring to FIGS. 2 to 4, the middle cover 34 has an upwardly extending portion 34a which projects upwardly and rearwardly from the rear end of the seat

14. Air introduction holes 34b, 34b allowing communication with the inside of the body cover 30 are provided on left and right sides of the upwardly extending portion 34a.

[0038] The rear cowl 35 is provided so as to be continuous with the rear edge of the upwardly extending portion 34a, and extends to the rear end of the body cover 30.

[0039] An outline of the rear cowl 35 is formed such that, in plan view, its width increases toward the front, and gradually decreases toward the rear of the vehicle, becoming narrower toward the rear end. Specifically, the outline of the rear cowl 35 in plan view (as seen from above) includes: a front edge portion 35a extending substantially laterally straight along the rear edge of the upwardly extending portion 34a; side edge portions 35b, 35b extending rearwardly from left and right ends of the front edge portion 35a such that the distance therebetween becomes smaller toward the rear of the vehicle; and a rear edge portion 35c connecting the rear ends of the side edge portions 35b, 35b.

[0040] The outline of the rear cowl 35 is formed such that in side view, its vertical extent increases toward the front end, and gradually decreases toward the rear of the vehicle, growing smaller toward the rear end.

[0041] A top face 41 of the rear cowl 35 is curved such that its lateral centre is positioned at the highest point, and portions continuous therewith become lower toward the laterally outer sides. The top face is also formed so as to be slightly inclined downwardly and rearwardly in side view.

[0042] A bottom face 42 of the rear cowl 35 is inclined upwardly and rearwardly in side view. The bottom face 42 of the rear cowl 35 has a downwardly bulging portion 42a which bulges downwardly in the lateral centre of the bottom face 42, and has a curved shape such that the lateral centre is positioned at the lowest point, and portions continuous therewith become higher toward the laterally outer sides. The downwardly bulging portion 42a extends from the front end of the rear cowl 35 to a rear portion thereof.

[0043] A longitudinally elongate ventilating hole 43 is provided on each of the left and right side faces of a front portion of the rear cowl 35. An inwardly bulging portion 43a where a part of the rear cowl 35 bulges inward is formed in a front portion of the ventilating hole 43.

[0044] In addition, in the bottom face 42 of the rear cowl 35, longitudinally elongate exhaust holes 44, 44 are provided in bottom face portions 42b, 42b, on the left and right sides of the downwardly bulging portion 42a. The exhaust holes 44, 44 are positioned behind the ventilating holes 43. A rear opening 45 designed to expose a rear portion of the rear bank muffler 29 is provided in a rear end portion of the downwardly bulging portion 42a.

[0045] The rear bank muffler 29 is cooled by traveling wind introduced from the air introduction holes 34b, 34b and discharged from the exhaust holes 44, 44 and the rear opening 45.

[0046] Stay fixing portions 46, 46 to which the front end of the rear stay 36 is fastened are provided in a base portion of the downwardly bulging portion 42a between the rear opening 45 and the left and right exhaust holes 44, 44.

[0047] FIG. 5 is a perspective view of the rear bank exhaust device 25.

[0048] As shown in FIG. 5, the exhaust pipe 28 of the rear bank exhaust device 25 includes: paired exhaust port connecting pipes 50, 50 extending rearwardly from the cylinder heads of the cylinders of the rear bank 47R; upwardly extending pipes 51, 51 which extend upwardly and rearwardly from the rear ends of the exhaust port connecting pipes 50, 50; and a junction pipe 52 where the upwardly extending pipes 51, 51 are joined into one pipe. The exhaust pipe 28 extends rearwardly on the side of the vehicle (here, the right side) on which the front bank muffler 27 is arranged.

[0049] The upwardly extending pipes 51, 51 are not only fitted to the exhaust port connecting pipes 50, 50, but are also connected to the exhaust port connecting pipes 50, 50 by multiple springs 53 extending between the exhaust port connecting pipes 50, 50 and the upwardly extending pipes 51, 51.

[0050] The junction pipe 52 has an exhaust valve (not shown) provided therein to vary an area of its flow path, and an actuator 54 provided on its outer face to activate the exhaust valve. The rear bank muffler 29 is connected to the rear end of the junction pipe 52.

[0051] FIG. 6 is a plan view of the rear bank muffler 29 as seen from above. Here, FIG. 6 shows not only the rear bank muffler 29 but also the outline of the rear cowl 35 (as indicated by a two-dot chain line).

[0052] As shown in FIGS. 5 and 6, the rear bank muffler 29 includes a muffler main body 55 formed as a box shape that fits inside the rear cowl 35, and a tubular tail portion 56 extending rearwardly from a rear portion of the muffler main body 55.

[0053] The muffler main body 55 is configured by coupling an upper half body 59a (FIG. 8) and a lower half body (FIG. 8), obtained by dividing the box shape into upper and lower parts. FIG. 6 shows a state where the upper half body 59a is separated and removed from the muffler main body 55, for a clearer view of the internal structure.

[0054] The muffler main body 55 is configured in accordance with the shape of the rear cowl 35, and is formed such that its width is largest at the front end, and decreases toward the vehicle rear. An outline of the muffler main body 55 has, in plan view, side edge portions 55a, 55a following the side edge portions 35b, 35b of the rear cowl 35, and a rear edge portion 55b connecting the rear ends of the side edge portions 55a, 55a.

[0055] The muffler main body 55 has an exhaust pipe connecting portion 57 extending downward and forwardly on one lateral side (here, the right side) of its front face. The rear end of the junction pipe 52 is connected to the exhaust pipe connecting portion 57.

[0056] Laterally projecting muffler fixing stays 58, 58 are provided on left and right sides of a front portion of

the muffler main body 55. The inwardly bulging portions 43a (FIG. 2) of the ventilating holes 43 of the rear cowl 35 are fixed from outside with bolts to the muffler fixing stays 58, 58.

[0057] The rear stay 36 includes a plate portion 36a positioned below the tail portion 56. Left and right edge portions of the plate portion 36a extend so as to be continuous with the rear ends of the side edge portions 55a, 55a of the muffler main body 55, and the width of the plate portion 36a decreases toward the rear. The plate portion 36a is formed so as to have a larger width than the tail portion 56 of the rear bank muffler 29, and covers the tail portion 56 from below.

[0058] FIG. 7 is a cross-sectional view taken along line VII-VII of FIG. 6. FIG. 8 is a cross-sectional view of the rear bank muffler 29 as seen from the left side. FIG. 9 is a cross-sectional view of a rear portion of the rear bank muffler 29.

[0059] As shown in FIGS. 6 to 9, the muffler main body 55 includes: a top wall portion 60 extending along the top face 41 of the rear cowl 35; a bottom wall portion 61 extending obliquely upwardly and rearwardly along the bottom face 42 of the rear cowl 35; a front wall portion 62 where the exhaust pipe connecting portion 57 is provided; and a rear wall portion 63 on which the tail portion 56 is provided.

[0060] The bottom wall portion 61 has: a bottom wall bulging portion 61 a which bulges downwardly at the lateral centre along the downwardly bulging portion 42a of the bottom face 42 of the rear cowl 35; and bottom face wall portions 61 b, 61 b extending along the bottom face portions 42b, 42b of the rear cowl 35, while connecting the bottom wall bulging portion 61 a to the left and right side edges of the top wall portion 60. Since the bottom wall bulging portion 61 a and the bottom face wall portions 61 b, 61 b bulge downwardly in the form of curved surfaces, it can also be said that they constitute parts of left and right side wall portions of the muffler main body 55 in side view.

[0061] As shown in FIG. 9, the muffler main body 55 is formed such that a width W2 of the bottom wall bulging portion 61 a is smaller than a width W1 on the top wall portion 60 side, and that the width gradually decreases from the top wall portion 60 toward the bottom wall bulging portion 61 a. That is, the cross-sectional shape of the muffler main body 55 as seen from the rear is a substantially inverted (downwardly pointing) triangular shape. The substantially inverted triangular shape is generally symmetrical with respect to a lateral centreline L of the vehicle.

[0062] Additionally, the rear cowl 35 is formed so as to follow the outline of the muffler main body 55 with a predetermined gap between itself and the muffler main body 55, and its cross-sectional shape is similarly a substantially inverted triangular shape. A plate-shaped insulating member 64 is provided between the top face 41 of the rear cowl 35 and the top wall portion 60 of the muffler main body 55.

[0063] The muffler main body 55 is a multistage expansion type muffler having a plate-shaped partition 65 which partitions the inside of the muffler main body 55 into front and rear parts. A first expansion chamber C1 positioned in a rear portion of the muffler main body 55, and a second expansion chamber C2 positioned in a front portion thereof, are formed inside the muffler main body 55 by means of the partition 65. The partition 65 is provided in the front portion of the muffler main body 55, and the first expansion chamber C1 on the rear side has a larger capacity than the second expansion chamber C2 on the front side.

[0064] The rear bank muffler 29 includes: an introduction pipe 66 provided in the exhaust pipe connecting portion 57 to introduce exhaust gas into the muffler main body 55; a first communication pipe 67 (including a connecting pipe and a catalyst) for introducing exhaust gas introduced into the introduction pipe 66 to the first expansion chamber C1; and a second communication pipe 68 (connecting pipe) through which the first expansion chamber C1 communicates with the second expansion chamber C2. The rear bank muffler 29 also has: a tail pipe 69 extending rearwardly from the second expansion chamber C2, and through which the second expansion chamber C2 communicates to the outside of the rear bank muffler 29; and a tubular cover 70 (cover member) covering a rear portion of the tail pipe 69.

[0065] The bottom wall portion 61 of the muffler main body 55 is inclined upwardly and rearwardly along the bottom face 42 of the rear cowl 35, and the partition 65 is provided so as to be substantially perpendicular to the bottom wall portion 61. Accordingly, the partition 65 is tilted forwardly from the vertical, in proportion to the amount of inclination of the bottom wall portion 61.

[0066] FIG. 10 is a view of the partition 65 as seen from the vehicle rear side.

[0067] The partition 65 has a substantially inverted triangular shape in accordance with the shape of the muffler main body 55, and its periphery is coupled with the inner wall of the muffler main body 55.

[0068] The partition 65 has a supporting hole portion 65a into which the first communication pipe 67 is fitted, a supporting hole portion 65b into which the second communication pipe 68 is fitted, and a supporting hole portion 65c into which the tail pipe 69 is fitted.

[0069] Each of the supporting hole portions 65a, 65b, 65c has a rib portion formed by bending the inner edge of the hole, and the first communication pipe 67, the second communication pipe 68, and the tail pipe 69 are each supported by being fitted to the inner face of the rib portion.

[0070] The supporting hole portion 65a is arranged close to one side (here, the right side) of the centreline L in an upper portion of the partition 65. The supporting hole portion 65b is arranged on the other side (here, the left side) of the centreline L in the upper portion of the partition 65. The supporting hole portion 65c is arranged in a position overlapping with the centreline L in a lower

portion of the partition 65.

[0071] The diameters of the supporting hole portion 65b and supporting hole portion 65c are substantially the same. The supporting hole portion 65a is formed so as to have a larger diameter than the supporting hole portion 65b or supporting hole portion 65c in correspondence with the shape of the first communication pipe 67, and has a flat shape which is larger laterally than vertically.

[0072] Referring to FIGS. 6 to 10, the first communication pipe 67 is arranged close to one side (here, the right side) of the centreline L in an upper portion inside the muffler main body 55. The first communication pipe 67 is supported by being fitted in the supporting hole portion 65a in a direction substantially orthogonal to the partition 65, and extends substantially straight and obliquely upwardly and rearwardly, along the bottom wall portion 61.

[0073] The first communication pipe 67 is a pipe formed so as to be larger in its lateral direction than its vertical direction, and flared such that its cross-sectional area increases toward its rear end.

[0074] A front end 67a of the first communication pipe 67 is connected to the rear end of the introduction pipe 66 inside the second expansion chamber C2. A rear end 67b of the first communication pipe 67 is positioned in a longitudinally central portion inside the first expansion chamber C1. A catalyzer in which a catalyst material is carried by a honeycomb type support (not shown) is fitted and supported to an inner circumference of the first communication pipe 67. The catalyzer is provided along substantially the entire length of the first communication pipe 67. That is, the first communication pipe 67 is not only a pipe configured to introduce exhaust gas into the first expansion chamber C1, but is also a catalyst for purifying exhaust gas.

[0075] The second communication pipe 68 is arranged on the other side (here, the left side) of the centreline L in the upper portion inside the muffler main body 55. The second communication pipe 68 is supported by being fitted in the supporting hole portion 65b in a direction substantially orthogonal to the partition 65, and extends substantially straight, obliquely upwardly and rearwardly, along the bottom wall portion 61.

[0076] The second communication pipe 68 is a pipe having a generally constant diameter along its entire length, and having a substantially circular cross-section. A front end 68a of the second communication pipe 68 is positioned inside the second expansion chamber C2. A rear end 68b of the second communication pipe 68 extends rearwardly beyond the rear end 67b of the first communication pipe 67, and is positioned in a rear portion inside the first expansion chamber C1.

[0077] A rear portion of the second communication pipe 68 is fitted to and supported by a supporting wall 71 provided in the first expansion chamber C1.

[0078] The second communication pipe 68 is provided adjacent to the side of the first communication pipe 67 with the centreline L in between, and is arranged at substantially the same vertical position as the first communication pipe 67 inside the muffler main body 55. As shown in FIG. 7, the diameter of the second communication pipe 68 is smaller than the vertical thickness of the first communication pipe 67, and in side view, a part of the second communication pipe 68 (except for its rear end portion) overlaps with the first communication pipe 67.

[0079] The width W1 of the muffler main body 55 corresponds to its width at a vertical position where the first communication pipe 67 and the second communication pipe 68 are arranged. The width W2 of the muffler main body 55 corresponds to its width at a vertical position where the tail pipe 69 is arranged.

[0080] The tail pipe 69 is provided laterally centrally in a lower portion inside the muffler main body 55, and is arranged such that the position of its centre substantially coincides with the centreline L. In other words, the tail pipe 69 is arranged so as to be downwardly offset from the first communication pipe 67 and second communication pipe 68.

[0081] The supporting hole portions 65a, 65b, 65c of the partition 65 are penetrating positions through which the first communication pipe 67, the second communication pipe 68, and the tail pipe 69 penetrate, respectively. The supporting hole portions 65a, 65b are provided at substantially the same vertical positions, and the supporting hole portion 65c is arranged so as to be downwardly offset from the supporting hole portions 65a, 65b.

[0082] The tail pipe 69 is supported by being fitted in the supporting hole portion 65c in a direction substantially orthogonal to the partition 65, and extends substantially straight, obliquely upwardly and rearwardly, along the bottom wall portion 61.

[0083] The tail pipe 69 is a pipe having a generally constant diameter along its entire length and having a substantially circular cross section, and is formed so as to have a smaller diameter but greater full length than the second communication pipe 68. The tail pipe 69 has one end (its front end 69a) fitted to and supported by the supporting hole portion 65c.

[0084] The rear wall portion 63 of the muffler main body 55 has a perpendicular portion 63a facing the rear end 67b and rear end 68b, and an inclined portion 63b extending obliquely downwardly and forwardly from the bottom end of the perpendicular portion 63a and connecting with the bottom wall bulging portion 61 a. To be specific, the inclined portion 63b is here formed by welding, to the rear wall portion 63, a plate member disposed so as to close an opening formed in the rear wall portion 63.

[0085] The inclined portion 63b has an opening 72 (connecting portion to be connected to the inner wall) which has a diameter larger than the outer diameter of the tail pipe 69. The tail pipe 69 has a tail pipe rear portion 69c extending to the outside of the muffler main body 55 and extending rearwardly and outwardly through the opening 72.

[0086] A tubular cover 70 covering the tail pipe rear

portion 69c from its outer peripheral side is provided in the rear wall portion 63 of the muffler main body 55. The tubular cover 70 includes a tubular portion 73 having a diameter larger than the tail pipe 69, and a cap 74 closing the rear end of the tubular portion 73.

[0087] The tubular portion 73 has, at its tip end, a tapered portion 73a which is formed by cutting the tubular portion 73 at an oblique angle, and the tapered portion 73a is connected to the periphery of the opening 72. The tubular cover 70 is welded to the inclined portion 63b by a welding bead (not shown) formed on the periphery of the tapered portion 73a. The tubular portion 73 is tapered such that its diameter increases toward the rear.

[0088] The cap 74 has a rear end-supporting hole 74a fitted to the other end (the rear end 69b) of the tail pipe 69, and an annular lid member 74b which closes a gap between an outer circumference of the rear end 69b and an inner circumference of the tubular portion 73. The lid member 74b is tapered so as to extend rearwardly from the rear end 69b such that its diameter increases toward the rear.

[0089] The tail portion 56 has a double pipe structure where the tail pipe 69 is covered by the tubular cover 70. The tubular cover 70 is arranged so as to be substantially coaxial with the tail pipe 69, and a rear expansion chamber 75 communicating with the first expansion chamber C1 through the opening 72 is formed between the tubular cover 70 and tail pipe 69. This ensures a large capacity of the first expansion chamber C1.

[0090] Exhaust gas G1 introduced into the rear bank muffler 29 through the junction pipe 52 flows into the first communication pipe 67 inside the first expansion chamber C1 from the introduction pipe 66 on one side of the muffler main body 55, and after being purified by the catalyst in the first communication pipe 67, flows into the first expansion chamber C1 in the rear portion and expands. Exhaust gas G2, which has expanded in the first expansion chamber C1, turns around, flows into the second expansion chamber C2 through the second communication pipe 68, and expands in the second expansion chamber C2 in the front portion. Additionally, a part of the exhaust gas G2 flows into the rear expansion chamber 75 and expands. Since the rear end 67b of the first communication pipe 67 faces the rear expansion chamber 75, exhaust gas flows into the rear expansion chamber 75 easily, and the rear expansion chamber 75 can be used effectively as an expansion chamber. Exhaust gas G3, having expanded in the second expansion chamber C2, turns around, passes through the tail pipe 69, and is discharged to the outside from the rear end 69b.

[0091] In this case, while the first communication pipe 67 is a pipe for directly introducing exhaust gas from the exhaust pipe 28 to the first expansion chamber C1 in the rear portion, it can also be said that the first communication pipe is a connecting pipe supported by the partition 65 to connect the first expansion chamber C1 and second expansion chamber C2.

[0092] In this embodiment, inside the muffler main body 55 (which is formed into a substantially inverted, downwardly projecting triangular shape), the first communication pipe 67 and second communication pipe 68 are provided side by side in the upper portion, and the tail pipe 69 is provided so as to be downwardly offset from the first communication pipe 67 and second communication pipe 68. Accordingly, the first communication pipe 67 and second communication pipe 68 can be prevented from interfering with the tail pipe 69, so that the tail pipe 69 can be formed as long as possible to allow the engine 11 to have a desired engine characteristic. Moreover, since the first expansion chamber C1 is provided in the rear portion of the muffler main body 55 and the second expansion chamber C2 in the front portion thereof, the tail pipe 69 can extend from the front portion to the rear portion of the muffler main body 55, thus achieving a long tail pipe 69.

[0093] In addition, since the tail pipe 69 is downwardly offset from the first communication pipe 67 and second communication pipe 68 at the lateral centre, the muffler main body 55 can be formed into the substantially inverted triangular shape, and the rear cowl 35 covering the muffler main body 55 can also be formed into the substantially inverted triangular shape having a small air resistance. Hence, while adopting the configuration where the tail pipe 69 can be elongated, air resistance of the motorcycle 10 can be reduced. Further, since traveling wind flows smoothly along the bottom face 42 of the rear cowl 35, hot air can be discharged efficiently from the exhaust holes 44, 44.

[0094] Since the first communication pipe 67 as the catalyst is formed flat (larger laterally than vertically), the capacity of the catalyst can be ensured while a space can be secured below the first communication pipe 67. Thus, the first communication pipe 67 does not interfere with the tail pipe 69, so that the tail pipe 69 can be arranged below the first communication pipe 67 to elongate the first communication pipe 67. Also, since the catalyst is provided in the muffler main body 55, there is no need to provide a catalyst in the exhaust pipe 28, whereby exhaust gas can pass through the exhaust pipe 28 at a higher flow velocity, and exhaust efficiency can be enhanced.

[0095] As shown in FIG. 2, in side view, the tail portion 56 has its bottom face extending rearwardly so as to be continuous with the bottom face of the downwardly bulging portion 42a, and its rear end positioned slightly forwardly of the rear edge portion 35c of the rear cowl 35. Hence, the tail portion 56 appears as though it is integrated with the rear cowl 35, which improves the appearance.

[0096] Moreover, since the stay fixing portions 46, 46 are provided in the base portion of the downwardly bulging portion 42a on laterally inner sides of the exhaust holes 44, 44, the stay fixing portions 46, 46 do not interfere with the exhaust holes 44, 44, and thus the rear bank muffler 29 can be cooled efficiently.

[0097] As has been described, according to the pre-

ferred embodiment, the outlines of the rear bank muffler 29 and the rear cowl 35 covering the rear bank muffler 29 are each formed such that the width decreases toward the rear of the vehicle rear; the tail pipe 69, first communication pipe 67, and second communication pipe 68 are provided so as to penetrate the partition 65; and the supporting hole portion 65c (being the position where the tail pipe 69 penetrates the partition 65) and the supporting hole portions 65a, 65b (being the positions where the first communication pipe 67 and second communication pipe 68 penetrate the partition 65) are vertically offset from each other. As a result, the penetrating positions of the first communication pipe 67 and second communication pipe 68 do not interfere with that of the tail pipe 69, whereby the tail pipe 69 can be elongated even when the rear bank muffler 29 and rear cowl 35 are formed such that their widths decrease toward the rear of the vehicle. Additionally, the width of the rear bank muffler 29 can be reduced.

[0098] The front end 69a of the tail pipe 69 is arranged in the second expansion chamber C2 (the frontmost among the expansion chambers of the rear bank muffler 29), and the rear end 69b of the tail pipe 69 is opened to outside air from the rear portion of the rear bank muffler 29. Hence, the tail pipe 69 can extend from the frontmost second expansion chamber C2, so that the tail pipe 69 can be elongated.

[0099] The rear bank muffler 29 is partitioned into the first expansion chamber C1 in the rear portion and the second expansion chamber C2 in the front portion; exhaust gas introduced into the rear bank muffler 29 from the exhaust pipe 28 flows into the second expansion chamber C2 through the first communication pipe 67 and second communication pipe 68; the front end 69a of the tail pipe 69 is arranged in the second expansion chamber C2; and the rear end 69b thereof is opened to outside air from the rear portion of the rear bank muffler 29. Thus, it is possible to elongate the tail pipe 69 by extending it from the second expansion chamber C2 in the front portion to the rear portion of the rear bank muffler 29.

[0100] The first communication pipe 67 as the catalyst accommodated inside the rear bank muffler 29 is supported by the partition 65, and the first communication pipe 67 and second communication pipe 68 are arranged at substantially the same vertical height. For this reason, although the first communication pipe 67 functioning as the catalyst is accommodated inside the rear bank muffler 29 in this configuration, the catalyst can be prevented from interfering with the tail pipe 69, and thus the tail pipe 69 can be elongated.

[0101] In addition, since the first communication pipe 67 as the catalyst is formed into a flat shape, the vertical extent of the first communication pipe 67 can be reduced while ensuring capacity of the catalyst. Consequently, the first communication pipe 67 does not interfere with the tail pipe 69, so that the tail pipe 69 can be elongated.

[0102] Furthermore, the outline of the rear bank muffler 29 is formed such that the width W2 in the vertical position where the tail pipe 69 is arranged is smaller than the width W1 in the vertical position where the first communication pipe 67 and second communication pipe 68 are arranged. Hence, the width of the portion of the rear cowl 35 covering the vicinity of the tail pipe 69 can be reduced, whereby the rear bank muffler 29 and the rear cowl 35 can be made smaller.

[0103] Moreover, there is provided the tubular cover 70 covering the tail pipe rear portion 69c from radially outside; the rear ends 67b, 68b of the first communication pipe 67 and second communication pipe 68 face the inner wall of the rear wall portion 63 of the rear bank muffler 29; and the space between the tubular cover 70 and tail pipe rear portion 69c communicates with the first expansion chamber C1 through the opening 72 being the connecting portion between the tubular cover 70 and rear wall portion 63. With this, since the space between the tubular cover 70 and tail pipe rear portion 69c can be used as the rear expansion chamber 75, the size of the rear bank muffler 29 can be reduced while the capacity of the first expansion chamber C1 can be ensured.

[0104] Additionally, the tubular cover 70 is connected to the muffler main body 55 by welding, and the tapered portion 73a being the connecting portion is tapered in side view. Hence, an area of the welding portion of the tubular cover 70 can be enlarged, and rigidity can be enhanced.

[0105] It should be noted that the above-described embodiment is only one aspect to which the present invention is applied, and the present invention is not limited to the above embodiment.

[0106] Although the above embodiment has been described with the first communication pipe 67 and second communication pipe 68 as examples of connecting pipes, the present invention is not limited to this. It is sufficient for the tail pipe 69 to be vertically offset at least from the second communication pipe 68. In this case, exhaust gas may be introduced into the first expansion chamber C1 through a pipe provided in a position different from that of the first communication pipe 67, for example.

[0107] Although in the description of the above embodiment the catalyzer is provided in the first communication pipe 67, the present invention is not limited to this. The first communication pipe 67 may be a simple pipe not provided with the catalyzer.

[0108] Although the above embodiment has been described using the V4 engine 11 as an example, the present invention is not limited to this. The invention is applicable regardless of whether the engine is a single cylinder, parallel, horizontally opposed, or other type.

Claims

1. An exhaust structure of a vehicle comprising:

an engine (11);
an exhaust device (25) of the engine (11); and

a rear cowl (35) covering a vehicle rear portion, said exhaust device (25) including an exhaust pipe (28) and a muffler (29) connected to a rear portion of the exhaust pipe (28); the muffler (29) including a plurality of expansion chambers (C1, C2) partitioned by a partition (65), first and second connecting pipes (67, 68) connecting the plurality of expansion chambers (C1, C2), and a tail pipe (69) configured to discharge exhaust gas from said muffler (29); said muffler (29) being covered by said rear cowl (35), wherein:

outlines of said muffler (29) and said rear cowl (35) are each formed such that the lateral width decreases toward the vehicle rear;
said tail pipe (69) and said first and second connecting pipes (67, 68) are provided so as to penetrate said partition (65); and
positions where said tail pipe (69) and said first and second connecting pipes (67, 68) penetrate said partition (65) are vertically offset from each other.

2. The exhaust structure of a vehicle according to claim 1, wherein:

one end (69a) of said tail pipe (69) is arranged in a frontmost expansion chamber (C2) of the said expansion chambers of said muffler (29); and
the other end (69b) of said tail pipe (69) extends from a rear portion of said muffler (29) and is open to outside air.

3. The exhaust structure of a vehicle according to any one of claims 1 and 2, wherein:

said muffler (29) is partitioned into a first expansion chamber (C1) in a rear portion and a second expansion chamber (C2) in a front portion;
exhaust gas introduced into said muffler (29) from said exhaust pipe (28) flows into said second expansion chamber (C2) through said first and second connecting pipes (67, 68);
the one end (69a) of said tail pipe (69) is arranged in said second expansion chamber (C2); and the other end (69b) of said tail pipe (69) extends from a rear portion of said muffler (29) and is open to outside air.

4. The exhaust structure of a vehicle according to any preceding claim, wherein:

said first connecting pipe (67) accommodated inside said muffler (29) is supported by said partition; and
said first and second connecting pipes (67, 68) are arranged at substantially the same vertical height.

5. The exhaust structure of a vehicle according to claim 4, wherein
said first connecting pipe (67) is formed into a flat shape.

6. The exhaust structure of a vehicle according to any one of claims 4 and 5, wherein
an outline of said muffler (29) is formed such that a width (W2) at a vertical position where said tail pipe (69) is arranged is smaller than a width (W1) at a vertical position where said first and second connecting pipes (67, 68) are arranged.

7. The exhaust structure of a vehicle according to any one of claims 1 to 6, wherein
a tubular cover member (70) covers a part of said tail pipe (69) from outside in the radial direction;
ends of said first and second connecting pipes (67, 68) face an inner wall of said muffler (29); and
a space between said cover member (70) and said tail pipe (69) communicates with said first expansion chamber (C1) through a connecting portion (72) between said cover member (70) and said inner wall.

8. The exhaust structure of a vehicle according to claim 7, wherein:

said cover member (70) is connected to said muffler (29) by welding; and
a connecting portion (73a) thereof is tapered in side view.

9. The exhaust structure of a vehicle according to any of claims 4 to 8, wherein:

a catalyst is accommodated in the first connecting pipe (67).

Fig.1

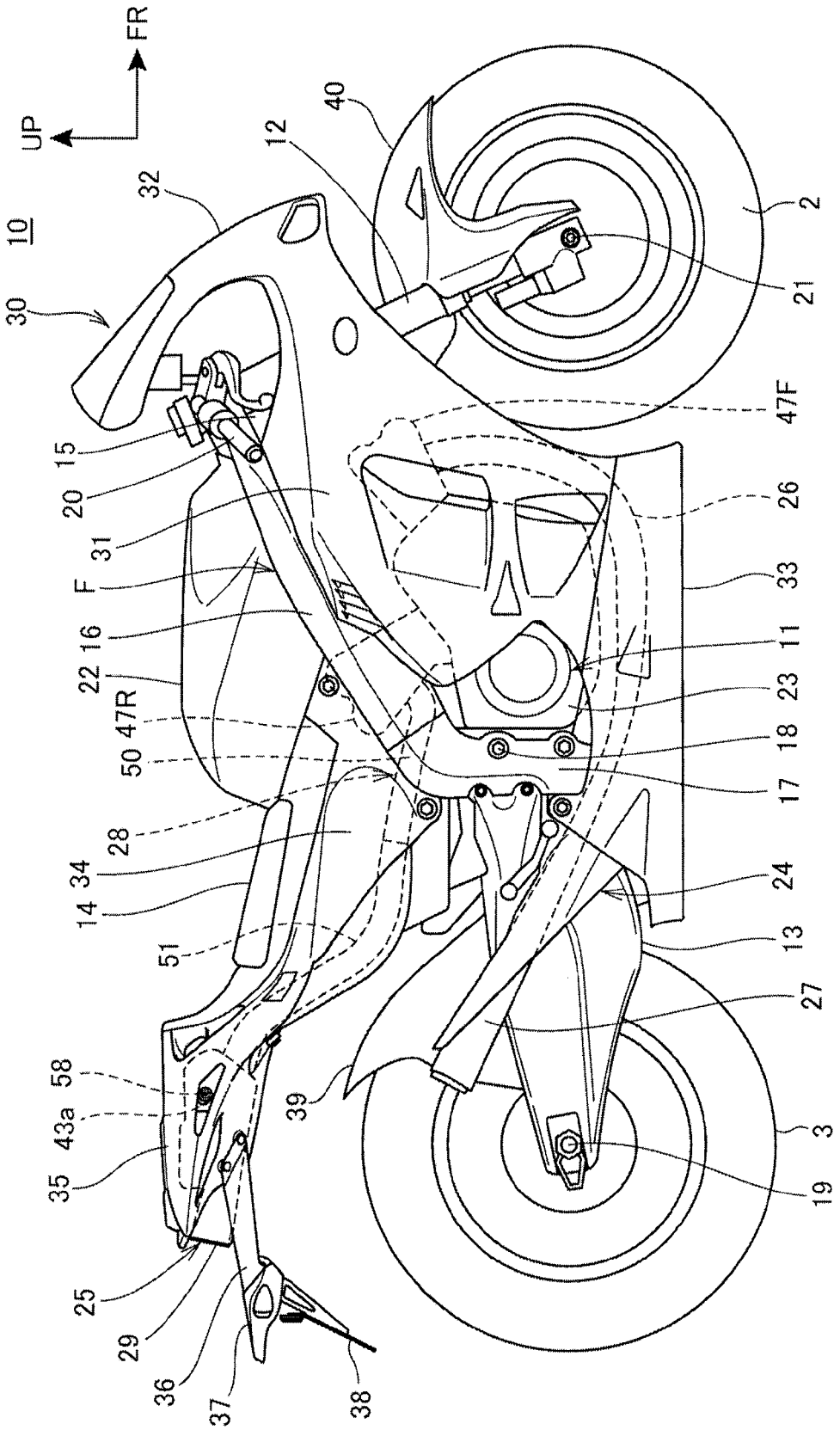
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Fig.2

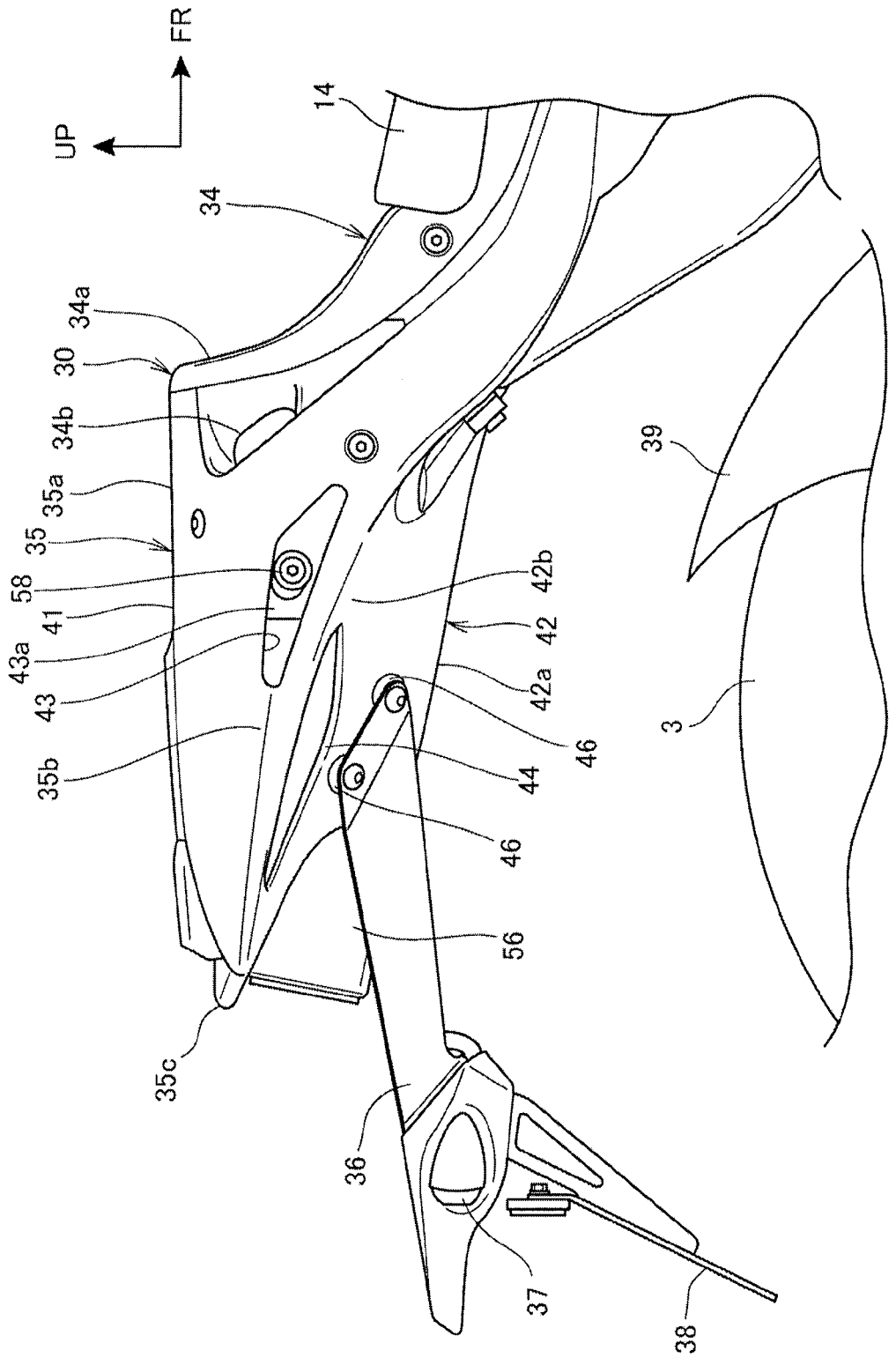
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Fig.3

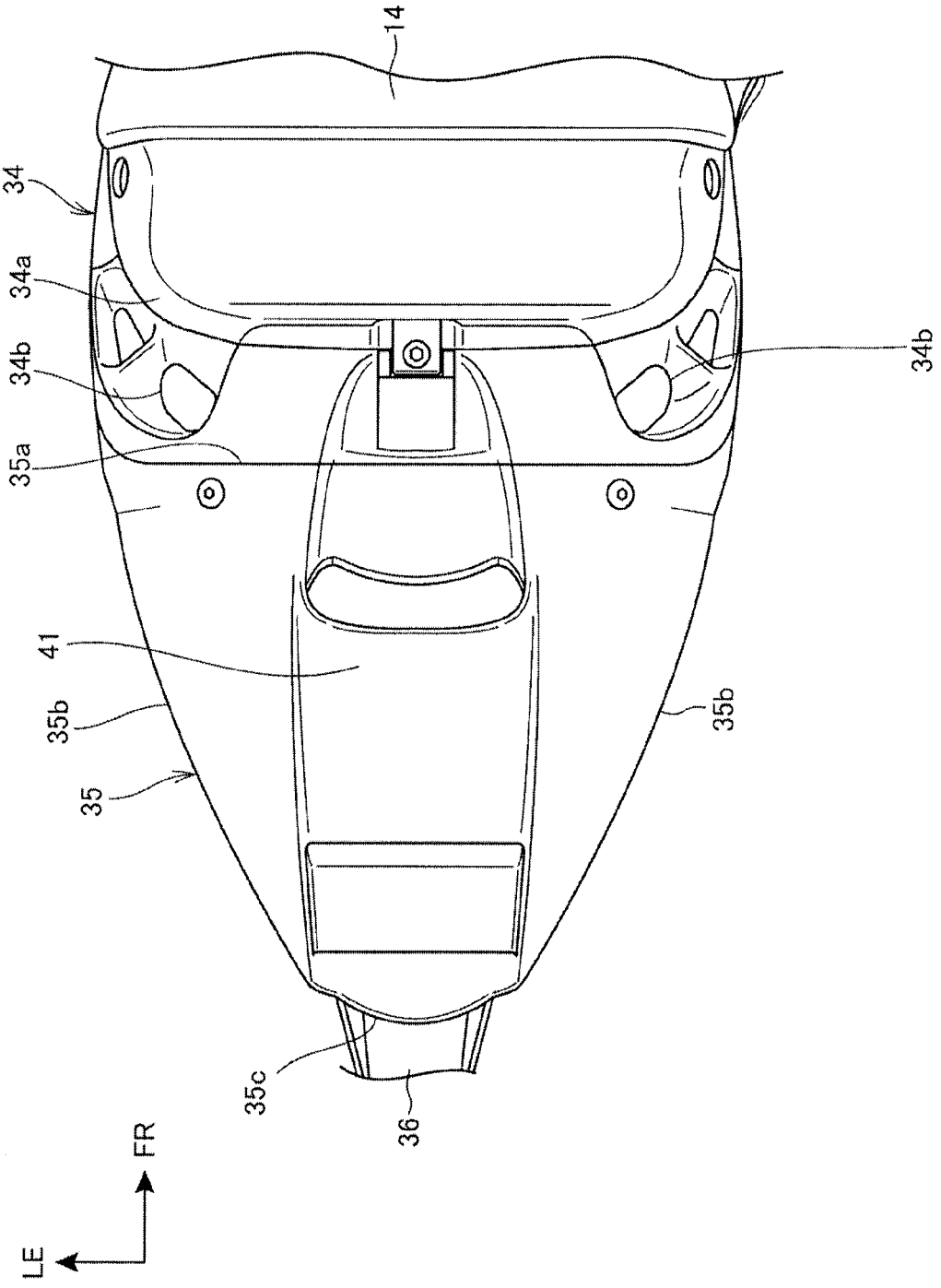

Fig.4

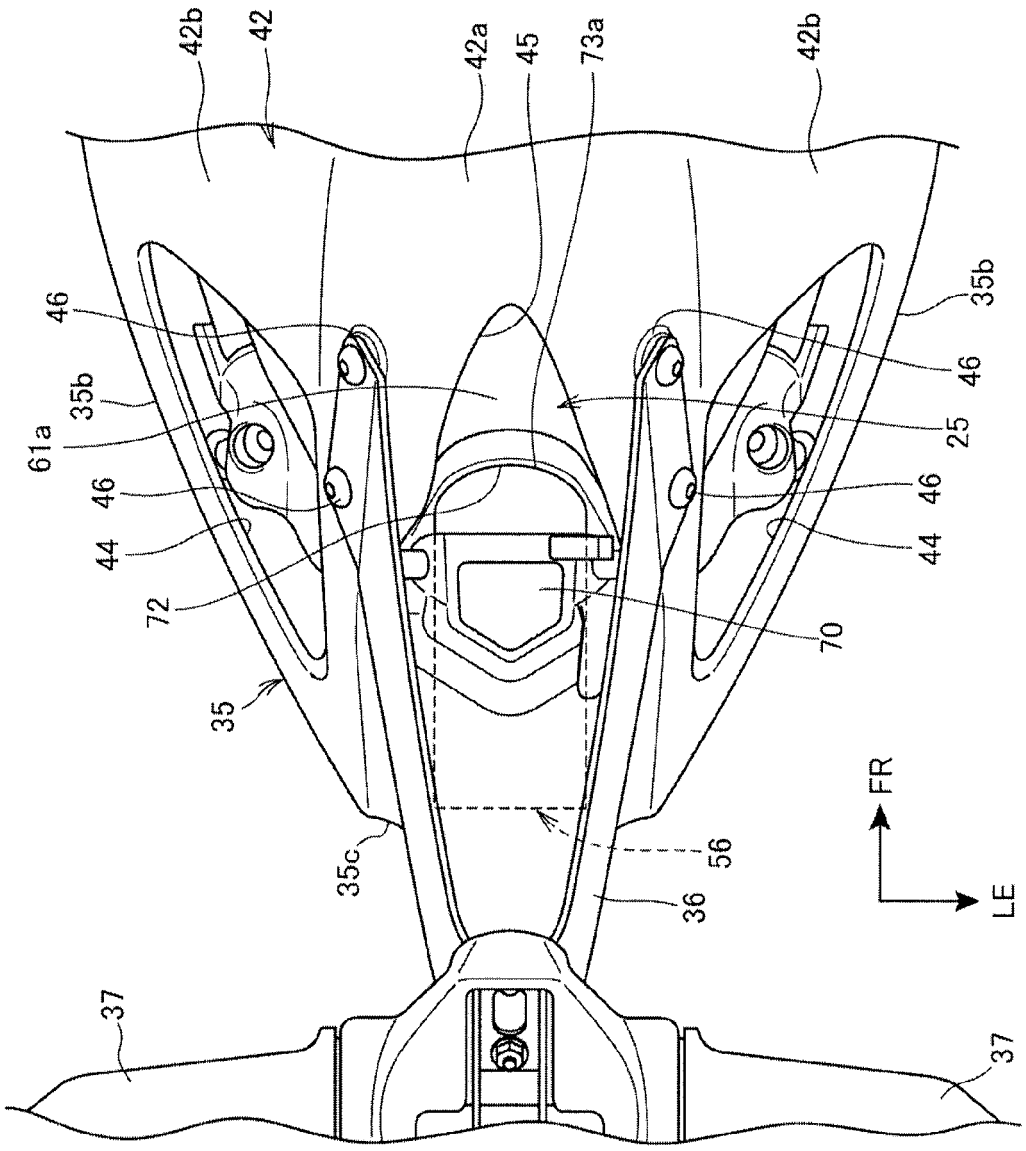
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Fig.5

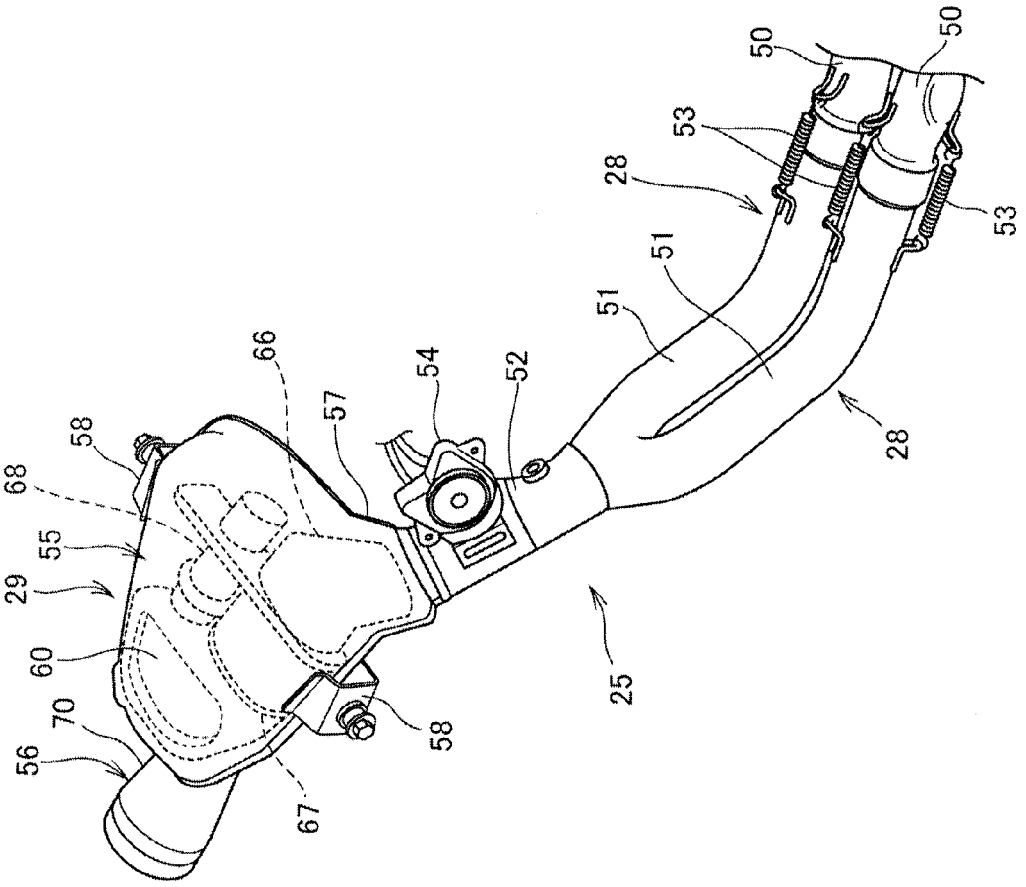

Fig.6

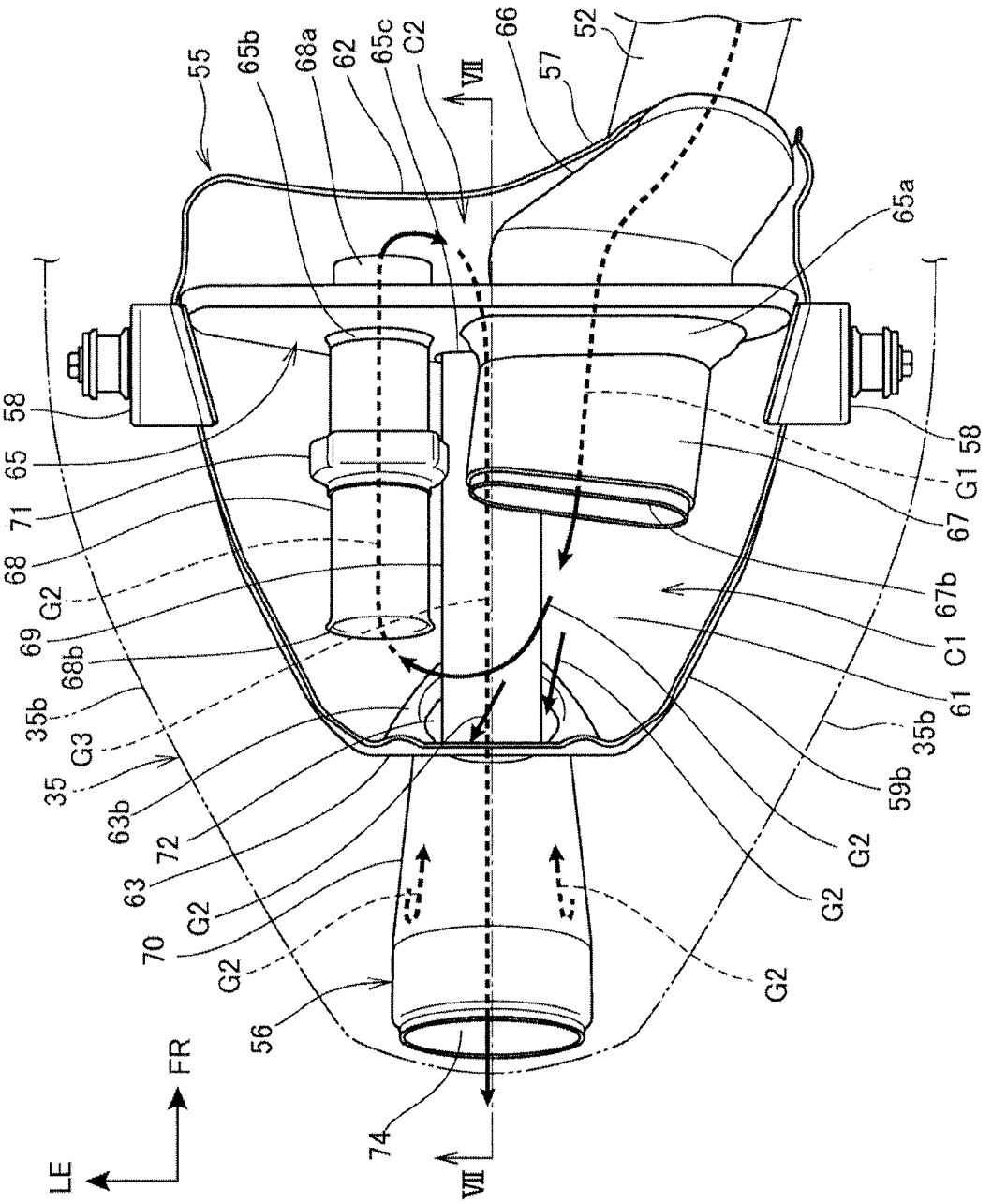
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Fig.7

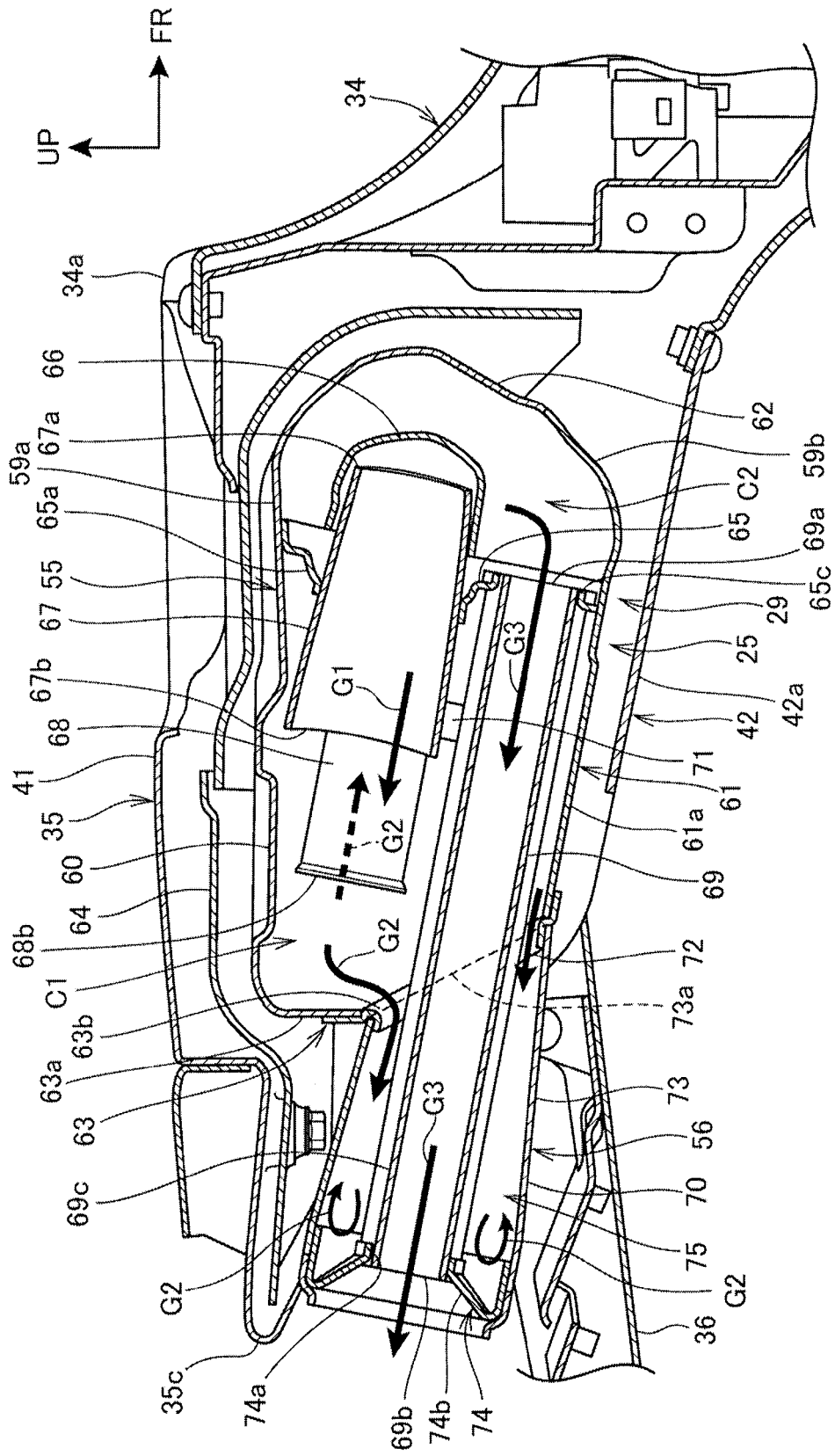
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Fig.8

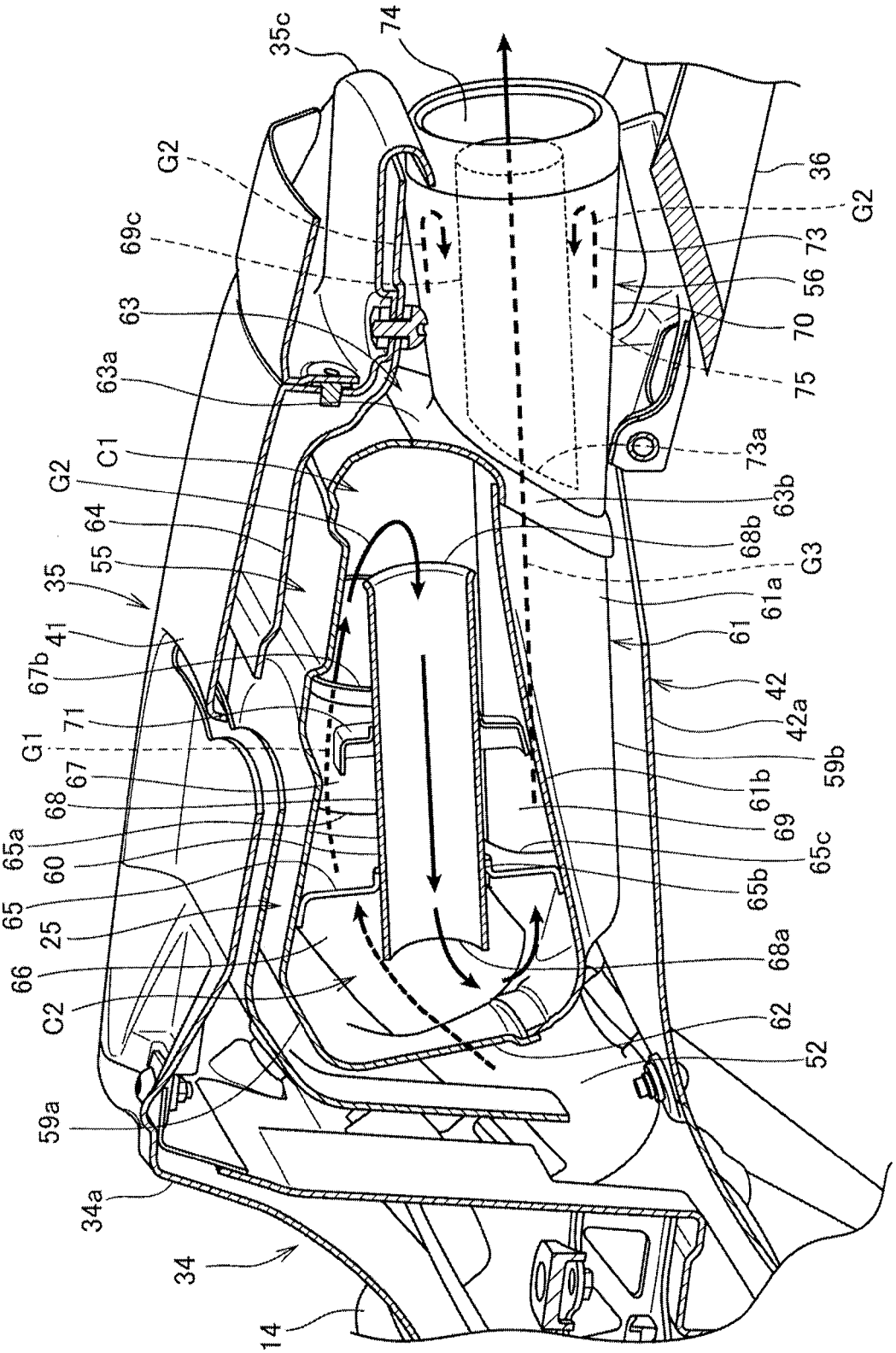
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Fig.9

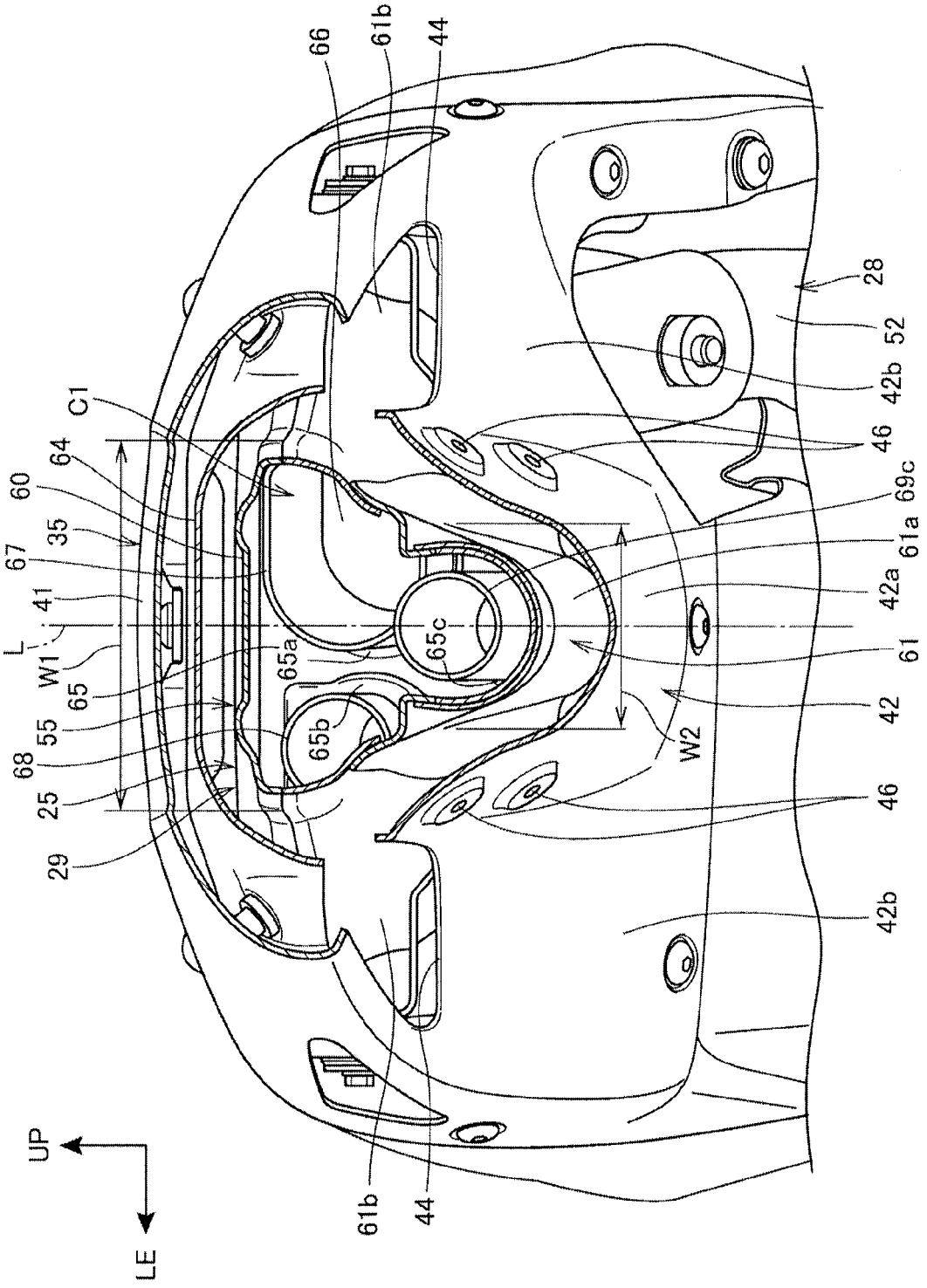
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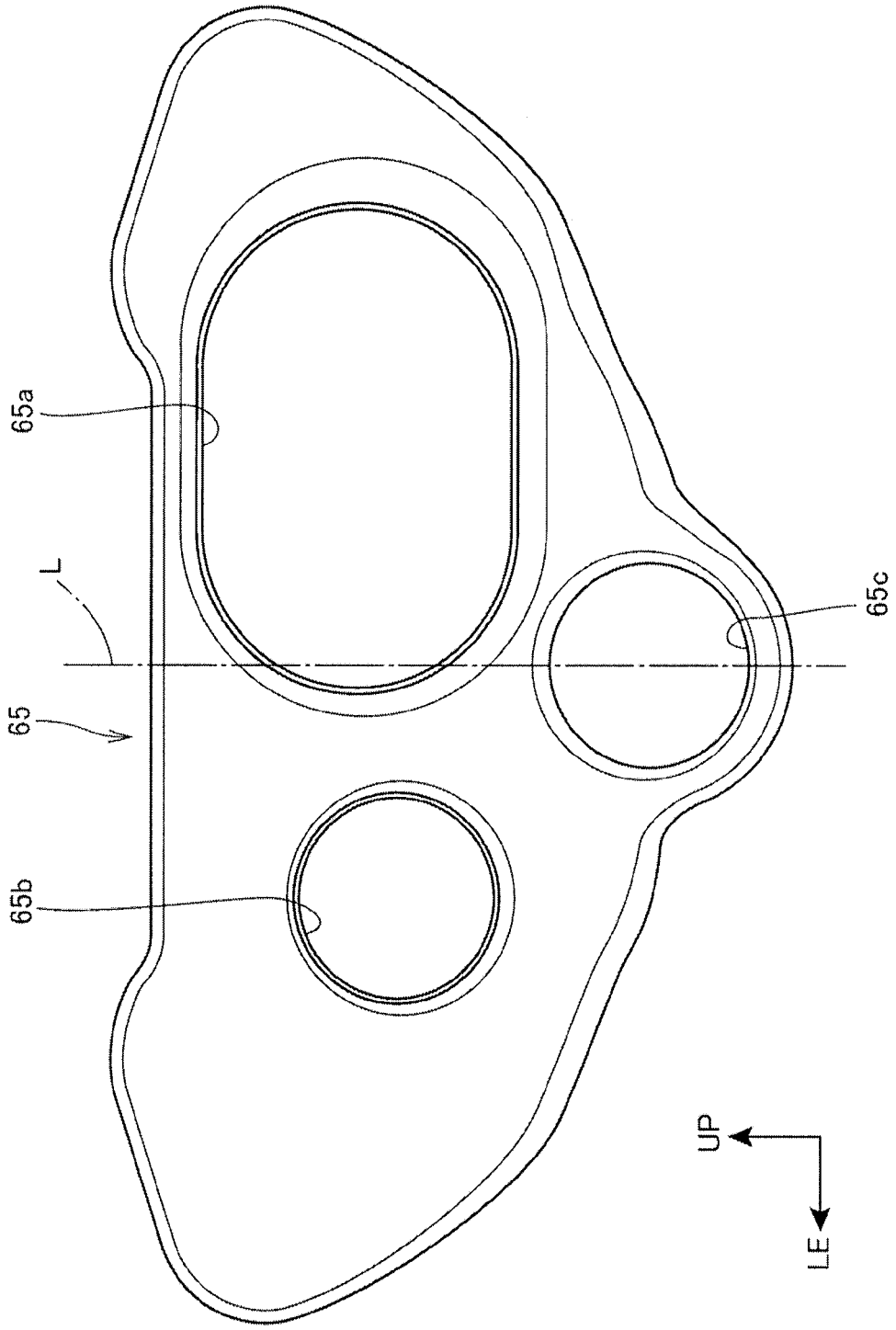
Fig.10



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EUROPEAN SEARCH REPORT

Application Number
EP 14 17 7403

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 448 728 A1 (HONDA MOTOR CO LTD [JP]) 2 October 1991 (1991-10-02) * the whole document * * figures 1,5 *	1-9	INV. F01N1/08
A	WO 03/104075 A1 (BRUMBY CORP LTD [GB]; SUTER ESKIL [CH]; SUTER SIMON [CH]; GIUSSANI ALE) 18 December 2003 (2003-12-18) * the whole document * * figures 18, 19 *	1-9	
A	WO 2013/035566 A1 (HONDA MOTOR CO LTD [JP]; YUTAKA GIKEN CO LTD [JP]; MUKAI TERUAKI [JP];) 14 March 2013 (2013-03-14) * the whole document * * figures 2-4 *	1-9	
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F01N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	1 December 2014	Wagner, A

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