



(11)

EP 3 543 503 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.09.2019 Bulletin 2019/39

(51) Int Cl.:
F02B 61/02 ^(2006.01) **F02B 77/08** ^(2006.01)

(21) Application number: **19162744.7**

(22) Date of filing: **14.03.2019**

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

(71) Applicant: **Honda Motor Co., Ltd.**
Tokyo 107-8556 (JP)

(72) Inventor: **Takiguchi, Chikashi**
Saitama, 351-0193 (JP)

(74) Representative: **Beder, Jens**
Mitscherlich PartmbB
Patent- und Rechtsanwälte
Sonnenstraße 33
80331 München (DE)

(30) Priority: **23.03.2018 JP 2018056997**

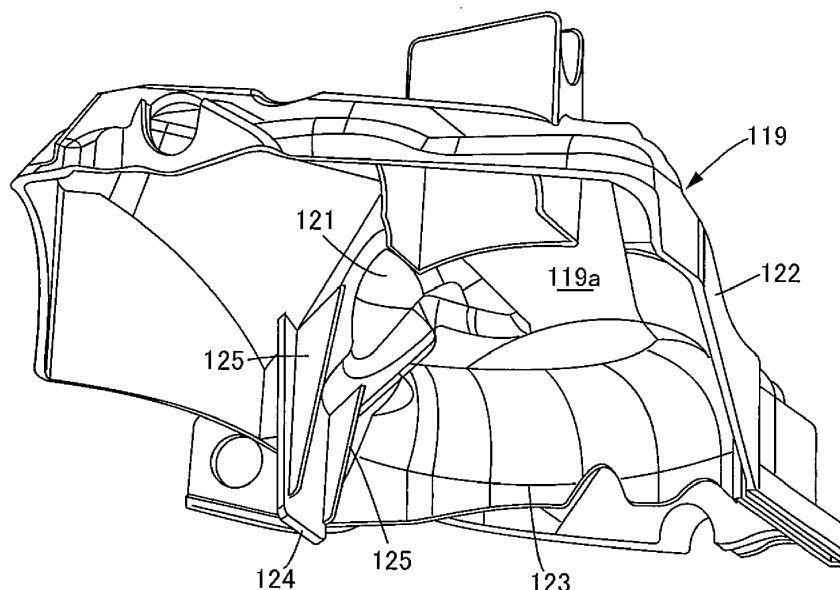
(54) **SWING UNIT-TYPE POWER UNIT**

(57) [SUBJECT] To provide a swing unit-type power unit that achieves a layout of a detection sensor less susceptible to a reciprocation motion of a piston in detecting a crank angle.

[MEANS FOR SOLUTION] The swing-type power unit includes a centrifugal fan 86 that is secured to one end of a crankshaft and rotates about a rotation axis Rx of the crankshaft, a crankcase 28 that houses the centrifugal fan 86 and includes an opening 116 that flows

out an airflow of the centrifugal fan 86 in parallel with the rotation axis Rx, a to-be-detected object that is secured to the crankshaft and rotates integrally with the crankshaft, and a detection sensor 113 that is disposed biased to a front end or a rear end of the opening 116 in a peripheral direction about the rotation axis Rx in side view, is caused to face a trajectory of the to-be-detected object, and generates a pulse signal corresponding to a motion of the to-be-detected object.

FIG.8



Description**[TECHNICAL FIELD]**

[0001] The present invention relates to a swing unit-type power unit that includes a crankshaft, a centrifugal fan that is secured to one end of the crankshaft and rotates about a rotation axis of the crankshaft, and a crankcase that houses the centrifugal fan and has an opening that flows out an airflow of the centrifugal fan in parallel with the rotation axis.

[BACKGROUND ART]

[0002] Patent Document 1 discloses a control device of an internal combustion engine configured to have a single cylinder. The control device detects a misfire caused by an over-lean air/fuel ratio in the single cylinder internal combustion engine. In the control device, it is determined whether a variation amount of an angular speed of a crankshaft exceeds a predetermined threshold value or not between preceding and subsequent combustion cycles. During preliminarily set cycle number, the control device presumes the misfire in the internal combustion engine when a count of the variation amount exceeding the threshold value reaches a specific count.

[0003] Patent Document 2 discloses a ring gear (to-be-detected object) mounted on a crankshaft of an internal combustion engine in determining a misfire. The ring gear has an outer peripheral surface to which a distal end of an eddy current type micro displacement sensor (detection sensor) faces. The micro displacement sensor detects a crank angle. A positional relationship between a crank chamber of the internal combustion engine and the micro displacement sensor is not disclosed.

[PRIOR ART DOCUMENT]**[PATENT DOCUMENT]****[0004]**

[Patent Document 1] Japanese Patent Application Laid-open No. 2014-199040

[Patent Document 2] Japanese Patent Application Laid-open No. 2002-371906

[SUMMARY OF THE INVENTION]**[PROBLEM TO BE SOLVED BY THE INVENTION]**

[0005] In the internal combustion engine, a piston makes a linear reciprocation motion along a cylinder axis, and thus, the internal combustion engine vibrates. In a single cylinder internal combustion engine in particular, amplitude of the vibration along the cylinder axis is large. Accordingly, the detection sensor is preferred to be disposed to have a layout in which the detection sensor

intersects with the cylinder axis at a crossing angle as close to 90 degrees as possible about the crankshaft. Meanwhile, for example, in a water-cooled power unit of a swing unit type, an opening to discharge a cooling air of a radiator is positioned at a position where the opening intersects with the cylinder axis at a crossing angle of 90 degrees about the crankshaft in some cases.

[0006] The present invention has been made in view of the actual situation described above, and it is an objective of the present invention to provide a swing unit-type power unit that achieves a layout of a detection sensor less susceptible to a reciprocation motion of a piston in detecting a crank angle.

[MEANS TO SOLVE THE PROBLEMS]

[0007] In order to achieve the object, according to a first feature of the present invention, there is provided a swing unit-type power unit comprising: a crankshaft; a centrifugal fan secured to one end of the crankshaft and rotating about a rotation axis of the crankshaft; and a crankcase that houses the centrifugal fan, the crankcase having an opening that flows out an airflow of the centrifugal fan in parallel with the rotation axis, characterized in that the power unit further comprises: a to-be-detected object secured to the crankshaft and rotating integrally with the crankshaft; and a detection sensor disposed biased to a front end or a rear end of the opening in a peripheral direction about the rotation axis as seen in a side view, the detection sensor facing a trajectory of the to-be-detected object and generating a pulse signal corresponding to a motion of the to-be-detected object.

[0008] According to a second feature, in addition to the first feature, the detection sensor expands in a direction displaced from the opening in a peripheral direction about the rotation axis as seen in the side view and is disposed on an outer surface of the crankcase.

[0009] According to a third feature, in addition to the first feature or the second feature, there is provided the swing unit-type power unit, further comprising: a cylinder block combined to the crankcase to be positioned ahead of the crankcase, the cylinder block guiding a linear reciprocation motion of a piston coupled to the crankshaft with a connecting rod in a vehicle front-rear direction; and a rear wheel disposed at a rear of the crankcase and including an axle in parallel with the rotation axis of the crankshaft.

[0010] According to a fourth feature, in addition to the third feature, the crankcase includes an oil pan underneath the crankshaft, and the detection sensor is disposed above the crankshaft.

[0011] According to a fifth feature, in addition to the fourth feature, there is provided the swing unit-type power unit, further comprising a radiator positioned on the rotation axis, which is extended from one end of the crankshaft, and coupled to the crankcase, the radiator exchanging heat from a cooling water flowing through at least the cylinder block to an external air.

[0012] According to a sixth feature, in addition to the fifth feature, there is provided the swing unit-type power unit, further comprising: a first air guide wall that extends in parallel with the rotation axis to partition a space coupled to the opening; a second air guide wall continuous from the first air guide wall and guiding an airflow flowing out of the opening toward the rear wheel along a curved surface; and an air guide member secured to an outer surface of the crankcase to cover over the detection sensor.

[0013] According to a seventh feature, in addition to the sixth feature, the air guide member is integrally formed with a blocking plate extending downward toward the crankcase from the air guide member at a rear of the detection sensor.

[0014] According to an eighth feature, in addition to the seventh feature, the air guide member includes a protruding wall that houses an upper end of the detection sensor by projecting outward from a top panel of the air guide member, the top panel facing the outer surface of the crankcase.

[EFFECTS OF THE INVENTION]

[0015] With the first feature of the present invention, the to-be-detected object rotates integrally with the crankshaft corresponding to the rotation of the crankshaft. The detection sensor generates the pulse signal corresponding to the motion of the to-be-detected object. The airflow generated by the rotation of the centrifugal fan flows out of the opening along the outer surface of the crankcase in parallel with the rotation axis of the crankshaft. The detection sensor is disposed biased to the front end or the rear end of the opening in side view, and therefore, an interference between the detection sensor and the airflow flowing out of the opening is reduced. Accordingly, even though the opening is positioned at a position that intersects with a cylinder axis at a crossing angle of 90 degrees about the crankshaft, the detection sensor can be disposed to have a layout in which the detection sensor intersects with the cylinder axis at a crossing angle as close to 90 degrees as possible about the crankshaft without blocking a distribution of the airflow. In detecting the crank angle, the effect of vibration can be reduced as much as possible.

[0016] With the second feature of the present invention, since the detection sensor is disposed without interfering with the airflow flowing out of the opening, a satisfactory airflow distribution can be achieved.

[0017] With the third feature of the present invention, the cylinder block guides the linear reciprocation motion of the piston along the cylinder axis extending in the vehicle front-rear direction. Since the rear wheel is disposed at the rear of the crankcase, even though the detection sensor is disposed to have the layout in which the detection sensor intersects with the cylinder axis at the crossing angle as close to 90 degrees as possible about the crankshaft, an interference between the detection sensor

and the rear wheel can be avoided. The crankcase can approach the rear wheel as close as possible. The power unit can be compactly configured.

[0018] With the fourth feature of the present invention, when the detection sensor is disposed to have the layout in which the detection sensor intersects with the cylinder axis at the crossing angle as close to 90 degrees as possible about the crankshaft, the detection sensor can be disposed above the crankshaft. As a result, the detection sensor can be caused to recede from the oil pan. The effect of the oil inside the crankcase to the detection sensor can be reduced.

[0019] With the fifth feature of the present invention, when the centrifugal fan rotates, the airflow of the external air moving toward the centrifugal fan along the rotation axis of the crankshaft is generated. The airflow of the external air passes through the radiator to deprive heat from the cooling water of the radiator. The airflow after the heat exchange is discharged outside the crankcase from the opening.

[0020] With the sixth feature of the present invention, the airflow that flows out of the opening in parallel with the rotation axis of the crankshaft is introduced toward the rear wheel guided by the first air guide wall and the second air guide wall. Since the air guide member covers over the detection sensor, the detection sensor can be protected from stones and water splashed from a road surface outside the crankcase. Moreover, since an exposure of the detection sensor is avoided outside the crankcase, designability of the power unit can be properly maintained.

[0021] With the seventh feature of the present invention, the detection sensor can be protected from stones and water swirled up to the rear wheel. In particular, since the blocking plate extends downward from the air guide member above the detection sensor following the rotation direction of the rear wheel, the detection sensor can be protected from the stone and water.

[0022] With the eighth feature of the present invention, regardless of a projection height of the detection sensor projecting from the outer surface of the crankcase, the top panel of the air guide member can be positioned close to an outer surface of the crankcase. Therefore, increase in an air resistance of a travelling vehicle can be avoided, and a distribution of the airflow flowing out of the opening of the crankcase can be properly maintained inside the air guide member.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0023]

FIG. 1 is a side view schematically illustrating a scooter type two-wheeled motor vehicle according to one embodiment of a saddle riding vehicle.

FIG. 2 is a horizontal cross-sectional view of a power unit taken along a line 2-2 in FIG. 1.

FIG. 3 is an enlarged side view of an engine main

body schematically illustrating a configuration of a water cooling system including a water pump and a radiator.

FIG. 4 is an enlarged cross-sectional view of an internal combustion engine observed on a cut surface including a rotation axis of a crankshaft.

FIG. 5 is an enlarged cross-sectional view of an internal combustion engine observed on a cut surface perpendicular to the rotation axis of the crankshaft.

FIG. 6 is an enlarged cross-sectional view of an electric generator observed on a cut surface including the rotation axis of the crankshaft.

FIG. 7 is a bottom view of an air guide member.

FIG. 8 is an enlarged perspective view of the air guide member.

FIG. 9 is an enlarged cross-sectional view schematically illustrating a centrifugal fan observed on a cut surface perpendicular to the rotation axis of the crankshaft.

[MODE FOR CARRYING OUT THE INVENTION]

[0024] The following describes one embodiment of the present invention with reference to the attached drawings. It should be noted that the following description defines respective directions of front and rear, up and down, and right and left as directions viewed from an occupant riding on a two-wheeled motor vehicle.

[0025] FIG. 1 schematically illustrates a scooter type two-wheeled motor vehicle according to one embodiment of a saddle riding vehicle. A two-wheeled motor vehicle 11 includes a body frame 12 and a vehicle body cover 13 mounted on the body frame 12. The body frame 12 includes a head tube 14, a pair of right and left main frames 15, a cross pipe 16, and a rear frame 17. The main frames 15 head downward from the head tube 14 at a rear of a front wheel WF, and curve at lower ends to extend rearward in parallel with the ground. The cross pipe 16 is combined to rear portions of the main frames 15 and extends in a vehicle width direction. The rear frame 17 is continuous with the main frames 15 to rise in a front of a rear wheel WR and curves at an upper end to gradually extend upward to the rear in a vehicle front-rear direction. The head tube 14 steerably supports a front fork 18 that supports the front wheel WF rotatably about an axle shaft and a rod-shaped steering handlebar 19.

[0026] The vehicle body cover 13 includes an occupant seat 21 above the rear frame 17. The vehicle body cover 13 includes a front cover 22, a leg shield 23, and a step floor 24. The front cover 22 covers the head tube 14 from the front. The leg shield 23 is continuous with the front cover 22. The step floor 24 is continuous with a lower end of the leg shield 23 to be disposed above the main frames 15 between the occupant seat 21 and the front wheel WF.

[0027] In a space underneath the rear frame 17, a swing unit-type power unit 25 is disposed. The power

unit 25 includes an internal combustion engine 26 and a transmission device 27. The internal combustion engine 26 has a water-cooled single-cylinder. The transmission device 27 is coupled to the internal combustion engine 26 and the rear wheel WR to transmit an output of the internal combustion engine 26 to the rear wheel WR. An axle shaft of the rear wheel WR is rotatably supported at both rear ends of the power unit 25 about a horizontal axis.

[0028] The internal combustion engine 26 includes a crankcase 28, a cylinder block 29, a cylinder head 31, and a head cover 32. The crankcase 28 supports the crankshaft (described below) rotatably about a rotation axis Rx that extends parallel to the axle shaft of the rear wheel WR. The cylinder block 29 is combined to the crankcase 28 and positioned ahead of the crankcase 28. The cylinder head 31 is combined to the cylinder block 29. The head cover 32 is combined to the cylinder head 31. The rear wheel WR is disposed in the rear of the crankcase 28.

[0029] The crankcase 28 is coupled rotatably about an axis parallel to the rotation axis Rx to a bracket 33 combined to a curved area of the rear frame 17 via a link 34. A transmission case 27a of the transmission device 27 is combined to the crankcase 28. In a position apart from the link 34 and the bracket 33, a rear cushion unit 35 is disposed between the rear frame 17 and the power unit 25. Such a power unit 25 functions as a suspension device of the rear wheel WR.

[0030] The cylinder head 31 is coupled to an intake device 37 and an exhaust device 38. The intake device 37 includes an air cleaner 39 and a throttle body 41. The air cleaner 39 is supported by the transmission case 27a, and suctions and purifies an external air. The throttle body 41 is as an intake system component that couples the air cleaner 39 to the cylinder head 31. The cylinder head 31 has an upper sidewall on which a fuel injection device 42 is mounted. The exhaust device 38 includes an exhaust pipe 43 and an exhaust muffler (not illustrated). The exhaust pipe 43 extends rearward passing through underneath the internal combustion engine 26 from a lower side wall of the cylinder head 31. The exhaust muffler is coupled to a downstream end of the exhaust pipe 43 to be coupled to the crankcase 28.

[0031] As illustrated in FIG. 2, the crankcase 28 is divided into a first case half body 28a and a second case half body 28b. The first case half body 28a and the second case half body 28b collaborate to partition a crank chamber 44. The crank chamber 44 houses a crank of a crankshaft 45. A bearing 46a that rotatably supports the crankshaft 45 is assembled to the first case half body 28a. A bearing 46b that rotatably supports the crankshaft 45 is assembled to the second case half body 28b.

[0032] In the cylinder block 29, a cylinder bore 47 is partitioned. In the cylinder bore 47, a piston 49 is engaged slidably along a cylinder axis C. The piston 49 is coupled to the crank of the crankshaft 45 with a connecting rod 48. The cylinder axis C inclines slightly upward to the

front from a horizon. The cylinder block 29 guides the linear reciprocation motion of the piston 49 along the cylinder axis C. The linear reciprocation motion of the piston 49 is transformed into a rotational motion of the crankshaft 45. A combustion chamber 51 is partitioned between the piston 49 and the cylinder head 31. An air-fuel mixture is introduced into the combustion chamber 51 via the intake device 37. An exhaust gas inside the combustion chamber 51 is discharged via the exhaust device 38.

[0033] In the cylinder block 29 and the cylinder head 31, water jackets 52a, 52b that guide a distribution of a cooling water around the combustion chamber 51 are formed. The water jacket 52a of the cylinder block 29 is partitioned around the cylinder bore 47 along a mating face with the cylinder head 31. The water jacket 52b of the cylinder head 31 is continuous with the water jacket 52a of the cylinder block 29 and expands along a ceiling wall of the combustion chamber 51.

[0034] The transmission device 27 includes a belt type continuously variable transmission (hereinafter referred to as "transmission") 57 and a deceleration gear mechanism 59. The transmission 57 includes a drive pulley 53 and a V belt 56 to steplessly shift a rotative power transmitted from the crankshaft 45. The drive pulley 53 is housed within the transmission case 27a and mounted to the crankshaft 45 projecting from an outer surface of the second case half body 28b. The V belt 56 is wound around a driven pulley 55 mounted to a driven shaft 54. The deceleration gear mechanism 59 is housed within the transmission case 27a, and decelerates and transmits the rotative power of the transmission 57 to an axle shaft 58 of the rear wheel WR.

[0035] The transmission case 27a includes a case entity 61, a case cover 63, and a gear cover 65. The case entity 61 is continuous with the second case half body 28b of the crankcase 28. The case cover 63 is fastened to the case entity 61 and partitions a transmission chamber 62 that houses the transmission 57 between the case cover 63 and the case entity 61. The gear cover 65 is fastened to the case entity 61 and partitions a gear chamber 64 between the gear cover 65 and the case entity 61. The gear chamber 64 houses the deceleration gear mechanism 59.

[0036] The drive pulley 53 includes a pulley half body 66 and a pulley half body 67. The pulley half body 66 is secured coaxially to the crankshaft 45 and has a conical-shaped inward surface that is caused to face the second case half body 28b. The pulley half body 67 is supported coaxially to the crankshaft 45 movably in an axial direction of the crankshaft 45 between the pulley half body 66 and the second case half body 28b and has a conical-shaped inward surface that is caused to face the inward surface of the pulley half body 66. The V belt 56 is wound around between the inward surface of the pulley half body 66 and the inward surface of the pulley half body 67. The pulley half body 67 has an outward surface to which a weight retaining plate 68 is caused to face. The weight

retaining plate 68 is secured to the crankshaft 45 in a non-displaceable manner in the axial direction. A centrifugal weight 69 is interposed between a cam surface 67a of the pulley half body 67 and the weight retaining plate 68. The cam surface 67a recedes from the pulley half body 66 as receding from the rotation axis Rx of the crankshaft 45 in a centrifugal direction. The centrifugal force is generated in the centrifugal weight 69 in association with a rotation of the crankshaft 45. The centrifugal weight 69 displaces in the centrifugal direction by the centrifugal force. As the centrifugal weight 69 displaces in the centrifugal direction while the centrifugal weight 69 rolling contacts the cam surface 67a, the pulley half body 67 is driven toward the pulley half body 66. Thus, the pulley half body 67 moves toward the pulley half body 66 in the axial direction corresponding to the rotation of the crankshaft 45, and thus, a winding radius of the V belt 56 changes.

[0037] The driven pulley 55 includes an inner pipe 71, a pulley half body 72, an outer pipe 73, and a pulley half body 74. The inner pipe 71 has a cylindrical shape coaxial with the driven shaft 54 to be coaxially mounted on the driven shaft 54. The pulley half body 72 is secured to the inner pipe 71 so as to be coaxial with the inner pipe 71, and has a conical-shaped inward surface caused to face the case cover 63. The outer pipe 73 has a cylindrical shape coaxial with the driven shaft 54 to be coaxially mounted on the inner pipe 71. The pulley half body 74 is secured to the outer pipe 73 so as to be coaxial with the outer pipe 73 between the pulley half body 72 and the case cover 63, and has a conical-shaped inward surface that faces the inward surface of the pulley half body 72. The V belt 56 is wound around between the inward surface of the pulley half body 72 and the inward surface of the pulley half body 74. The inner pipe 71 is relatively rotatably supported by the driven shaft 54. The outer pipe 73 is supported relatively rotatably and relatively displaceably in the axial direction by the inner pipe 71. Corresponding to the relative displacement in the axial direction of the outer pipe 73 and the inner pipe 71, the pulley half body 74 approaches the pulley half body 72 and recedes from the pulley half body 72.

[0038] On the driven shaft 54, a centrifugal clutch 75 is mounted. The centrifugal clutch 75 includes a clutch plate 75a secured to the inner pipe 71. Between the clutch plate 75a and the pulley half body 74, a coiled spring 76 is disposed. The coiled spring 76 provides an elastic force to press the pulley half body 74 toward the pulley half body 72. When the winding radius of the V belt 56 increases on the drive pulley 53, the pulley half body 74 recedes from the pulley half body 72 against the elastic force of the coiled spring 76, and the winding radius of the V belt 56 decreases on the driven pulley 55.

[0039] The centrifugal clutch 75 includes an outer plate 75b secured to the driven shaft 54. The outer plate 75b is caused to face the clutch plate 75a. When the clutch plate 75a rotates, the outer plate 75b is combined to the clutch plate 75a by an action of the centrifugal force.

Thus, a rotation of the driven pulley 55 is transmitted to the driven shaft 54. As soon as the engine rotation speed exceeds a set rotation speed, the centrifugal clutch 75 establishes a power transmission state.

[0040] The deceleration gear mechanism 59 includes a drive gear 77, a final gear 78, and idle gears 79a, 79b. The drive gear 77 is secured to the driven shaft 54 protruding to the gear chamber 64. The final gear 78 is secured to the axle shaft 58 of the rear wheel WR. The idle gears 79a, 79b are disposed between the drive gear 77 and the final gear 78. The idle gears 79a, 79b are secured to a shared intermediate shaft 81. The drive gear 77 engages with an idle gear 85a, and the final gear 78 engages with an idle gear 85b. Thus, the rotation of the driven shaft 54 is decelerated and transmitted to the axle shaft 58 of the rear wheel WR.

[0041] The crankshaft 45 has one end to which an AC generator (ACG) 82 is coupled. The AC generator 82 includes a pipe shaped rotor 82a and a stator 82b. The rotor 82a is secured to the one end of the crankshaft 45 projecting from an outer surface of the first case half body 28a. The stator 82b is disposed around the crankshaft 45 surrounded by the rotor 82a. The stator 82b includes a plurality of stator cores secured to the first case half body 28a and collocated into a ring shape. A coil is wound around the individual stator core. The rotor 82a includes a magnet tracing a circular trajectory outside the stator core in a diameter direction. The AC generator 82 generates electricity corresponding to a relative rotation of the rotor 82a and the stator 82b. The AC generator 82 may be used as an ACG starter.

[0042] An electric generator cover 84 that forms an electric generator chamber 83 between the electric generator cover 84 and the first case half body 28a is combined to the first case half body 28a. The AC generator 82 is housed in the electric generator chamber 83. In the electric generator cover 84, an air inlet 84a is partitioned at a position to be caused to face the one end of the crankshaft 45. A radiator 85 is incorporated in the air inlet 84a. Thus, the radiator 85 is positioned on the rotation axis Rx extended from the one end of the crankshaft 45 and coupled to the crankcase 28.

[0043] In the electric generator chamber 83, a centrifugal fan 86 that rotates about the rotation axis Rx of the crankshaft 45 is combined to the one end of the crankshaft 45. The centrifugal fan 86 is housed in a space inside the first case half body 28a surrounding the electric generator chamber 83. The centrifugal fan 86 includes a rotator 86a and a plurality of vanes 86b. The rotator 86a is secured to the rotor 82a of the AC generator 82. The plurality of vanes 86b are disposed upright in the axial direction of the rotation axis Rx from a surface of the rotator 86a and collocated in a peripheral direction about the rotation axis Rx. When the centrifugal fan 86 rotates, the air is pulled in the axial direction of the rotation axis Rx toward the surface of the rotator 86a, and the air is discharged in the centrifugal direction. The air that flows toward the centrifugal fan 86 in the axial direction passes

through the radiator 85.

[0044] The internal combustion engine 26 includes a water pump 88 that is coupled to a camshaft 87 driving an intake valve and an exhaust valve, and discharges a cooling water in conjunction with a rotation of the camshaft 87. In rotatably driving the camshaft 87, a cam chain 91 is wound around a sprocket 89a of the camshaft 87 and a sprocket 89b of the crankshaft 45.

[0045] The water pump 88 circulates the cooling water inside a closed passage passing through the radiator 85. The passage is formed of a first pipe 92a, a second pipe 92b, and a third pipe 92c as illustrated in FIG. 3. The first pipe 92a couples the water jacket 52a of the cylinder block 29 to a discharge port 88a of the water pump 88. The second pipe 92b couples an inlet of the radiator 85 to the water jacket 52b of the cylinder head 31. The third pipe 92c couples a thermostat 93 to the discharge port of the radiator 85. The thermostat 93 is coupled to a suction pipe 88b of the water pump 88.

[0046] The cooling water discharged from the water pump 88 is introduced to the water jacket 52a of the cylinder block 29 from the first pipe 92a. The cooling water flows through the water jacket 52a of the cylinder block 29 and the water jacket 52b of the cylinder head 31 to cool the internal combustion engine 26. The cooling water discharged from the cylinder head 31 flows to the radiator 85 via the second pipe 92b. The radiator 85 exchanges heat from the cooling water to the external air. The radiator 85 radiates heat. The cooling water cooled at the radiator 85 flows into the thermostat 93 from the third pipe 92c, and returns to the water pump 88. Thus, the internal combustion engine 26 is cooled.

[0047] The radiator 85 includes an upper tank 95a, a lower tank 95b, a radiator core 95c, and a tank cover 96. The upper tank 95a has a filler neck 94 extending upward. The lower tank 95b is disposed underneath the upper tank 95a. The radiator core 95c is disposed between the upper tank 95a and the lower tank 95b. The tank cover 96 covers the upper tank 95a from an outer side in the vehicle width direction. The upper tank 95a is coupled to the second pipe 92b. The lower tank 95b is coupled to the third pipe 92c. The radiator core 95c is only necessary to be formed of a pipe that couples the upper tank 95a to the lower tank 95b and passes through the cooling water toward the lower tank 95b from the upper tank 95a, and a heat radiating fin combined to the pipe. The cooling water introduced into the upper tank 95a is cooled in the radiator core 95c, and flows into the lower tank 95b.

[0048] As illustrated in FIG. 4, the crank in the crankshaft 45 includes a circular-plate shaped crank web 97, a circular-plate shaped crank web 98, and a crank pin 99. The crank web 97 is continuous with a crank journal 97a coupled to the first case half body 28a with the bearing 46a. The crank web 98 is continuous with a crank journal 98a coupled to the second case half body 28b with the bearing 46b. The crank pin 99 is held by the crank webs 97, 98 at a position that deviates from an axial center of the crank journals 97a, 98a, and coupled

to a large end portion of the connecting rod 48 in a relatively rotatable manner about an axis parallel to the rotation axis Rx. The individual crank webs 97, 98 include balance weights 101 projecting from the inward surfaces at positions that deviates from the crank pin 99 about the axial center of the crank journals 97a, 98a.

[0049] On an outward surface of the crank web 97, an annular plate 102 formed into a ring shape around the crank journal 97a is stacked coaxially with the rotation axis Rx. The annular plate 102 is combined to the crank web 97. The annular plate 102 has an outer periphery with which a plurality of reluctors (to-be-detected objects) 103 protruding outside in the diameter direction with respect to an outer periphery of the crank web 97 are continuous. The reluctors 103 are collocated at regular intervals into a ring shape around the rotation axis Rx of the crankshaft 45 as illustrated in FIG. 5. The reluctors 103 are collocated at, for example, each center angles of 10 degrees. The reluctors 103 are configured of, for example, a magnetic material. As illustrated in FIG. 4, a cylinder liner that is fitted to the cylinder block 29 to partition the cylinder bore 47 has a cutout 104 that constitutes a clearance for the reluctors 103. The reluctors 103 rotate integrally with the crankshaft 45.

[0050] The annular plate 102 has an inner periphery with which a cover plate 105 formed into a ring shape around the crank journal 97a is continuous coaxially with the rotation axis Rx. The cover plate 105 forms an oil pocket 106 between the cover plate 105 and the outward surface of the crank web 97. The oil pocket 106 is coupled to an oil passage 107 partitioned along an axial center of the crank pin 99 in the crank pin 99. The cover plate 105 has an inner periphery that forms a circular clearance around the crank journal 97a, that is, an inlet of a lubricating oil. The inner periphery of the cover plate 105 may be in contact with an inner race of the bearing 46a. The cover plate 105 collaborates with the annular plate 102 to constitute a centrifugal oil filter. The centrifugal oil filter filters foreign objects in the lubricating oil based on the centrifugal force of the crank web 97 in rotation.

[0051] In the crank pin 99, a supply passage 108 that extends in the diameter direction (direction perpendicular to axial center) from the oil passage 107 is partitioned. The supply passage 108 has an outer end that opens to a bearing of the connecting rod 48. The lubricating oil of the oil pocket 106 is supplied to the bearing of the connecting rod 48 via the oil passage 107 and the supply passage 108.

[0052] As illustrated in FIG. 5, the crankcase 28 has an oil pan 109 formed underneath the crankshaft 45. The lubricating oil in the crankcase 28 flows into the oil pan 109 by the action of the gravitation. The oil pan 109 internally has a space to which a suction port 111a of an oil pump 111 opens. The oil pump 111 suctions the lubricating oil in the oil pan 109 from the suction port 111a in conjunction with the rotation of the crankshaft 45, and discharges the lubricating oil toward an oil passage 112 (see FIG. 4) in the crankcase 28. The lubricating oil is

supplied to the oil pocket 106 and each lubricating site from the oil passage 112.

[0053] In the crankcase 28, a pulsar sensor (detection sensor) 113 that is caused to face a trajectory of the reluctors 103 at a detection end 113a, and generates a pulse signal corresponding to a motion of the reluctors 103 is supported. The pulsar sensor 113 includes a sensor main body 115a, a mounting piece 115b, and a sensor harness 115c. The sensor main body 115a is inserted from an outside into a sensor hole 114 drilled in the first case half body 28a above the crankshaft 45 and has the detection end 113a facing the crank chamber 44. The mounting piece 115b is stacked on an outer surface of the crankcase 28 in the rear of the sensor hole 114 in the peripheral direction of the rotation axis Rx, and fastened to the crankcase 28. The sensor harness 115c extends upward from an upper end of the sensor main body 115a outside the crankcase 28, and folded back to be bundled on a side surface of the sensor main body 115a.

[0054] The pulsar sensor 113 outputs an electric signal, that is, a pulse signal corresponding to presence/absence of the magnetic material detected on the trajectory of the reluctors 103 by the action of, for example, a magnetoresistive element. An angular location of the crankshaft 45 is specified by the pulse signal. In the pulsar sensor 113, a detection axis 113b with the highest sensitivity is oriented along the rotation axis Rx. The pulsar sensor 113 is disposed to have a layout in which the pulsar sensor 113 intersects with a cylinder axis C at a crossing angle close to 90 degrees about the crankshaft 45. The pulsar sensor 113 is held in a posture inclining rearward with respect to a vehicle up and down direction perpendicular to a ground GD, at an inclined angle α . The sensor harness 115c extends forward along an outer surface of the crankcase 28.

[0055] As illustrated in FIG. 6, in the crankcase 28, an opening 116 that flows out an airflow of the centrifugal fan 86 parallel to the rotation axis Rx of the crankshaft 45 is partitioned. In partitioning the opening 116, the crankcase 28 includes a bulging wall 117 that bulges in the centrifugal direction with respect to an outer wall surface that follows an outer periphery of the crank web 97 at a position outside with respect to an outer periphery of the AC generator 82. The bulging wall 117 has an inner wall surface parallel to the rotation axis Rx of the crankshaft 45.

[0056] The crankcase 28 has an outer surface to which an air guide member 119 that partitions an air guide path 118 between the air guide member 119 and the outer surface of the crankcase 28 is secured. The air guide path 118 is coupled to the electric generator chamber 83 through the opening 116. The air guide member 119 covers over the pulsar sensor 113 as illustrated in FIG. 5. The air guide member 119 includes a protruding wall 121 that projects outward and upward from a top panel 119a of the air guide member 119 and houses an upper end of the pulsar sensor 113. The top panel 119a faces the

outer surface of the crankcase 28.

[0057] With reference to FIG. 7 and FIG. 8 together, the air guide member 119 extends in parallel with the rotation axis Rx of the crankshaft 45, and includes a first air guide wall 122 and a second air guide wall 123. The first air guide wall 122 partitions a space coupled to the opening 116 in series. The second air guide wall 123 is continuous with the first air guide wall 122 and guides the airflow flowing out of the opening 116 toward the rear wheel WR following the curved surface. The air guide member 119 is integrally formed with a blocking plate 124 extending downward toward the crankcase 28 from the top panel 119a of the air guide member 119 at the rear of the pulsar sensor 113. The blocking plate 124 expands between the pulsar sensor 113 and the rear wheel WR to block the pulsar sensor 113 from the rear. The blocking plate 124 is reinforced by a rib 125 standing upright from the top panel 119a of the air guide member 119.

[0058] As illustrated in FIG. 9, the electric generator cover 84 includes a surrounding wall 126 that is continuous without interruption around the rotation axis Rx of the crankshaft 45 to surround an outer periphery of the centrifugal fan 86 outside the centrifugal fan 86. The surrounding wall 126 includes a first guide wall 126a and a second guide wall 126b. The first guide wall 126a is caused to face the outer periphery of the centrifugal fan 86 and extends to a second dividing piece 127b positioned at a downstream end of the opening 116 from the upstream end divided by a first dividing piece 127a along a rotation direction DR of the centrifugal fan 86. The second guide wall 126b is caused to face the outer periphery of the centrifugal fan 86 and extends to a discharge port 128 positioned underneath in the gravitation direction from the second dividing piece 127b in the rotation direction DR of the centrifugal fan 86. The surrounding wall 126 of the electric generator cover 84 comes closest to the outer periphery of the centrifugal fan 86 at the first dividing piece 127a and the second dividing piece 127b. The first guide wall 126a recedes from the outer periphery of the centrifugal fan 86 as approaching the downstream from the first dividing piece 127a. The second guide wall 126b recedes from the outer periphery of the centrifugal fan 86 as approaching the downstream from the second dividing piece 127b. When the centrifugal fan 86 rotates in the rotation direction DR, the air discharged in the centrifugal direction from the centrifugal fan 86 is guided by the first guide wall 126a to flow toward the opening 116 and guided by the second guide wall 126b to flow toward the discharge port 128.

[0059] The pulsar sensor 113 is disposed biased to the rear end of the opening 116 in a peripheral direction around the rotation axis Rx in side view observed from an infinity of the rotation axis Rx. The mounting piece 115b of the pulsar sensor 113 is disposed in a direction (here, rearward) displaced from the opening 116 in the peripheral direction about the rotation axis Rx in side view. However, the pulsar sensor 113 may be disposed

biased to a front end of the opening 116 in the peripheral direction about the rotation axis Rx in side view. In such a case, it is only necessary that the mounting piece 115b is disposed ahead with respect to the sensor main body 115a in the peripheral direction about the rotation axis Rx in side view.

[0060] Next, a description will be given of an operation of the power unit 25 according to the embodiment. Repeated strokes of air intake, compression, combustion, and exhaustion in the internal combustion engine 26 cause the piston 49 to make the linear reciprocation motion within the cylinder bore 47. Actions of the crankshaft 45 and the connecting rod 48 transform the linear reciprocation motion of the piston 49 into the rotational motion of the crankshaft 45. The reluctors 103 rotate about the rotation axis Rx integrally with the crankshaft 45. The reluctors 103 move along the circular trajectory. The pulsar sensor 113 outputs the pulse signal corresponding to the presence/absence of the magnetic material detected on the trajectory of the reluctors 103. The pulse signal specifies the angular location of the crankshaft 45.

[0061] The rotation of the crankshaft 45 is transmitted to the camshaft 87 by the action of the cam chain 91. The water pump 88 discharges the cooling water in conjunction with the rotation of the camshaft 87. The cooling water circulates inside the passage, deprives heat energy from the cylinder block 29 and the cylinder head 31, and radiates the heat from the radiator 85. Thus, the internal combustion engine 26 is cooled.

[0062] The rotation of the crankshaft 45 causes the rotation of the centrifugal fan 86. When the centrifugal fan 86 rotates, the airflow of the external air moving toward the centrifugal fan 86 along the rotation axis Rx of the crankshaft 45 is generated. The external air flows in the axial direction of the rotation axis Rx from the air inlet 84a of the electric generator cover 84. The external air passes the radiator 85 to execute the heat exchange with the cooling water. In the radiator 85, cooling of the cooling water is accelerated.

[0063] A part of the air discharged in the centrifugal direction from the centrifugal fan 86 is guided to the first guide wall 126a to flow toward the opening 116. The airflow flows out along the rotation axis Rx of the crankshaft 45 from the opening 116. The airflow flows into the air guide path 118 inside the air guide member 119. In the air guide path 118, a direction of the airflow is changed by the action of the first air guide wall 122 and the second air guide wall 123, and the airflow advances in the direction perpendicular to the rotation axis Rx. Thus, the airflow is discharged outside the crankcase 28 toward the rear wheel WR.

[0064] A part of the air discharged in the centrifugal direction from the centrifugal fan 86 is guided to the second guide wall 126b and flows toward the discharge port 128. The airflow is discharged outside the crankcase 28 toward the ground GD from the discharge port 128.

[0065] In this embodiment, the pulsar sensor 113 is disposed displaced rearward from the passage of the

airflow flowing out along the outer surface of the crankcase 28 in parallel with the rotation axis Rx of the crankshaft 45 from the opening 116. Since an interference between the pulsar sensor 113 and the airflow flowing out of the opening 116 is reduced to the minimum, even though the opening 116 is positioned at a position that intersects with the cylinder axis C at a crossing angle of 90 degrees about the crankshaft 45, the pulsar sensor 113 is disposed to have a layout in which the pulsar sensor 113 intersects with the cylinder axis C at a crossing angle as close to 90 degrees as possible about the crankshaft 45. Accordingly, even though the internal combustion engine 26 vibrates in a direction of the cylinder axis C corresponding to the linear reciprocation motion of the piston 49, the effect of the vibration is reduced as much as possible in detecting the crank angle. In particular, on the internal combustion engine 26 with the single cylinder, the amplitude of the vibration along the cylinder axis C is large, the effect of the vibration is effectively reduced.

[0066] The pulsar sensor 113 according to the embodiment has the mounting piece 115b positioned at a rear side with respect to the sensor hole 114 in the vehicle front-rear direction. Accordingly, the mounting piece 115b is disposed displaced further rearward with respect to the sensor main body 115a from the passage of the airflow that flows out along the outer surface of the crankcase 28 in parallel with the rotation axis Rx of the crankshaft 45 from the opening 116. The mounting piece 115b of the pulsar sensor 113 is disposed without interfering with the airflow flowing out of the opening 116, thereby achieving a satisfactory airflow distribution.

[0067] In the power unit 25 according to the embodiment, the cylinder block 29 is combined to the crankcase 28 to be positioned ahead of the crankcase 28 so as to guide the linear reciprocation motion of the piston 49 in the vehicle front-rear direction. Since the rear wheel WR is positioned at the rear of the crankcase 28, even though the pulsar sensor 113 is disposed to have the layout in which the pulsar sensor 113 intersects with the cylinder axis C at the crossing angle as close to 90 degrees as possible about the crankshaft 45, the interference between the pulsar sensor 113 and the rear wheel WR is avoided. The crankcase 28 can approach the rear wheel WR as close as possible. The power unit 25 can be compactly configured.

[0068] In this embodiment, while the oil pan 109 is formed in the crankcase 28 underneath the crankshaft 45, the pulsar sensor 113 is disposed above the crankshaft 45. When the pulsar sensor 113 is disposed to have the layout in which the pulsar sensor 113 intersects with the cylinder axis C at the crossing angle as close to 90 degrees as possible about the crankshaft 45, the pulsar sensor 113 is disposed above the crankshaft 45, as a result, the pulsar sensor 113 is caused to recede from the oil pan 109. The effect of the oil inside the crankcase 28 to the pulsar sensor 113 is reduced.

[0069] The air guide member 119 according to the embodiment includes the first air guide wall 122, which ex-

tends in parallel with the rotation axis Rx of the crankshaft 45 and partitions the space coupled to the opening 116, and the second air guide wall 123, which is continuous with the first air guide wall 122 and guides the airflow that flows out of the opening 116 toward the rear wheel WR following the curved surface. The airflow that flows out of the opening 116 in parallel with the rotation axis Rx of the crankshaft 45 is guided by the first air guide wall 122 and the second air guide wall 123 to be introduced toward the rear wheel WR. Since the air guide member 119 covers over the pulsar sensor 113, the pulsar sensor 113 is protected from stones and water splashed from a road surface outside the crankcase 28. Moreover, since an exposure of the pulsar sensor 113 is avoided outside the crankcase 28, designability of the power unit 25 is properly maintained.

[0070] In the air guide member 119, the blocking plate 124, which extends downward toward the crankcase 28 from the air guide member 119 at the rear of the pulsar sensor 113, is integrally formed. The pulsar sensor 113 is protected from the stones and water swirled up to the rear wheel WR. In particular, the blocking plate 124 extends downward from the air guide member 119 above the pulsar sensor 113 following the rotation direction of the rear wheel WR, and therefore, the pulsar sensor 113 is protected from the stones and water.

[0071] In the air guide member 119 according to the embodiment, the protruding wall 121 that houses the upper end of the pulsar sensor 113 is formed projecting outward from the top panel 119a of the air guide member 119. The top panel 119a faces the outer surface of the crankcase 28. Regardless of a projection height of the pulsar sensor 113 projecting from the outer surface of the crankcase 28, the top panel 119a of the air guide member 119 can be positioned close to the outer surface of the crankcase 28. Therefore, increase in the air resistance of the travelling vehicle is avoided, and the distribution of the airflow flowing out of the opening 116 of the crankcase 28 is properly maintained inside the air guide member 119.

[DESCRIPTION OF REFERENCE NUMERALS AND SYMBOLS]

[0072]

25...	Swing unit-type power unit
28...	Crankcase
29...	Cylinder block
45...	Crankshaft
48...	Connecting rod
49...	Piston
58...	Axle shaft (of rear wheel)
85...	Radiator
86...	Centrifugal fan
103...	To-be-detected object (reluctor)
109...	Oil pan
113...	Detection sensor (pulsar sensor)

115b...	Mounting piece
116...	Opening
119...	Air guide member
119a...	Top panel
121...	Protruding wall
122...	First air guide wall
123...	Second air guide wall
124...	Blocking plate
Rx...	Rotation axis (of crankshaft)
WR...	Rear wheel

Claims

1. A swing unit-type power unit comprising:

a crankshaft (45);
 a centrifugal fan (86) secured to one end of the crankshaft (45) and rotating about a rotation axis (Rx) of the crankshaft (45); and
 a crankcase (28) that houses the centrifugal fan (86), the crankcase (28) having an opening (116) that flows out an airflow of the centrifugal fan (86) in parallel with the rotation axis (Rx),
characterized in that
 the power unit further comprises:

a to-be-detected object (103) secured to the crankshaft (45) and rotating integrally with the crankshaft (45); and
 a detection sensor (113) disposed biased to a front end or a rear end of the opening (116) in a peripheral direction about the rotation axis (Rx) as seen in a side view, the detection sensor (113) facing a trajectory of the to-be-detected object (103) and generating a pulse signal corresponding to a motion of the to-be-detected object (103).

2. The swing unit-type power unit according to claim 1, wherein the detection sensor (113) expands in a direction displaced from the opening (116) in a peripheral direction about the rotation axis (Rx) as seen in the side view and is disposed on an outer surface of the crankcase (28).

3. The swing unit-type power unit according to claim 1 or 2, further comprising:

a cylinder block (29) combined to the crankcase (28) to be positioned ahead of the crankcase (28), the cylinder block (29) guiding a linear reciprocation motion of a piston (49) coupled to the crankshaft (45) with a connecting rod (48) in a vehicle front-rear direction; and
 a rear wheel (WR) disposed at a rear of the crankcase (28) and including an axle (58) in parallel with the rotation axis (Rx) of the crankshaft

(45).

4. The swing unit-type power unit according to claim 3, wherein the crankcase (28) includes an oil pan (109) underneath the crankshaft (45), and the detection sensor (113) is disposed above the crankshaft (45).

5. The swing unit-type power unit according to claim 4, further comprising a radiator (85) positioned on the rotation axis (Rx), which is extended from one end of the crankshaft (45), and coupled to the crankcase (28), the radiator (85) exchanging heat from a cooling water flowing through at least the cylinder block (29) to an external air.

6. The swing unit-type power unit according to claim 5, further comprising:

a first air guide wall (122) that extends in parallel with the rotation axis (Rx) to partition a space coupled to the opening (116);
 a second air guide wall (123) continuous from the first air guide wall (122) and guiding an airflow flowing out of the opening (116) toward the rear wheel (WR) along a curved surface; and
 an air guide member (119) secured to an outer surface of the crankcase (28) to cover over the detection sensor (113).

7. The swing unit-type power unit according to claim 6, wherein the air guide member (119) is integrally formed with a blocking plate (124) extending downward toward the crankcase (28) from the air guide member (119) at a rear of the detection sensor (113).

8. The swing unit-type power unit according to claim 7, wherein the air guide member (119) includes a protruding wall (121) that houses an upper end of the detection sensor (113) by projecting outward from a top panel (119a) of the air guide member (119), the top panel (119a) facing the outer surface of the crankcase (28).

FIG. 1

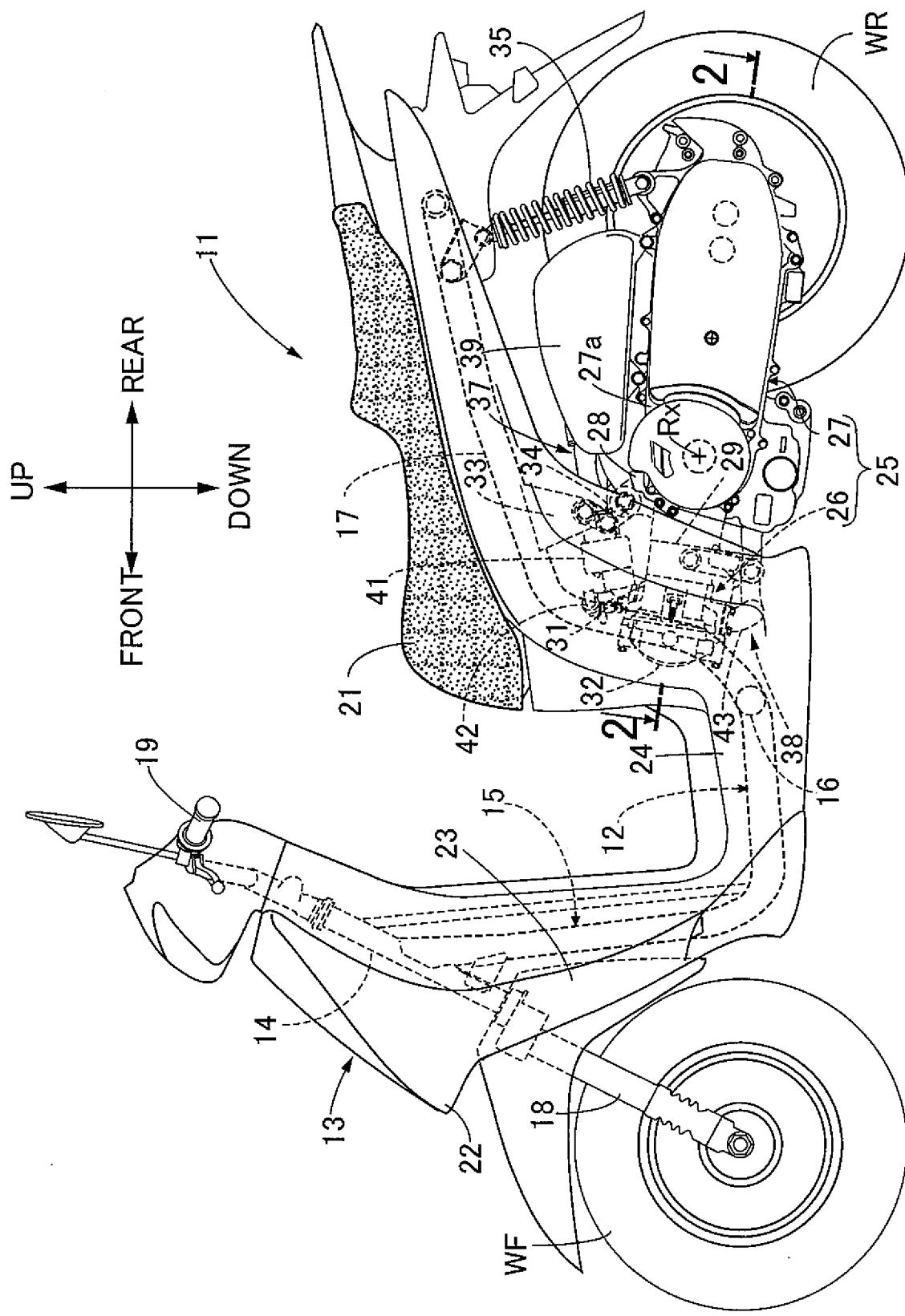


FIG.2

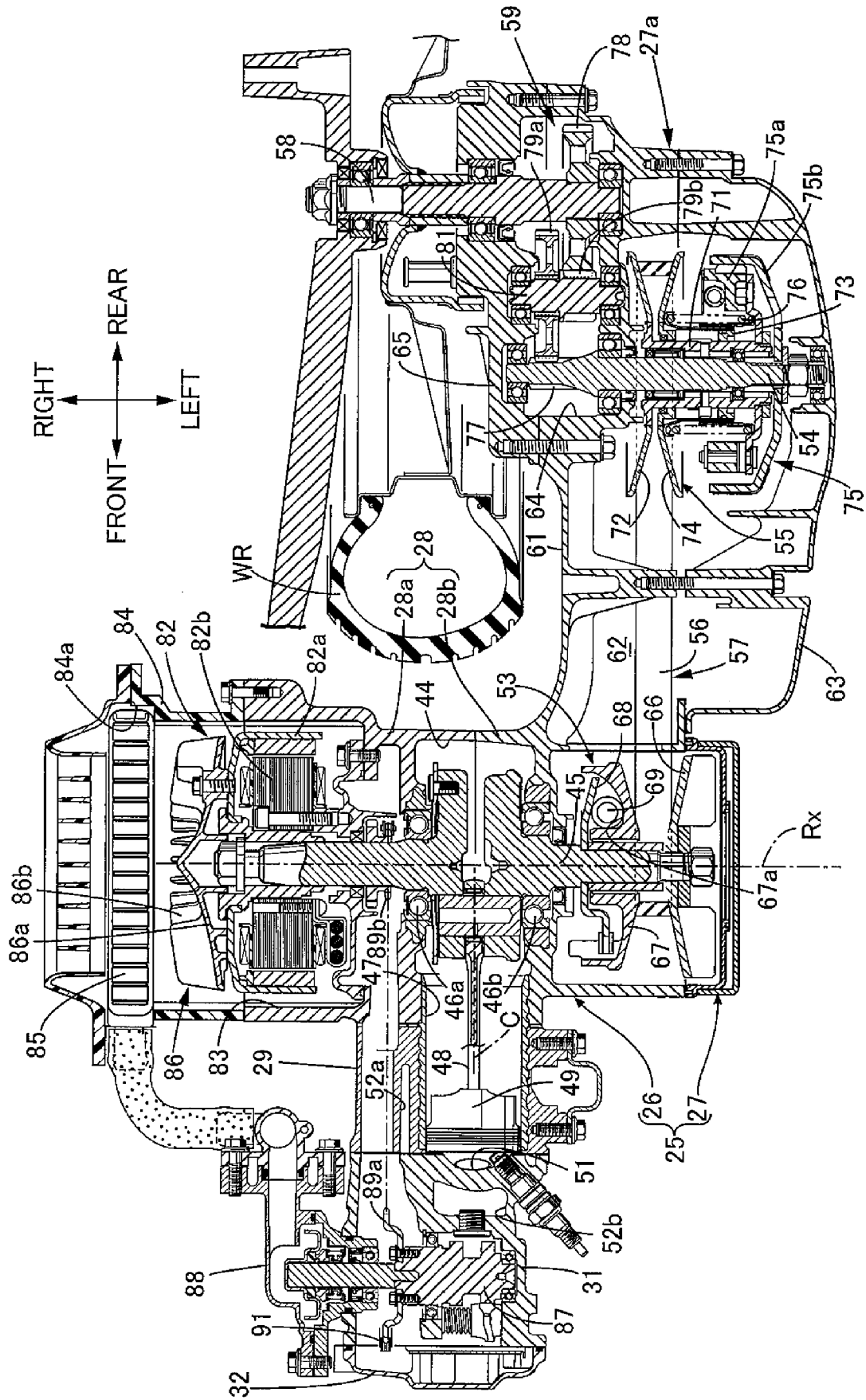


FIG.3

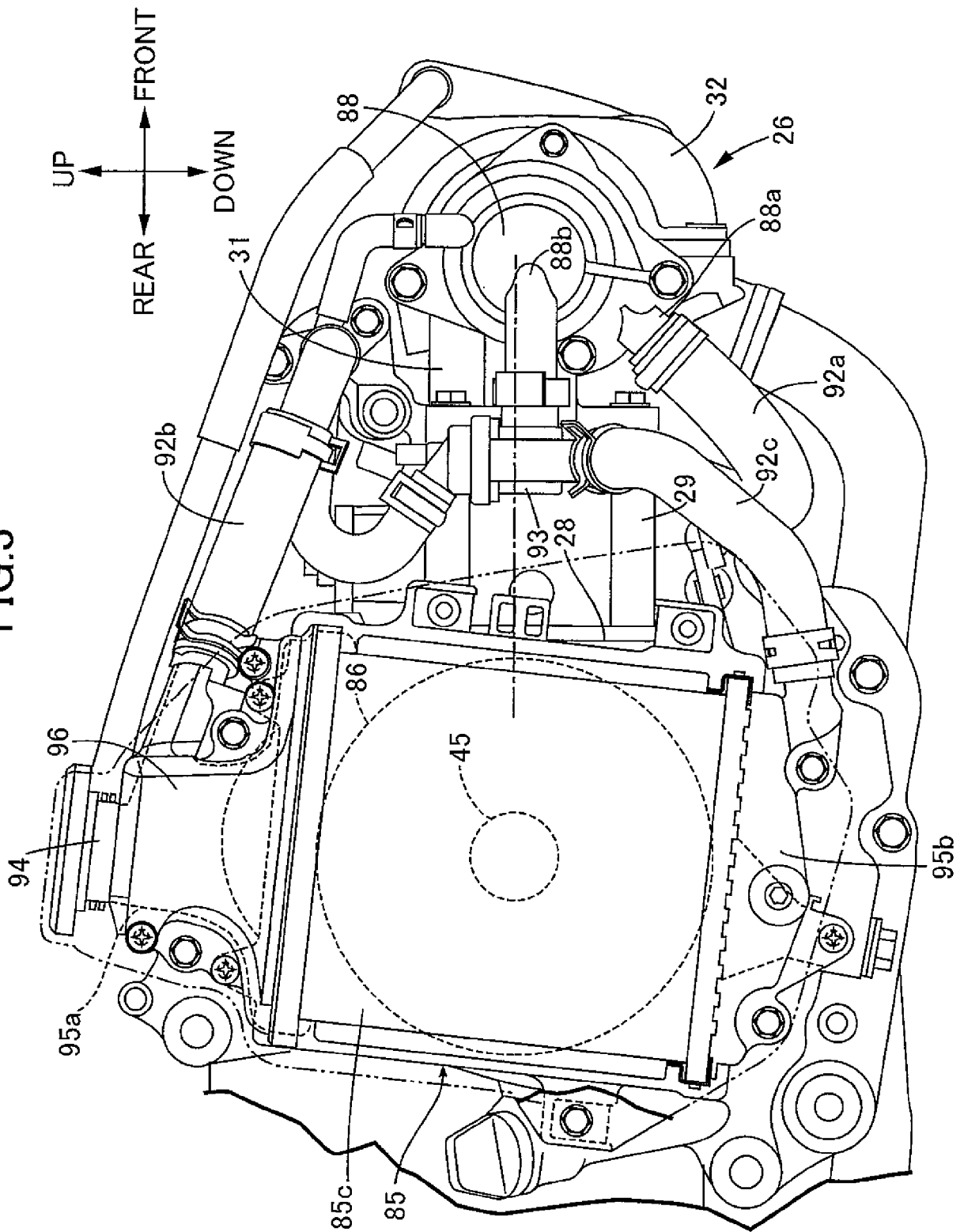


FIG.4

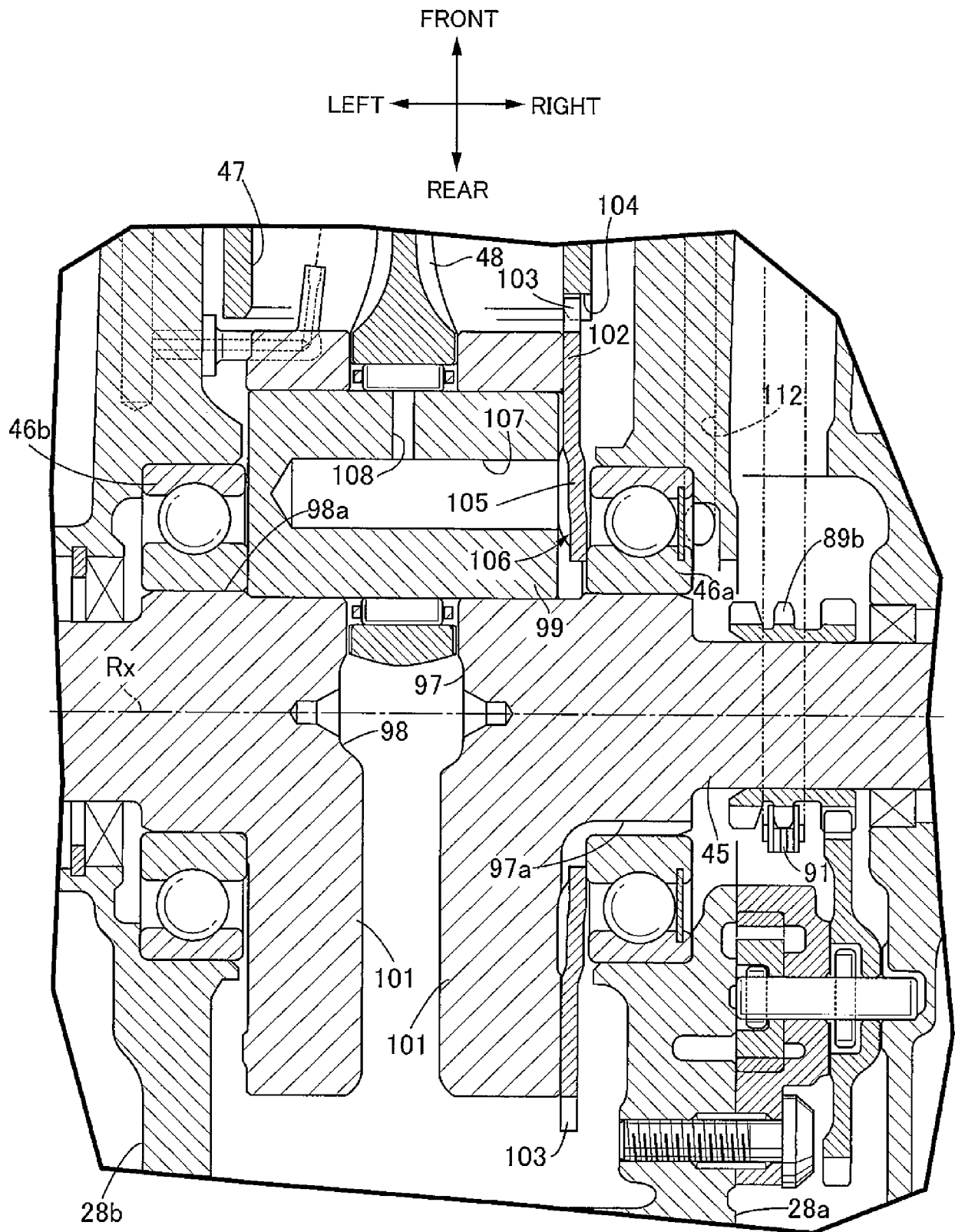


FIG.5

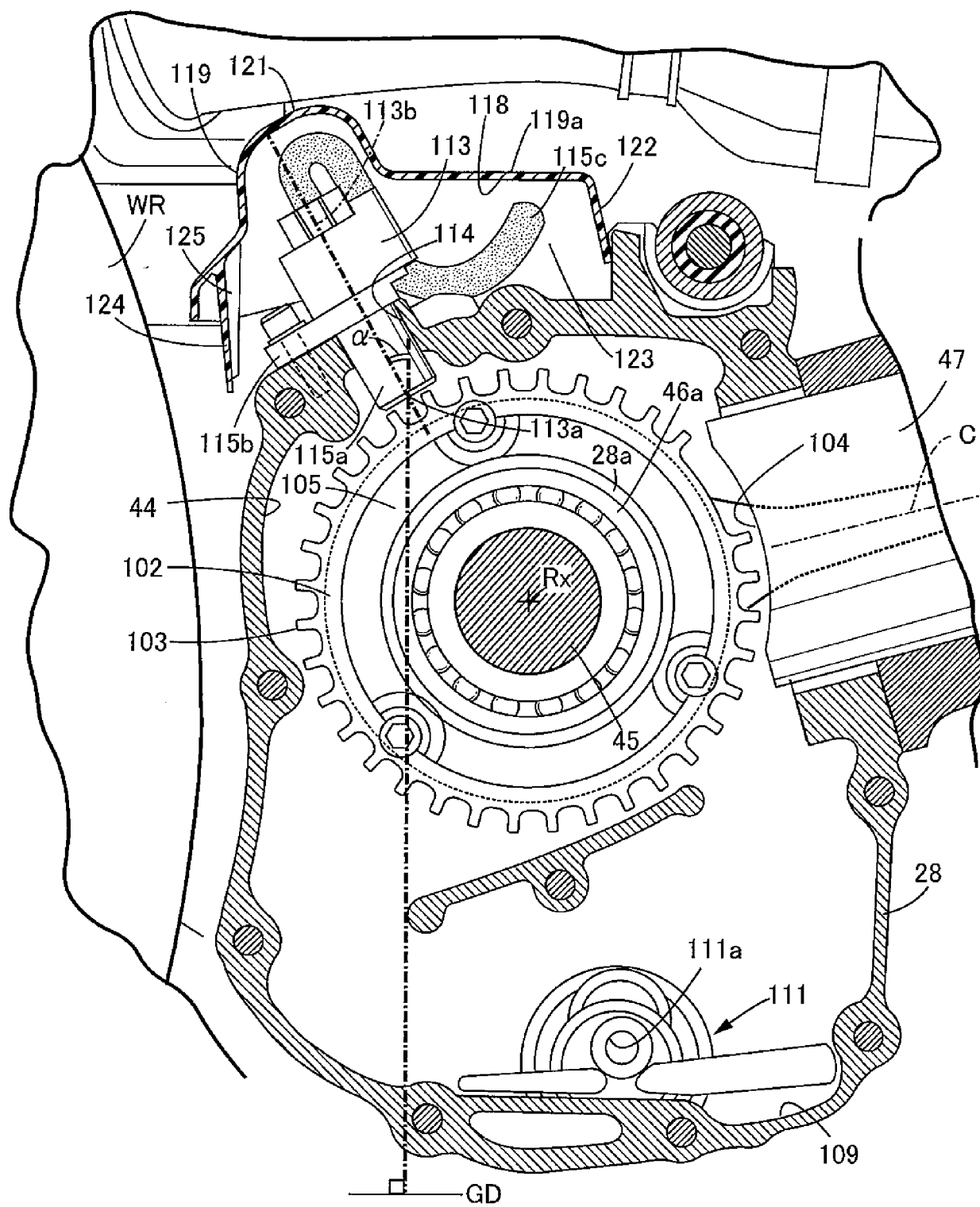


FIG.6

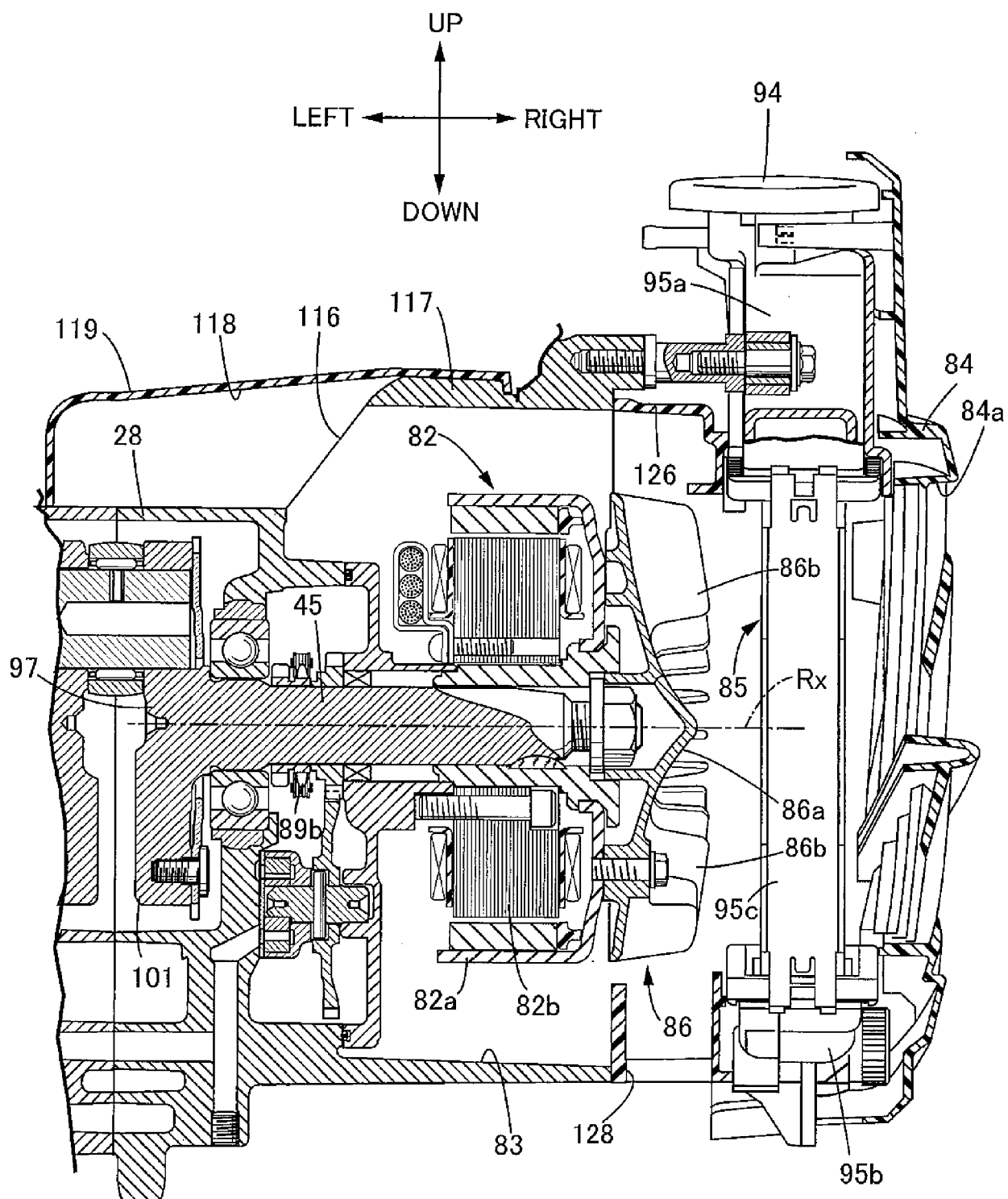


FIG.7

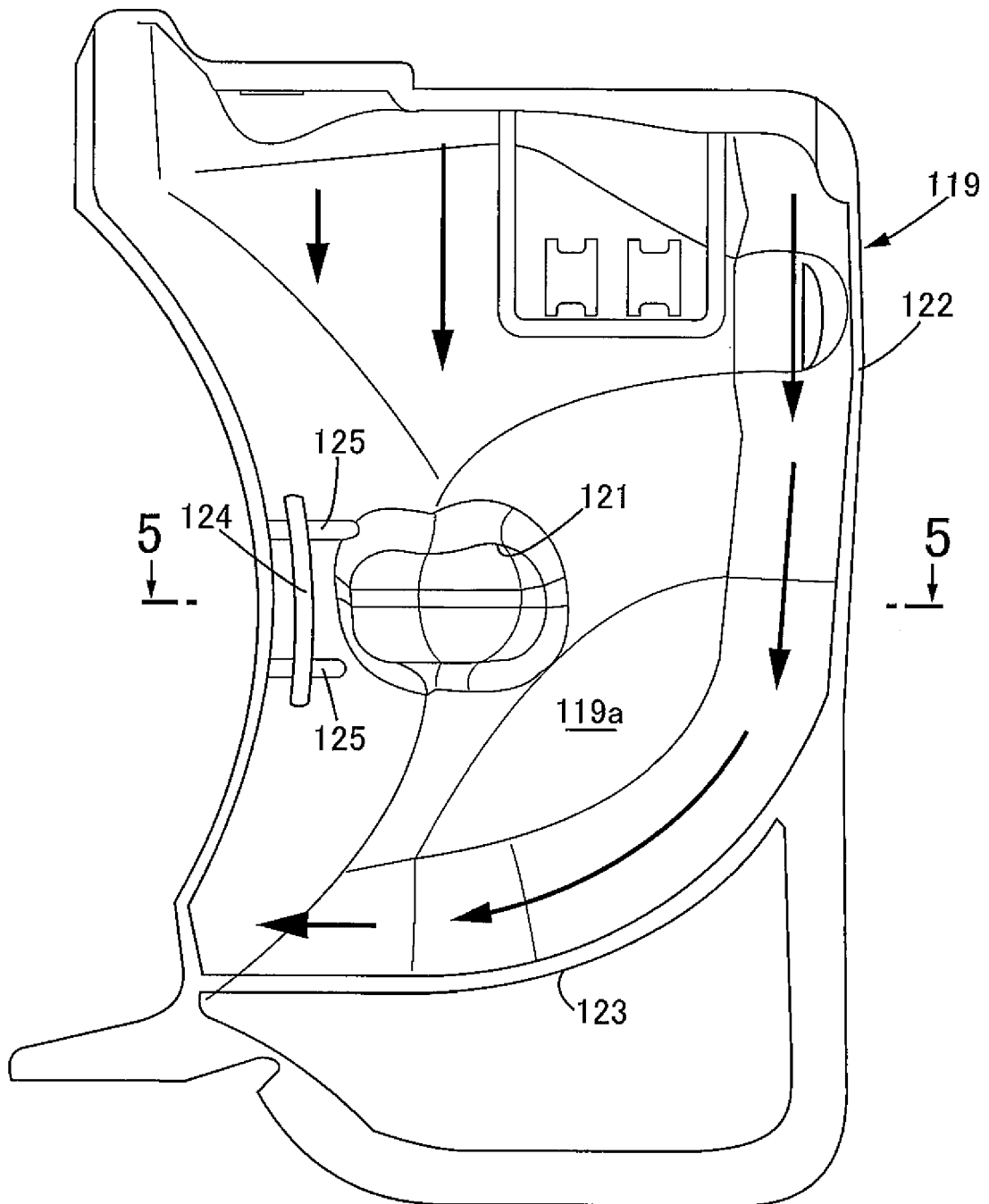


FIG.8

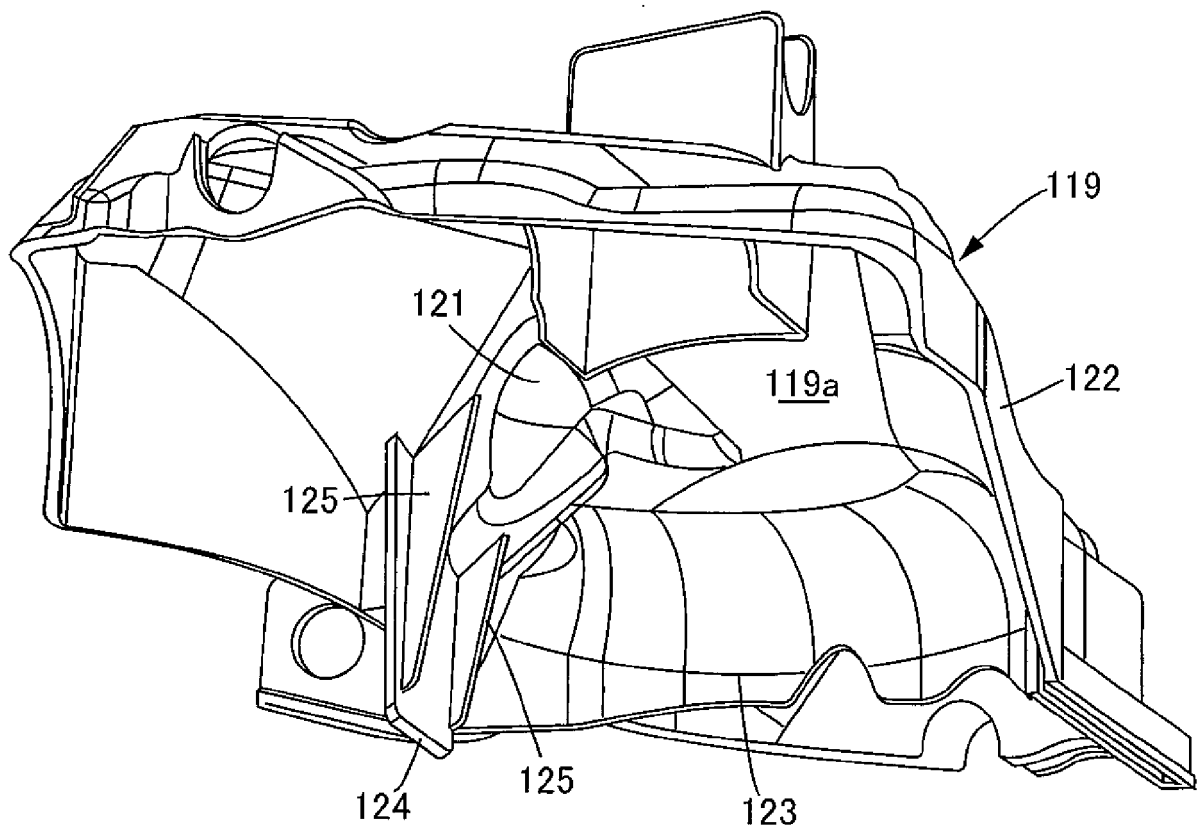
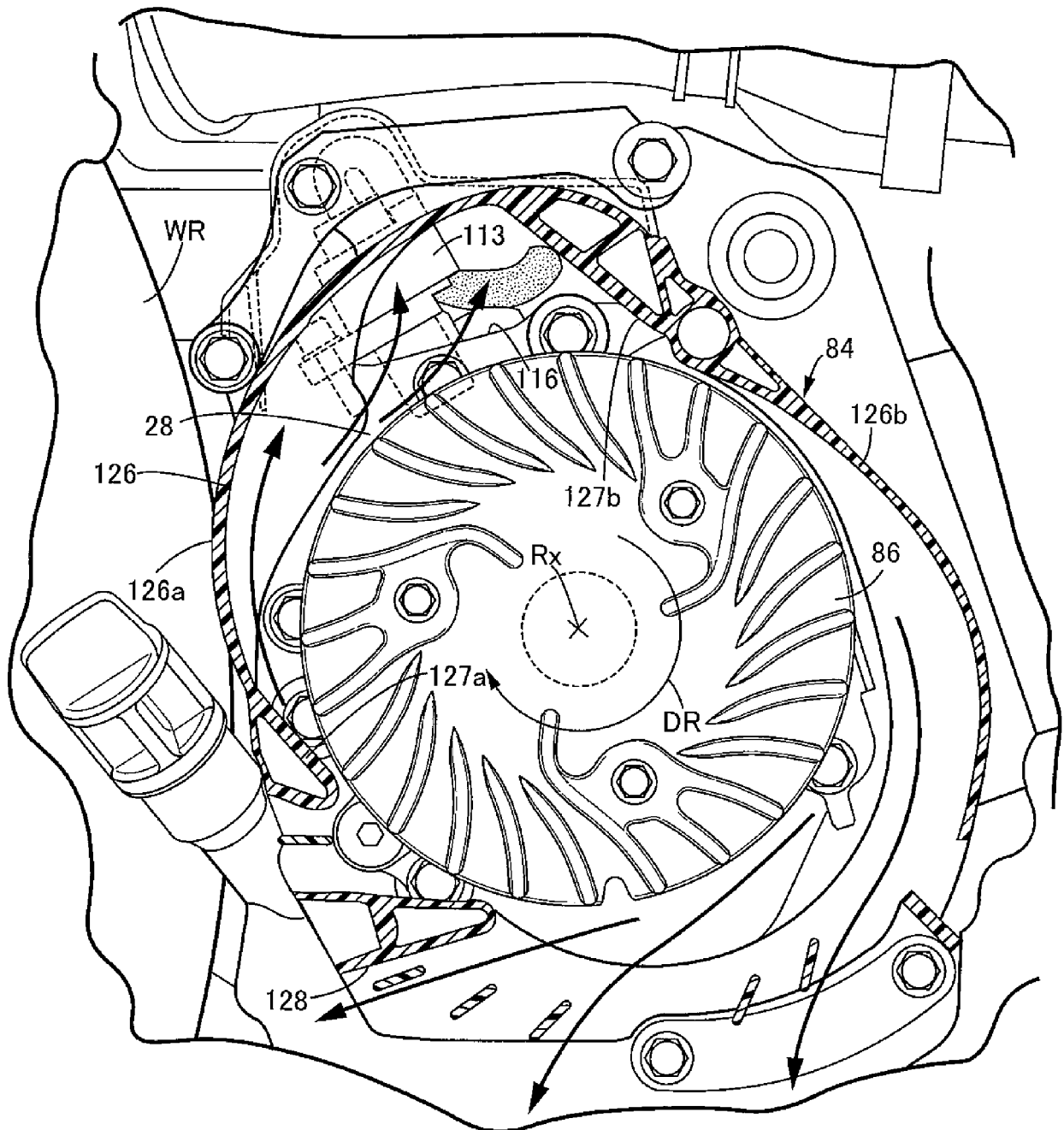


FIG.9





EUROPEAN SEARCH REPORT

Application Number
EP 19 16 2744

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2011 163191 A (SUZUKI MOTOR CORP) 25 August 2011 (2011-08-25) * paragraph [0047] - paragraph [0051]; figure 5 *	1-8	INV. F02B61/02 ADD. F02B77/08
X	EP 2 910 820 A2 (HONDA MOTOR CO LTD [JP]) 26 August 2015 (2015-08-26) * paragraph [0115] - paragraph [0124]; figures 3,6 *	1-3,6-8	
X	EP 2 019 233 A1 (HONDA MOTOR CO LTD [JP]) 28 January 2009 (2009-01-28) * paragraph [0120] - paragraph [0121]; figure 5 *	1,2	
A	JP 2001 001971 A (HONDA MOTOR CO LTD) 9 January 2001 (2001-01-09) * paragraph [0040] - paragraph [0041]; figure 3 *	1-8	
			TECHNICAL FIELDS SEARCHED (IPC)
			F02B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 13 May 2019	Examiner Tietje, Kai
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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

EP 19 16 2744

5

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

13-05-2019

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2011163191 A	25-08-2011	JP 5648292 B2	07-01-2015
		JP 2011163191 A	25-08-2011
EP 2910820 A2	26-08-2015	EP 2910820 A2	26-08-2015
		ES 2656517 T3	27-02-2018
EP 2019233 A1	28-01-2009	EP 2019233 A1	28-01-2009
		ES 2338189 T3	04-05-2010
JP 2001001971 A	09-01-2001	ES 2179738 A1	16-01-2003
		IT T020000579 A1	17-12-2001
		JP 2001001971 A	09-01-2001
		TW 432155 B	01-05-2001

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2014199040 A [0004]
- JP 2002371906 A [0004]