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(54) **Engine and vehicle**

(57) To provide an engine that is capable of reducing the swing of a crank angle sensor, an engine 10 includes an oil pump cover 40 at a right side section of a crank

case 21. A crank angle sensor 70 is attached to sensor attachment sections 42a, 42b that are formed in the oil pump cover 40.

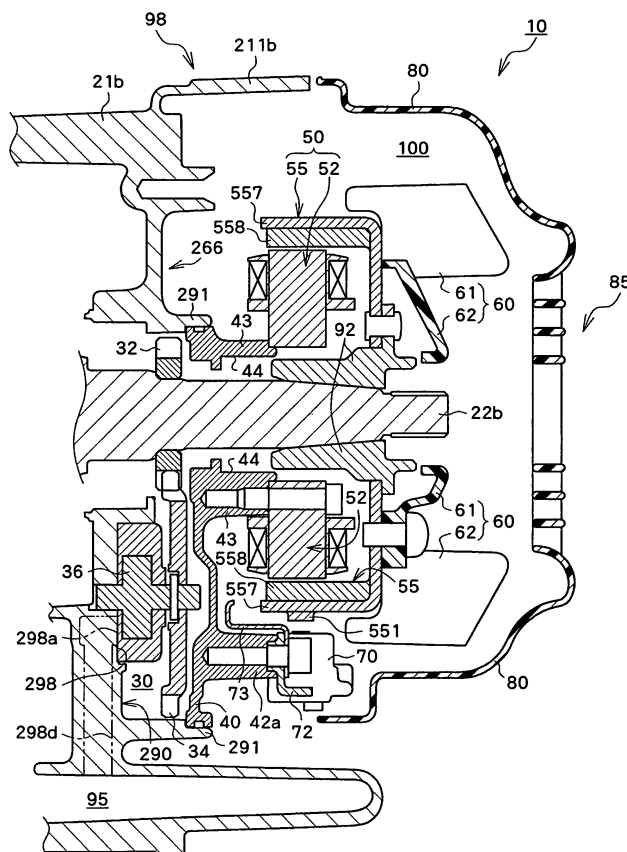


FIG. 4

Description

Technical Field

[0001] The present invention relates to an engine and a vehicle, for example a straddle-type vehicle.

Background Art

[0002] In known technology, an engine of a motorcycle etc. is provided with a crank angle sensor that detects a rotation angle of a crank shaft. The detected rotation angle is used for an ignition timing control and a fuel injection control of the engine. The crank angle sensor is attached, for example, to an attachment section extending from the crank case, and faces a member, such as a rotor of a generator, that rotates together with the crank shaft.

[0003] However, when the crank angle sensor is attached to the attachment section that extends from the crank case, the attachment section has to extend a relatively long distance along the crank shaft. As a result, the crank angle sensor tends to swing as a result of receiving vibration of the vehicle body.

[0004] Further, Japanese Patent No. 2649527 discloses a technology in which the crank angle sensor is attached to a cover for covering the engine. However, also in this case, the crank angle sensor tends to swing due to vibration of the cover.

[0005] The invention has been devised in light of the above-described circumstances and aims to provide an engine and a vehicle that are capable of reducing the swing of a crank angle sensor.

Summary

[0006] An aspect of the invention can provide an engine that includes: a crank case that supports a crank shaft; a crank angle sensor that detects a rotation angle of the crank shaft at a determined detection position; and a member that has an insertion hole into which the crank shaft is inserted and that is provided at a side closer to the detection position than the crank case. The crank angle sensor is attached to an attachment section that is formed in the member.

[0007] In such an engine, the attachment section to which the crank angle sensor is attached is formed in the member that is provided at the side closer to the detection position than the crank case. Therefore, the attachment section can be made shorter as compared to a case where the attachment section extends from the crank case. Accordingly, the swing of the crank angle sensor can be reduced.

[0008] In an embodiment the member can be an oil pump cover for closing an oil pump housing that is formed in the crank case. This arrangement allows the oil pump cover to also be used as the above-described member.

[0009] In this embodiment, an oil pump housed in the oil pump housing and the attachment section formed in

the oil pump cover may be located on the same side with respect to the crank shaft. With this arrangement, because the attachment section is located on the same side as the oil pump, the oil pump cover that covers the oil pump does not need to be made unnecessarily large.

[0010] Further, in an embodiment, the insertion hole of the member can be provided at a position away from a center section. This arrangement makes it easy to secure a space for forming the attachment section.

[0011] Further, in an embodiment, the member can have a disc shape and can include the insertion hole at a position offset from a center section. This arrangement makes it easy to secure a space for forming the attachment section.

[0012] In such arrangements, the attachment section may be located, with respect to the center section, at an opposite side from the insertion hole. This makes it possible to secure a space provided between the crank shaft and the attachment section.

[0013] Moreover, in an embodiment, a fan that rotates together with the crank shaft can be further provided. The attachment section can be formed at a position away from a flow passage through which a gas flow generated by the rotation of the fan passes from a side of the crank case to a side of a cylinder. This arrangement makes it possible to inhibit the gas flow that flows from the crank shaft side to the cylinder side from being obstructed by the attachment section and the crank angle sensor.

[0014] Further, in an embodiment, a fan that rotates together with the crank shaft can be further provided. A guide wall that guides a gas flow generated by the rotation of the fan can be formed in the member, and the attachment section and the guide wall can be formed adjacent to each other in a direction in which the gas flow is guided by the guide wall. This arrangement allows the attachment section and the crank angle sensor, as well as the guide wall, to guide the gas flow.

[0015] In such an embodiment, the crank angle sensor may be attached to the attachment section such that at least a part of the crank angle sensor protrudes to a back-side of a side to which the gas flow is guided by the guide wall. This arrangement allows the attachment section and the crank angle sensor to guide more gas flow.

[0016] Moreover, in an embodiment, the member can be assembled to the crank case after the member has been positioned with respect to the crank case using a positioning pin. With this arrangement, the member can be assembled more easily.

[0017] In addition, an aspect of the invention can provide a vehicle, for example a straddle-type vehicle, that includes any one of the engines described above. Examples of a straddle-type vehicle include a motorcycle (including a scooter), a four-wheeled buggy (an all terrain vehicle), and a snow mobile. The invention provides a straddle-type vehicle that is capable of reducing the swing of the crank angle sensor in the engine.

Brief Description of the Drawings

[0018] Embodiments of the invention are described hereinafter, by way of example only, with reference to the accompanying drawings.

FIG. 1 is a schematic side view of a straddle-type vehicle according an embodiment of the invention.
 FIG. 2 is a right side view of an engine according to the embodiment of the invention.
 FIG. 3 is a cross sectional view along line III-III in FIG. 2.
 FIG. 4 is a cross sectional view along line IV-IV in FIG. 2.
 FIG. 5 is a schematic view showing a state where an oil pump cover is fitted into a right side case of a crank case.
 FIG. 6 is a schematic view of the right side case.
 FIG. 7 is a schematic view of the oil pump cover.
 FIG. 8 is a partially enlarged view of FIG. 4.
 FIG. 9 is a partial cross sectional view along line IX-IX in FIG. 5.

Detailed description

[0019] An embodiment of the invention will be described with reference to the drawings.

[0020] FIG. 1 is a schematic side view of a motorcycle 1 according to an embodiment of a straddle-type vehicle, forming an example of a vehicle embodying of the invention. The motorcycle 1 includes a front fork 2 positioned in front (in the direction shown by F in the figure) of a vehicle body. A front wheel 3 is axially supported at the lower end of the front fork 2, and a handle 4 is attached to the upper end of the front fork 2. Further, the motorcycle 1 includes a seat 7 at the center of the vehicle body, and an engine 10 according to the embodiment of the invention is provided below the seat 7.

[0021] The engine 10 is supported by a pivot shaft attached to a body frame (not shown in the figures) such that the engine 10 can swing in an up-down direction. A rear arm 8 is provided to the rear of the engine 10, and a rear wheel 9 is axially supported at the rear end of the rear arm 8. In addition, a rear suspension 6 is provided between the rear end of the body frame and the rear end of the rear arm 8.

[0022] FIG. 2 is a right side view of the engine 10 according to the embodiment of the invention. In the figure, the structure to the inside of a cover 80 that covers the right side of the engine 10 is denoted by dotted lines. FIG. 3 is a cross sectional view along line III-III in FIG. 2. FIG. 4 is a cross sectional view along line IV-IV in FIG. 2.

[0023] FIG. 5 is a schematic view showing a state where an oil pump cover 40 is fitted into a right side case 21b of a crank case 21. Further, a crank angle sensor 70 is attached to the oil pump cover 40 shown in the figure. FIG. 6 is a schematic view of the right side case 21b.

FIG. 7 is a schematic view of the oil pump cover 40.

[0024] FIG. 8 is a partially enlarged view of FIG. 4. FIG. 9 is a partial cross sectional view along line IX-IX in FIG. 5. These figures illustrate the crank angle sensor 70 and sensor attachment sections 42a, 42b.

[0025] As shown in FIG. 2 and FIG. 3, in the engine 10, the crank case 21, a cylinder 24 and a cylinder head 27 are disposed in this order toward the front of the vehicle. A piston 25 is provided in the cylinder 24, and a combustion chamber 271 is formed between the piston 25 and the cylinder head 27. The piston 25 reciprocates in the cylinder 24 when an air-fuel mixture in the combustion chamber 271 is ignited by an igniter 28 and combusted.

[0026] The piston 25 is connected, via a connecting rod 23, to a crank shaft 22 that is rotatably supported by the crank case 21. Accordingly, the crank shaft 22 rotates in association with the reciprocation of the piston 25.

[0027] The crank shaft 22 includes a crank pin 221 to which the connecting rod 23 is connected, a pair of crank webs 222a, 222b arranged with the crank pin 221 interposed therebetween, and a pair of shaft sections 22a, 22b extending from the respective crank webs 222a, 222b to the outside in the vehicle width direction.

[0028] The crank case 21 is divided into left and right sections, and includes a left side case 21a and the right side case 21b. The left side case 21a and the right side case 21b are disposed with the pair of crank webs 222a, 222b of the crank shaft 22 interposed therebetween.

[0029] The shaft section 22a on the left side of the crank shaft 22 is axially supported by the left side case 21a, and extends outwardly from the left side case 21a to the left. A power transmission device (not shown in the figures) is attached to the shaft section 22a, and transmits power generated by the engine 10 to the rear wheel 9.

[0030] On the other hand, the shaft section 22b on the right side of the crank shaft 22 is inserted into an insertion hole 293 formed in the right side case 21b. The shaft section 22b is axially supported by the right side case 21b, and extends outwardly from the right side case 21b to the right. A generator 50, described later, is provided on the shaft section 22b.

[0031] The cover 80 is provided on the right side of the engine 10. The cover 80 covers a greater part of the right side of the crank case 21, the cylinder 24 and the cylinder head 27. A generator housing 100 is formed between the cover 80 and the crank case 21, the cylinder 24 and the cylinder head 27.

[0032] Walls 211a, 211b and 211c, which protrude toward the outside in the vehicle width direction, are formed at the rear of, above, and at the lower front of an edge of a right side section 26b of the right side case 21b. An edge of the cover 80 is fixed to these walls. Further, an air intake port 85 for taking outside air into the generator housing 100 is formed in the cover 80 in the vicinity of the tip end of the shaft section 22b.

[0033] In addition, an insertion opening 87 into which

the igniter 28 is inserted, and an exhaust opening 88 connected to an exhaust port in the cylinder head 27 are formed in the cover 80 in the vicinity of the cylinder head 27. An exhaust pipe 90 is attached to the exhaust opening 88 (refer to FIG. 2).

[0034] In addition, as shown in FIG. 6, a circular section 290 and an opening section 291 are formed in the right side section 26b of the right side case 21b. The circular section 290 includes, above a center section thereof, an insertion hole 293 to which the shaft section 22b is inserted. The opening section 291 extends to the outside, in the vehicle width direction, of the circular section 290 so as to surround the circular section 290. Further, a pump attachment section 298 that is recessed toward the center in the vehicle width direction is formed below the insertion hole 293 in the circular section 290. As shown in FIG. 4, a trochoid type oil pump 36 is attached to the pump attachment section 29.

[0035] The oil pump cover 40, which is disc shaped, is fitted into the opening section 291. An oil pump housing 30 is formed between the circular section 290 and the oil pump cover 40. The oil pump cover 40 is one example of a member of the invention. Further, an insertion hole 44 is formed in the oil pump cover 40 at a position corresponding to the insertion hole 293 in the circular section 290, and the shaft section 22b is inserted into the insertion hole 44.

[0036] In addition to the oil pump 36, a driving gear 32 fitted into the shaft section 22b, and a driven gear 34 having a shaft section that is also used as a shaft section of the oil pump 36 are housed in the oil pump housing 30 such that the driving gear 32 and the driven gear 34 mesh with each other. Thus, the oil pump 36 rotates along with rotation of the shaft section 22b.

[0037] A suction port 298a that is used for the oil pump 36 to suck oil, and a discharge port 298b that is used for the oil pump 36 to discharge oil are formed in the pump attachment section 298. As shown in FIG. 4, the oil that collects in an oil reservoir 95 provided at the bottom of the crank case 21 is sucked up through a suction passage 298d, and is sucked into the oil pump 36 from the suction port 298a. Further, the oil that is discharged from the oil pump 36 is supplied to the various sections of the engine 10 from the discharge port 298b through a supply passage (not shown in the figures).

[0038] A plurality of attachment sections 295 are formed in the periphery of the circular section 290. The attachment sections 295 support the oil pump cover 40 at the tip end of the opening section 291, and the oil pump cover 40 is screwed to the attachment sections 295. Screw holes 46 are provided in the oil pump cover 40 at positions corresponding to the respective attachment sections 295 of the circular section 290.

[0039] Moreover, a pin hole 296 is formed in the periphery edge of the circular section 290. A positioning pin 47 is provided on a rear surface (a surface on the oil pump housing 30 side) of the oil pump cover 40, and is inserted into the pin hole 296. The disc shaped oil pump

cover 40 is fitted into the annular opening section 291 while the positioning pin 47 is inserted into the pin hole 296 formed in the circular section 290. Thus, the oil pump cover 40 is fixed in the circumferential direction. As a result, the respective screw holes 46 of the oil pump cover 40 are positioned at the locations of the respective attachment sections 295 of the circular section 290.

[0040] Further, as shown in FIG. 3 and FIG. 4, the generator 50 is provided on the outer side, in the vehicle width direction, of the right side section 26b of the right side case 21b and the oil pump cover 40 fitted into the right side case 21b. The generator 50 includes a stator 52 that is fixed to the right side case 21b, and a rotor 55 that is fixed to the shaft section 22b and rotates together with the shaft section 22b.

[0041] The stator 52 includes a generating coil, and is attached to stator attachment sections 43 that are formed around the insertion hole 44 of the oil pump cover 40. The stator attachment sections 43 extend toward the outside in the vehicle width direction along the shaft section 22b, and the stator 52 is screwed and fixed to the stator attachment sections 43.

[0042] The rotor 55 is attached to a collar section 92 that is fitted to the shaft section 22b, and has an annular section 557 that surrounds the outer periphery of the stator 52. A magnet 558 is provided along an inner peripheral surface of the annular section 557.

[0043] Further, protrusions 551 are formed in an outer peripheral surface of the annular section 557 at predetermined intervals in the circumferential direction. These protrusions 551 are provided to allow the crank angle sensor 70 to detect the rotation angle of the crank shaft 22.

[0044] Further, a fan 60 is provided at the tip end of the shaft section 22b. The fan 60 includes an attachment section 62 that is attached to the annular section 557 of the rotor 55, and a plurality of vanes 61 that are formed in the attachment section 62.

[0045] The fan 60 rotates together with the shaft section 22b, and thereby takes in the outside air from the air intake port 85 provided in the cover 80 to generate gas flow in the generator housing 100. The generated gas flow flows to the cylinder 24 side, as shown by the chain double-dashed line in FIG. 2, and cools the cylinder 24.

[0046] Note that, as shown in FIG. 2, the cover 80 has a lower end section 82b having a shape that is deformed in the vicinity of the boundary between the right side case 21b and the cylinder 24 such that the distance between an upper end section 82a and the center of the cylinder 24 is longer than the distance between the lower end section 82b and the center of the cylinder 24. Further, as shown in FIG. 5, the distance between the shaft section 22b and the wall 211b provided at the upper side of the right side case 21b is longer than the distance between the shaft section 22b and the wall 211c provided at the lower front side of the right side case 21b.

[0047] In this manner, the generator housing 100 has a wider space on the upper side than on the lower side,

in the vicinity of the boundary between the right side case 21b and the cylinder 24. Accordingly, the gas flow that is generated by the rotation of the fan 60 flows from above the shaft section 22b to the side of the cylinder 24. That is, the space above the shaft section 22b serves as a flow passage 98 through which the gas flow passes from the side of the right side case 21b to the side of the cylinder 24.

[0048] Further, the gas flow that is generated below the shaft section 22b does not flow to the cylinder 24 side, but flows to the rear, and is fed to the upper side along the wall 211a provided at the rear. Then, the gas flow flows to the cylinder 24 side through the flow passage 98. Note that the oil pump cover 40 includes a guide wall 49 with a tabular shape at the lower front of the shaft section 22b. The guide wall 49 guides the gas flow generated below the shaft section 22b toward the rear.

[0049] Furthermore, the oil pump cover 40 includes, at a position below the shaft section 22b, the pair of sensor attachment sections 42a, 42b for attaching the crank angle sensor 70. The crank angle sensor 70 is attached between the sensor attachment sections 42a and 42b using brackets 72, 73.

[0050] The sensor attachment sections 42a, 42b are located at a position below the center section of the oil pump cover 40. Accordingly, the sensor attachment sections 42a, 42b are located, with respect to the center section, on the opposite side from the insertion hole 44 into which the shaft section 22b is inserted. Further, the sensor attachment sections 42a, 42b are located, with respect to the shaft section 22b, on the same side as the oil pump 36.

[0051] Moreover, the sensor attachment sections 42a, 42b are formed adjacent to each other in the direction in which the gas flow is guided by the guide wall 49. Further, the crank angle sensor 70 that is attached between the sensor attachment sections 42a and 42b is attached such that a part of the crank angle sensor 70 protrudes to the backside of the side (the shaft section 22b side) to which the gas flow is guided by the guide wall 49.

[0052] Note that, as shown in FIG. 8 and FIG. 9, the sensor attachment sections 42a, 42b are provided to extend, in the axial direction of the shaft section 22b, from a surface (a surface on the generator housing 100 side) of the oil pump cover 40 toward the outside in the vehicle width direction where the generator 50 is located. The brackets 72, 73 are screwed to the tip ends of the sensor attachment sections 42a, 42b such that the crank angle sensor 70 is fixed.

[0053] More specifically, the bracket 72 has a U-shape that includes a hook like center section at a side away from the shaft section 22b. The crank angle sensor 70 is supported by the center section. Further, both ends of the bracket 72 have a screw hole, and are screwed to the sensor attachment sections 42a, 42b. In addition, the bracket 73 has a U-shape that extends downward toward the oil pump housing 30 side at a side close to the shaft section 22b. Both ends of the bracket 73 have a screw

hole, and are screwed to the sensor attachment sections 42a, 42b.

[0054] The crank angle sensor 70, which is attached to the tip ends of the sensor attachment sections 42a, 42b in this manner, faces an outer peripheral surface of the rotor 55 of the generator 50. The crank angle sensor 70 includes a coil, and detects the rotation angle of the crank shaft 22 by outputting induced current that is generated when the protrusions 551 provided on the outer peripheral surface of the rotor 55 approach.

[0055] That is, the detection position of the crank angle sensor 70 is set to the surrounding of the generator 50 that is provided away from the right side case 21b in the axial direction of the shaft section 22b, and more specifically is set to the position that faces the outer peripheral surface of the rotor 55 that rotates together with the shaft section 22b. Further, the detection position of the crank angle sensor 70 is set to a position that is to the outside in the vehicle width direction of the oil pump cover 40 that is attached to the right side section 26b of the right side case 21b.

[0056] Therefore, the sensor attachment sections 42a, 42b extend from the surface (the surface on the generator housing 100 side) of the oil pump cover 40 to the outside in the vehicle width direction where the generator 50 is located, and the crank angle sensor 70 that is attached to the tip ends of the sensor attachment sections 42a, 42b is disposed to face the outer peripheral surface of the rotor 55.

[0057] Because the oil pump cover 40 is attached to the outside in the vehicle width direction of the right side case 21b, the distance from the detection position of the crank angle sensor 70 to the oil pump cover 40 is shorter than the distance from the detection position to the right side case 21b. For example, the distance from the detection position of the crank angle sensor 70 to the oil pump cover 40 is shorter than the distance from the detection position of the crank angle sensor 70 to a section in the right side case 21b, for example, the circular section 290 (particularly, the pump attachment section 298) that serves as the bottom of the oil pump housing 30, or the right side section 26b located in the surrounding of the circular section 290.

[0058] In this manner, the sensor attachment sections 42a, 42b extend from the oil pump cover 40. Therefore, the length of the sensor attachment sections 42a, 42b can be made shorter, as compared to a case where the sensor attachment sections 42a, 42b are provided to extend from the right side case 21b. As a result, the swing of the crank angle sensor 70 can be reduced.

[0059] In addition, the shaft section 22b is inserted to the insertion hole 44 in the oil pump cover 40, and the oil pump cover 40 is disposed between the right side case 21b and the generator 50 such that the oil pump cover 40 is fitted and fixed to the right side case 21b. As a result, the swing of the crank angle sensor 70 can be reduced, as compared to other members such as the cover 80.

[0060] Hereinabove, one embodiment of the invention

is described. However, the invention is not limited to the above-described embodiment. In the above-described embodiment, the oil pump cover 40 is used as an example of the member according to the invention. However, the member is not limited to the oil pump cover 40, and it is sufficient that the member includes an insertion hole to which the crank shaft 22 is inserted, and is provided at a side closer to the detection position of the crank angle sensor 70 than the crank case 21.

[0061] Moreover, in the above-described embodiment, the detection target of the crank angle sensor 70 is the rotor 55 that rotates together with the crank shaft 22. However, the detection target is not limited to the rotor 55, and another member that rotates together with the crank shaft 22 may be taken as the detection target.

Description of the Reference Numerals and Signs

[0062] 1... Motorcycle (One example of a vehicle), 2... Front fork, 3... Front wheel, 4... Handle, 6... Rear suspension, 7... Seat, 8... Rear arm, 9... Rear wheel, 10... Engine, 21... Crank case, 21a... Left side case, 21b... Right side case, 22... Crank shaft, 22a, 22b... Shaft section, 23... Connecting rod, 24... Cylinder, 25... Piston, 26b... Right side section, 27... Cylinder head, 28... Igniter, 30... Oil pump housing, 32... Driving gear, 34... Driven gear, 36... Oil pump, 40... Oil pump cover (One example of a member), 42a, 42b... Sensor attachment section, 43... Stator attachment section, 44... Insertion hole, 46... Screw hole, 47... Positioning pin, 49... Guide wall, 50... Generator, 52... Stator, 55... Rotor, 60... Fan, 61... Vane, 62... Attachment section, 70... Crank angle sensor, 72, 73 ... Bracket, 80... Cover, 82a... Upper end section, 82b... Lower end section, 85... Air intake port, 87... Insertion opening, 88... Exhaust opening, 90... Exhaust pipe, 92... Collar section, 95... Oil reservoir, 98... Flow passage, 100... Generator housing, 211a, 211b, 211c... Wall, 221... Crank pin, 222a, 222b... Crank web, 271... Combustion chamber, 290... Circular section, 291... Opening section, 293... Insertion hole, 295... Attachment section, 296... Pin hole, 298... Pump attachment section, 298a... Suction port, 298b... Discharge port, 298d... Suction passage, 551... Protrusion, 557... Annular section, 558... Magnet

Claims

1. An engine, comprising:

a crank case that supports a crank shaft;
a crank angle sensor that detects a rotation angle of the crank shaft at a determined detection position; and
a member that has an insertion hole into which the crank shaft is inserted and that is provided at a side closer to the detection position than the crank case, wherein

the crank angle sensor is attached to an attachment section that is formed in the member.

2. The engine according to claim 1, wherein the member is an oil pump cover for closing an oil pump housing that is formed in the crank case.

3. The engine according to claim 2, wherein an oil pump housed in the oil pump housing and the attachment section formed in the oil pump cover are located on the same side with respect to the crank shaft.

4. The engine according to any one of claims 1 to 3, wherein the insertion hole of the member is provided at a position away from a center section.

5. The engine according to any one of claims 1 to 3, wherein the member has a disc shape and includes the insertion hole at a position offset from a center section.

6. The engine according to claim 4 or claim 5, wherein the attachment section is located, with respect to the center section, at an opposite side from the insertion hole.

7. The engine according to any one of claims 1 to 6, further comprising:

a fan that rotates together with the crank shaft, wherein
the attachment section is formed at a position away from a flow passage through which a gas flow generated by the rotation of the fan passes from a side of the crank case to a side of a cylinder.

8. The engine according to any one of claims 1 to 6, further comprising:

a fan that rotates together with the crank shaft, wherein
a guide wall that guides a gas flow generated by the rotation of the fan is formed in the member, and
the attachment section and the guide wall are formed adjacent to each other in a direction in which the gas flow is guided by the guide wall.

9. The engine according to claim 8, wherein the crank angle sensor is attached to the attachment section such that at least a part of the crank angle sensor protrudes to a backside of a side to which the gas flow is guided by the guide wall.

10. The engine according to any one of claims 1 to 9, characterized in that the member is assembled to the crank case after the member has been positioned

with respect to the crank case using a positioning pin.

- 11.** A vehicle comprising the engine according to any one of claims 1 to 10.

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- 12.** The vehicle of claim 11, wherein the vehicle is a straddle-type vehicle.

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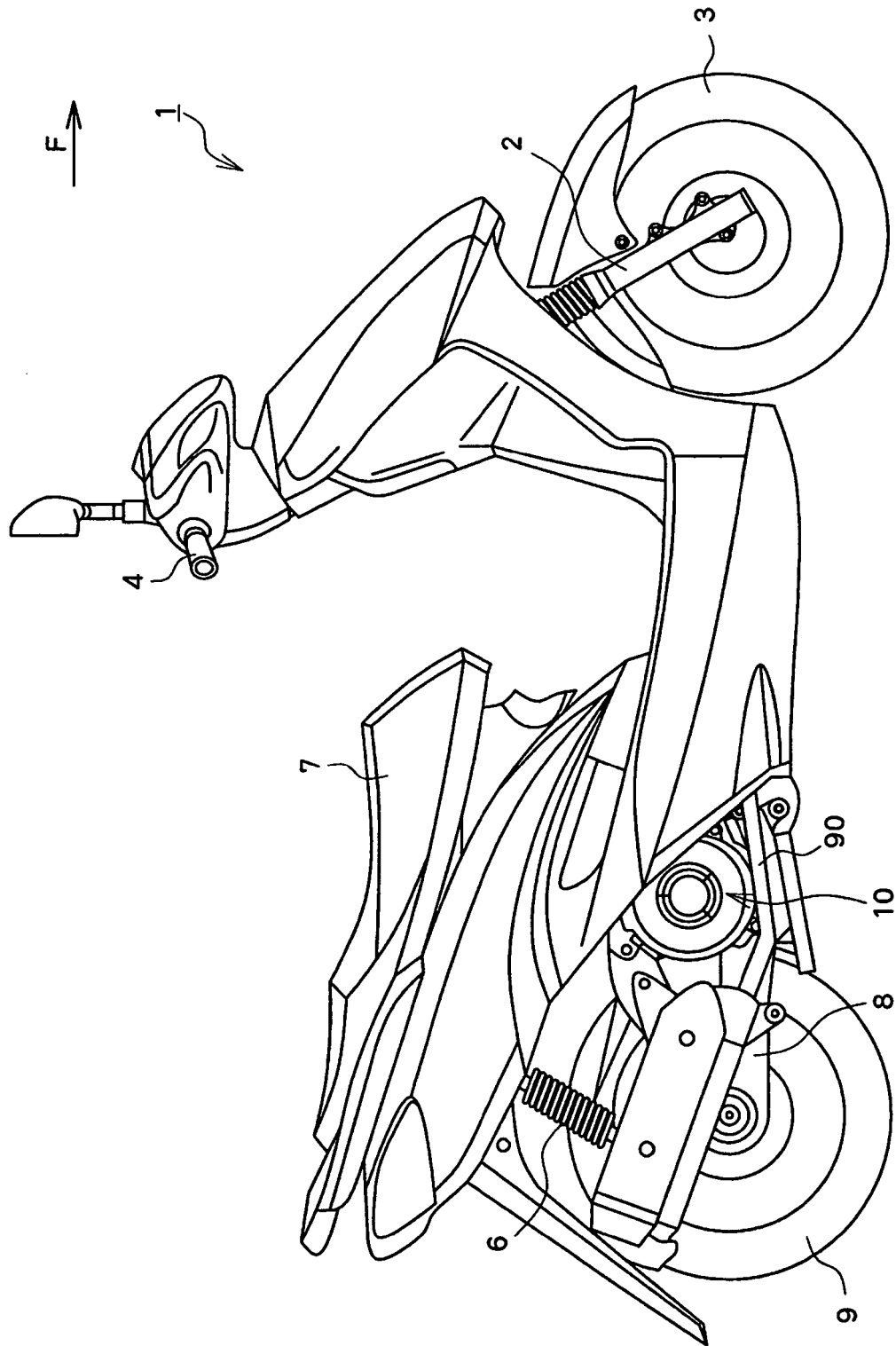


FIG. 1

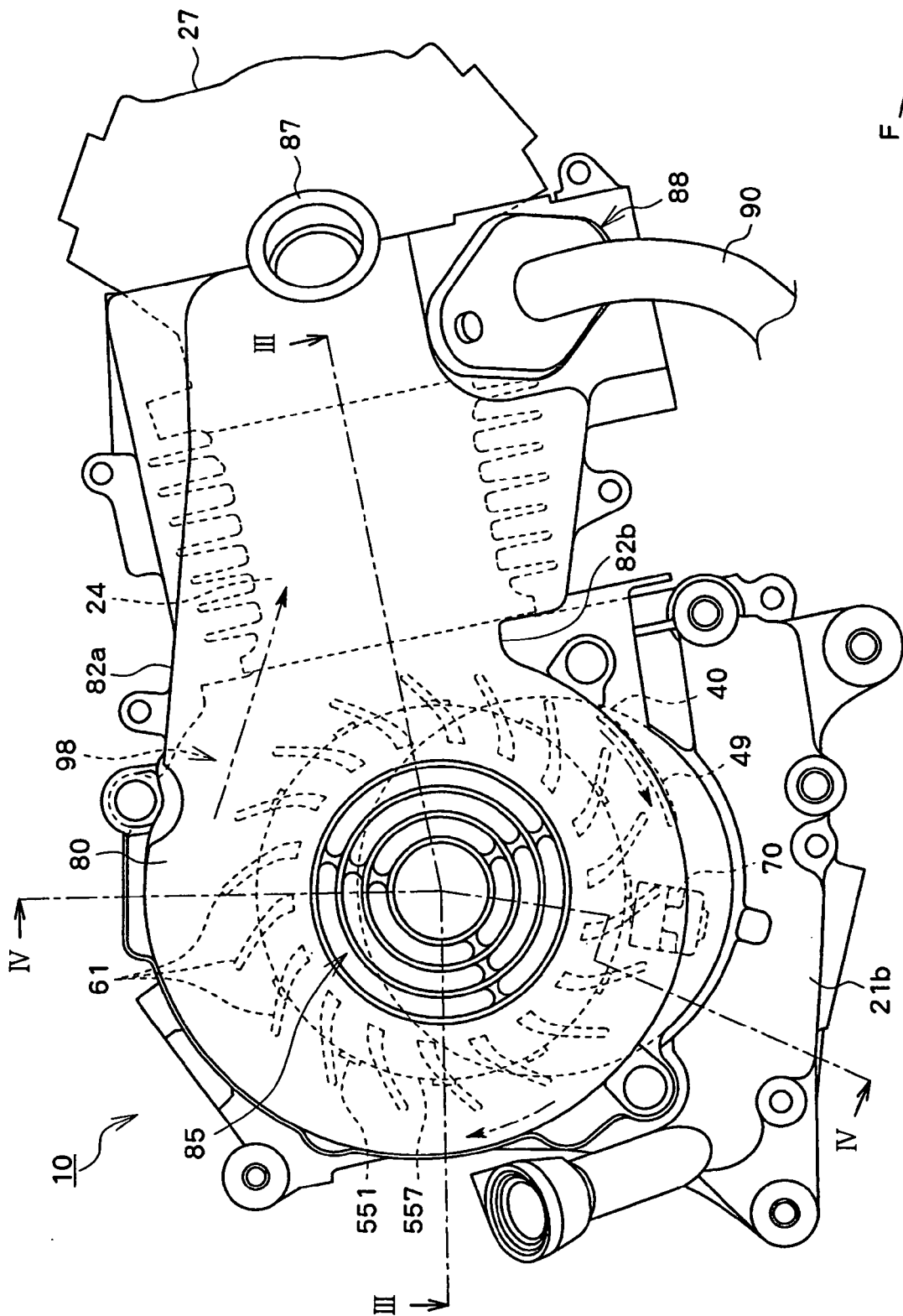


FIG. 2

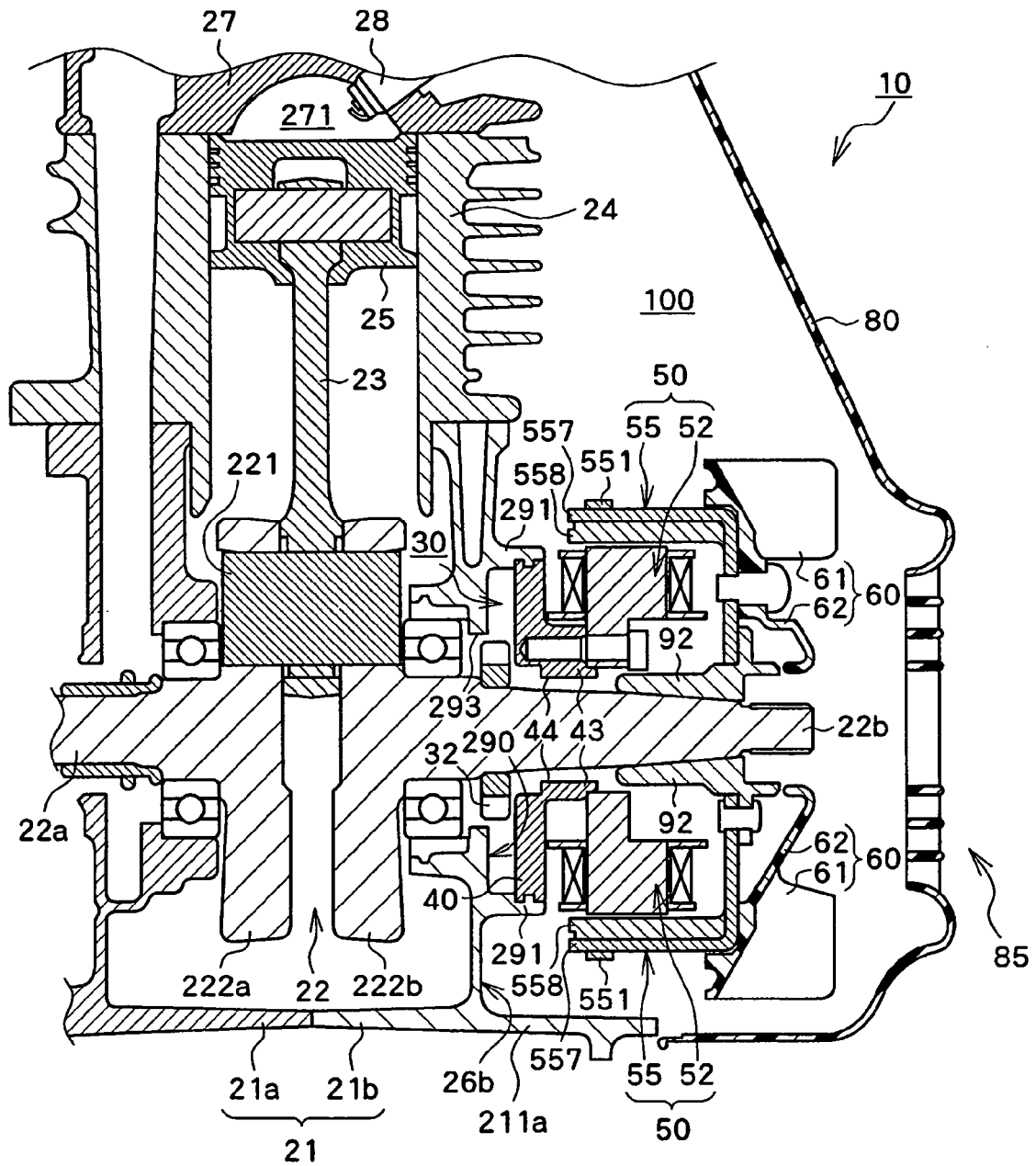


FIG. 3

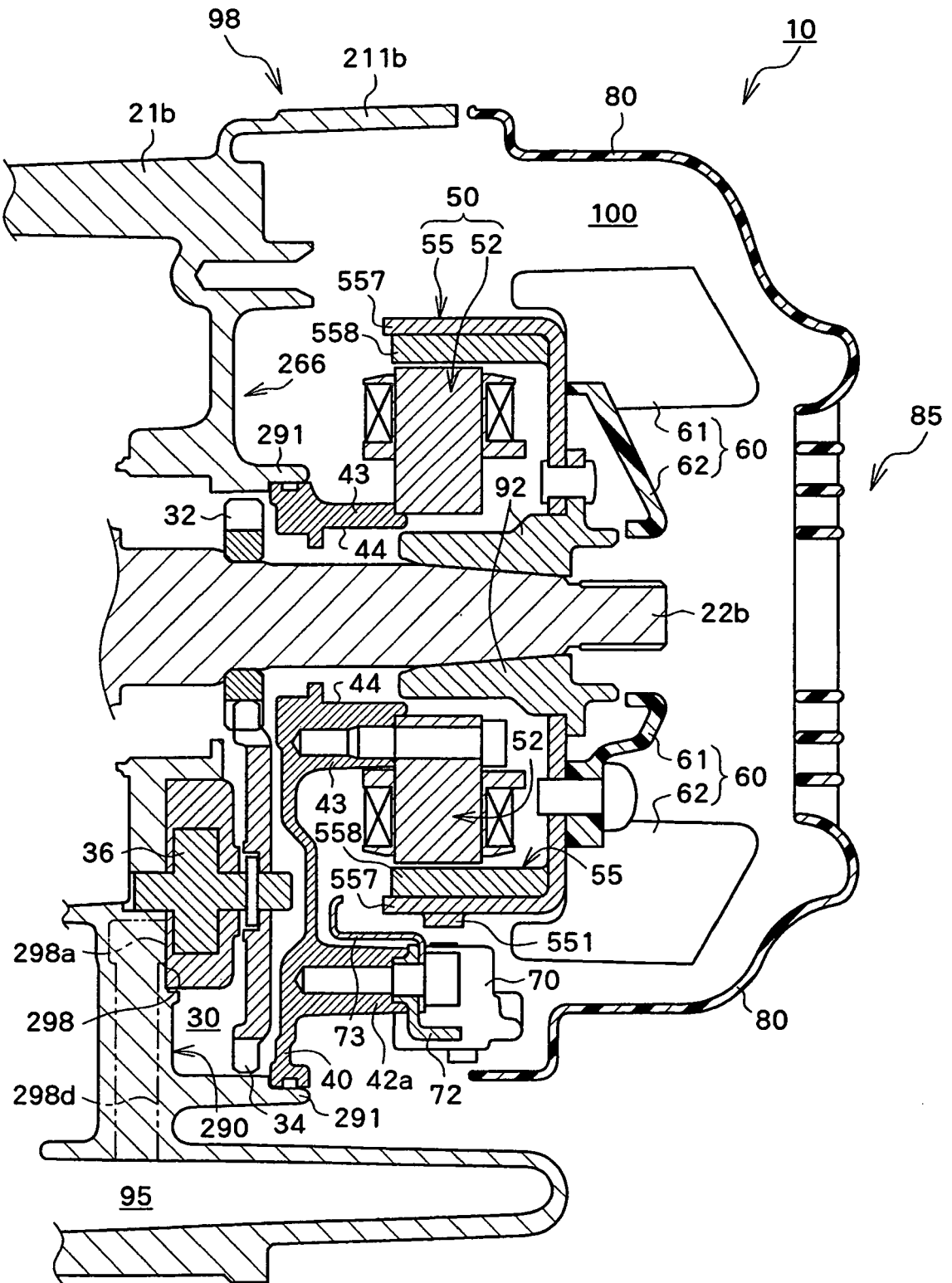


FIG. 4

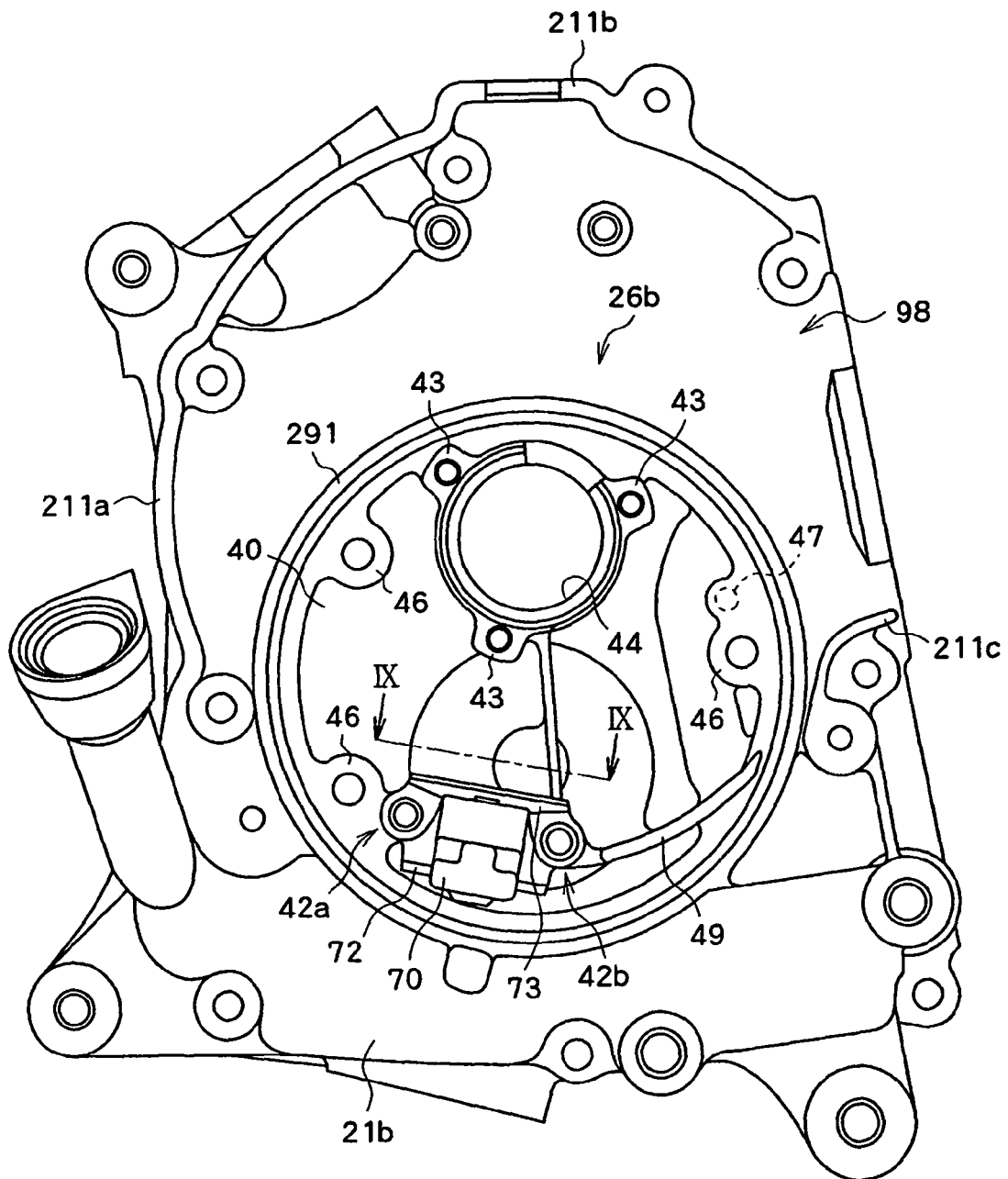


FIG. 5

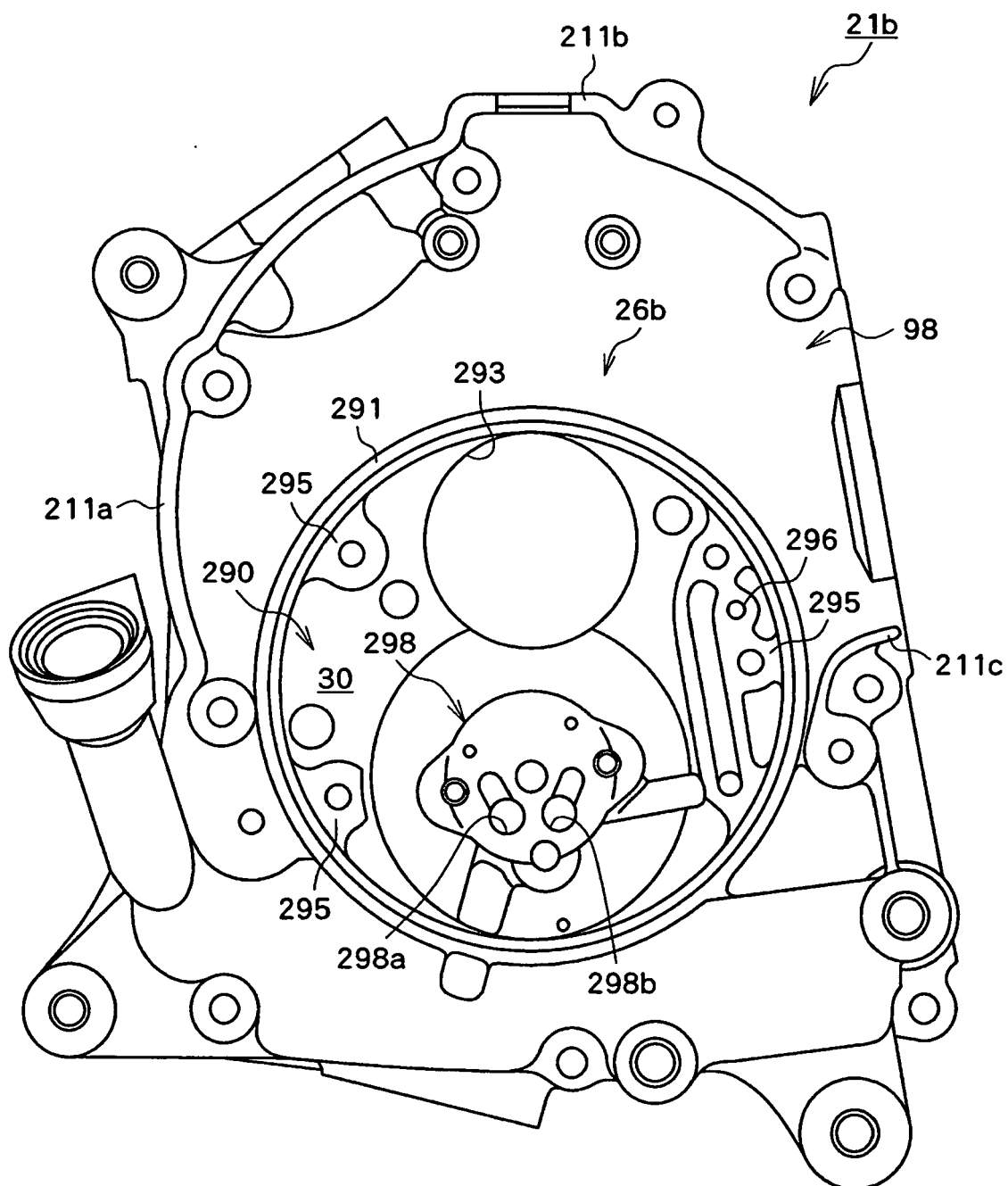


FIG. 6

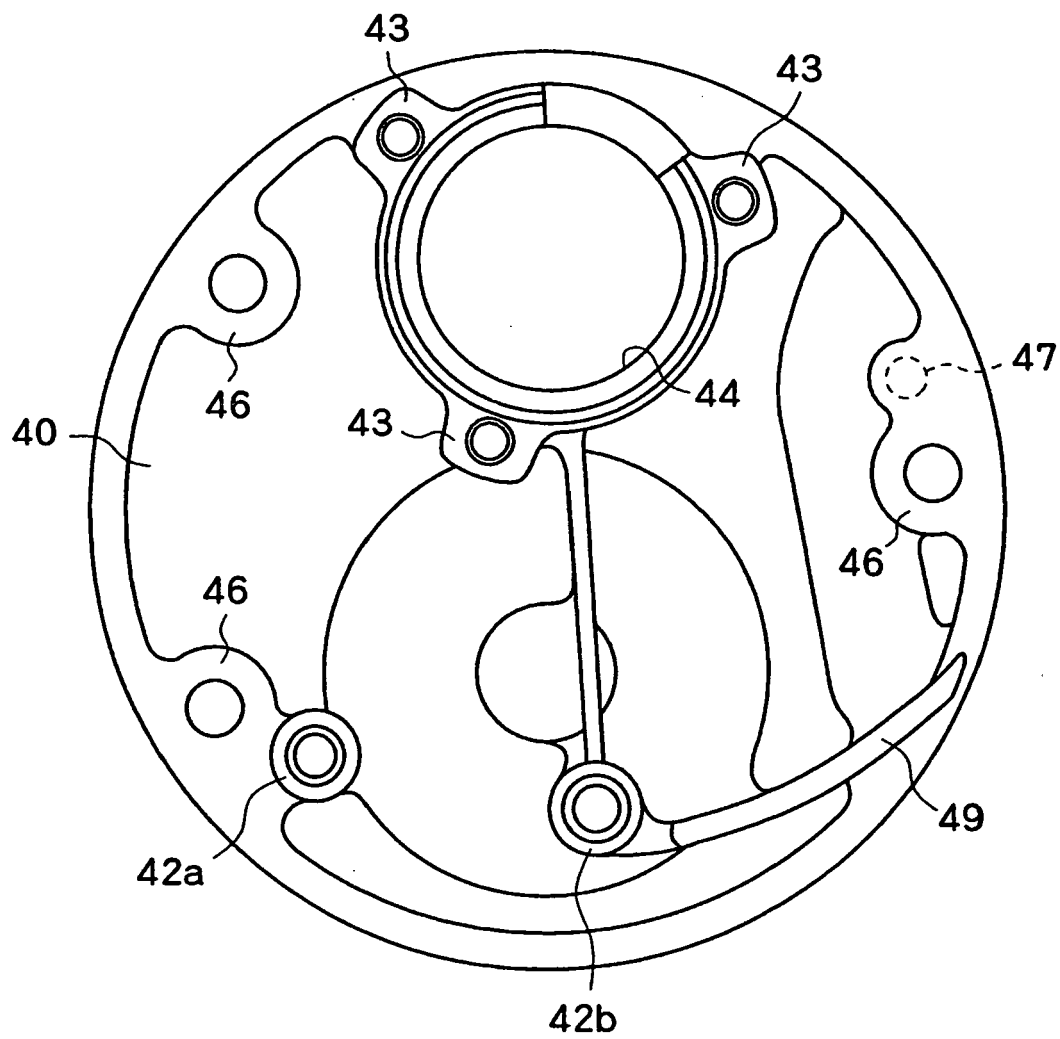


FIG. 7

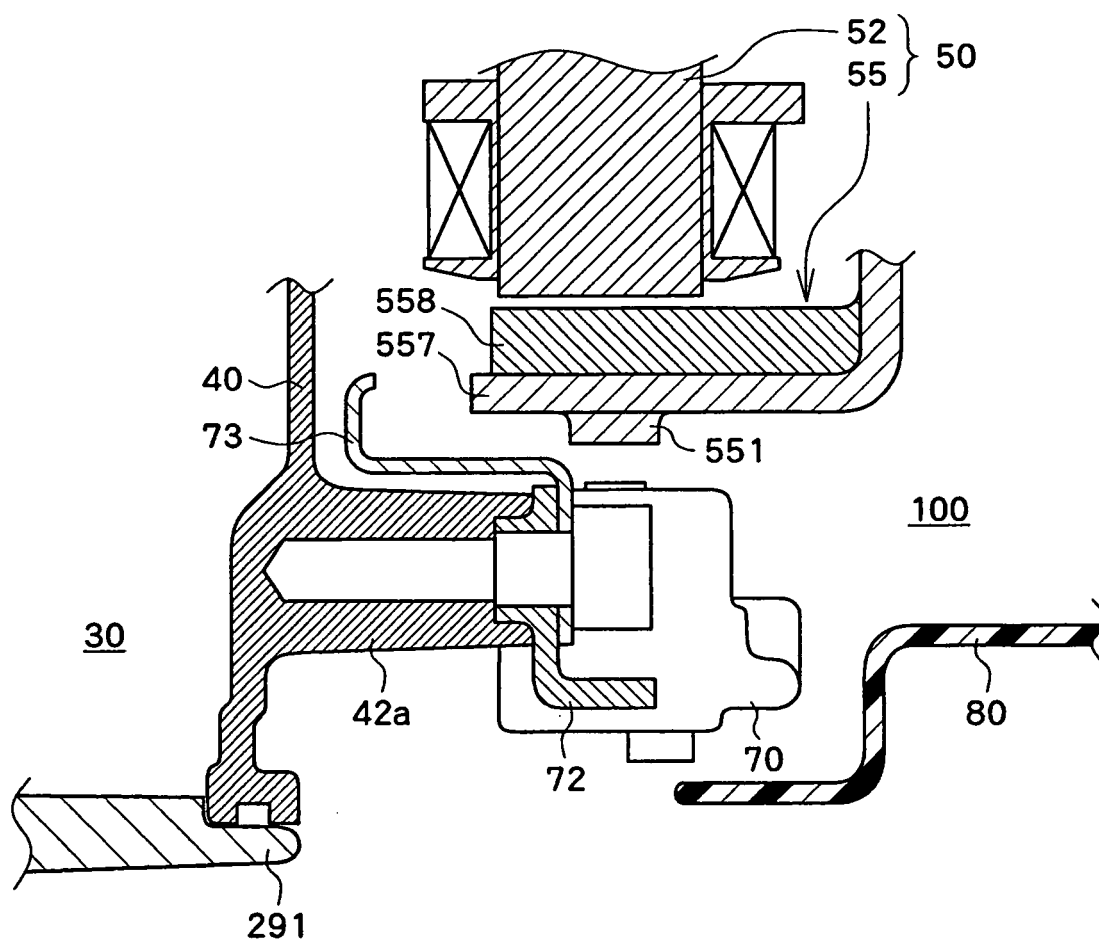


FIG. 8

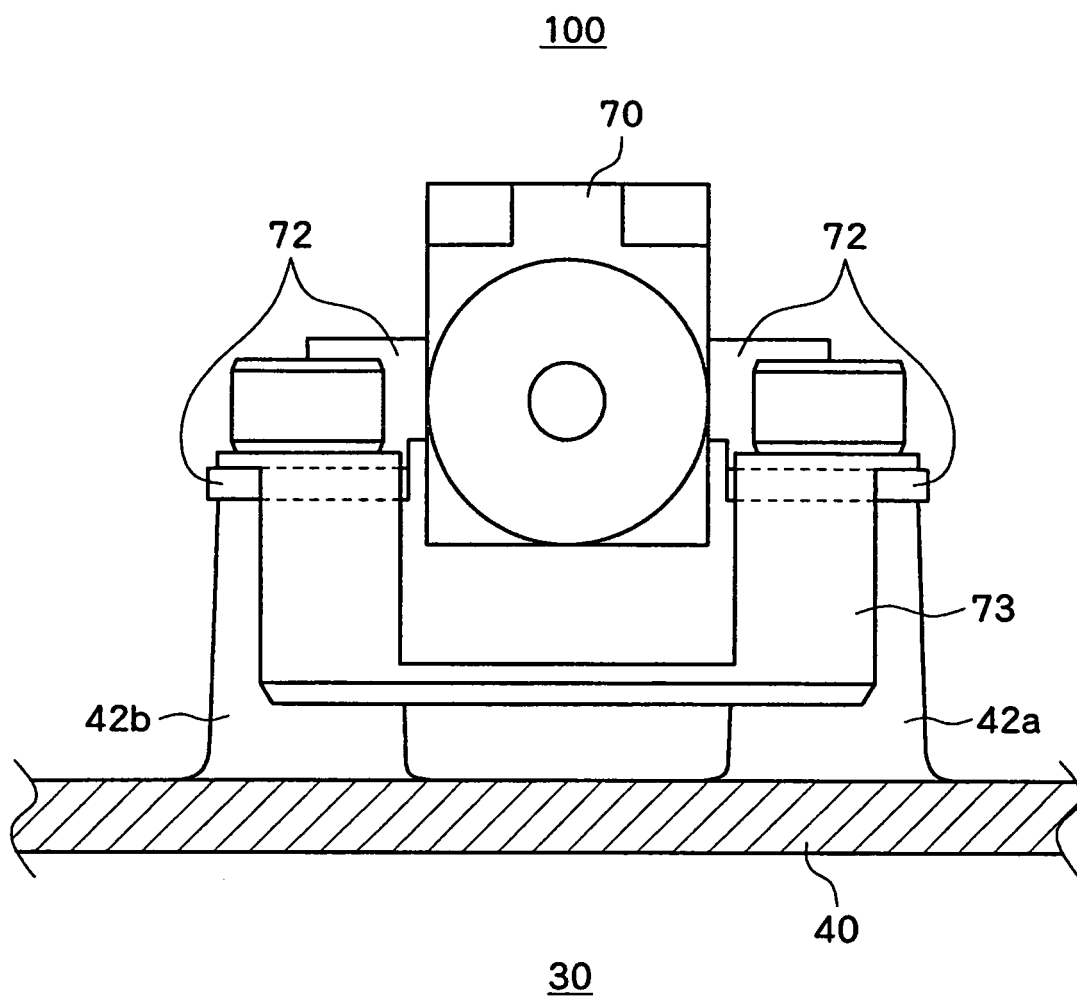


FIG. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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