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(54) **INTERNAL COMBUSTION ENGINE**
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Description

[Technical Field]

5 **[0001]** This invention relates to an internal combustion engine.

[Background of the Invention]

10 **[0002]** Conventionally, an engine with a variable valve timing mechanism is known as an engine mounted on a vehicle (see JP 2008- 215 323 A).

[0003] In the engine with the variable valve timing mechanism, an intake side actuator and an exhaust side actuator are attached to one of axial end portions of an intake cam shaft and an exhaust cam shaft.

[0004] The intake side actuator and the exhaust side actuator are operated by an operating fluid supplied from a hydraulic control valve to change rotation phases of the intake cam shaft and the exhaust cam shaft with respect to a crankshaft.

15 **[0005]** The intake side actuator and the exhaust side actuator are covered with a cover member. A mount attachment portion is provided on an upper portion of the cover member and is connected to a vehicle body through an engine mount.

[0006] DE10 2019 210463 A1, JP 4 517514 B2 and CN 105 386 806 A disclose internal combustion engines with parallel intake and exhaust cam shafts and variable valve devices arranged at axial end portions of the cam shafts and covered by a cover member attached to an end portion of an engine main body.

20 **[0007]** US 9 046 014 B2 discloses an internal combustion engine with parallel intake and exhaust cam shafts and variable valve devices at the axial ends thereof. The variable valve devices are respectively driven by an electric motor. The electric motors are supported by the intake and exhaust cam shafts and are sealed by two separate cover members that are respectively fixed to an outside surface of a chain cover.

25 [Summary of the Invention]

[Problem to be solved by the Invention]

30 **[0008]** However, in such a conventional engine with the variable valve timing mechanism, end surfaces of the intake and exhaust side actuators facing the cover member are located on the same plane.

[0009] In addition, a wall surface of the cover member facing the end surfaces of the intake and exhaust side actuators is a flat surface and the mount attachment portion is provided on the flat surface.

35 **[0010]** Therefore, the surface rigidity of the cover member at the attachment position of the mount attachment portion may decrease, the mount attachment portion may be likely to vibrate due to the vibration of the engine, and the support rigidity of the internal combustion engine may decrease. Thus, there is still room for improvement in order to increase the support rigidity of the internal combustion engine.

40 **[0011]** This invention has been made in view of the above-described circumstances and an object of this invention is to provide an internal combustion engine capable of improving surface rigidity of a cover member at an attachment position of a mount attachment portion and suppressing a vibration of the mount attachment portion due to a vibration of the internal combustion engine, thereby increasing support rigidity of the internal combustion engine.

[Means to solve the problem]

45 **[0012]** According to this invention, there is provided an internal combustion engine with the features of claim 1.

[Effect of the Invention]

50 **[0013]** In this way, according to this invention, it is possible to improve surface rigidity of a cover member at an attachment position of a mount attachment portion and suppress a vibration of the mount attachment portion due to a vibration of the internal combustion engine, thereby increasing support rigidity of the internal combustion engine.

[Brief description of figures]

55 **[0014]**

Fig. 1 is a right side view of an internal combustion engine according to an embodiment of this invention.

Fig. 2 is a right side view of the internal combustion engine according to an embodiment of this invention and is a

right side view of an upper portion of the internal combustion engine from which an intake solenoid and an exhaust solenoid are removed.

Fig. 3 is a top view of the internal combustion engine according to an embodiment of this invention and is a top view of a right portion of the internal combustion engine from which a cylinder head cover is removed.

Fig. 4 is a cross-sectional view when viewed from a direction IV-IV of Fig. 1.

Fig. 5(a) is a configuration diagram of an intake variable valve device of the internal combustion engine according to an embodiment of this invention.

Fig. 5(b) is a configuration diagram of an exhaust variable valve device of the internal combustion engine according to an embodiment of this invention.

[Embodiment(s) of the Invention]

[0015] Hereinafter, embodiments of an internal combustion engine according to this invention will be described with reference to the drawings.

[0016] Figs. 1 to 5 are diagrams showing an internal combustion engine according to an embodiment of this invention. In Figs. 1 to 5, the up, down, front, rear, right, and left directions are based on the state of the internal combustion engine installed in the vehicle, the front and rear direction of the vehicle is the front and rear direction, the right and left direction of the vehicle (the vehicle width direction) is the right and left direction, and the up and down direction of the vehicle (the height direction of the vehicle) is the up and down direction.

[0017] First, a configuration will be described.

[0018] As shown in Fig. 1, an engine 1 mounted on the vehicle includes an engine main body 2. As shown in Fig. 4, the engine main body 2 includes a cylinder block 3 and a cylinder head 4. The cylinder head 4 is provided on the upper portion of the cylinder block 3.

[0019] A cylinder head cover 5 is attached to the upper portion of the cylinder head 4 and an oil pan 6 storing oil is attached to the lower portion of the cylinder block 3 (see Fig. 1). The engine 1 and the engine main body 2 of this embodiment constitute the internal combustion engine and the internal combustion engine main body, respectively.

[0020] A plurality of cylinders (not shown) are provided in the cylinder block 3 so as to be arranged side by side in the width direction of the vehicle (hereinafter referred to as the vehicle width direction) which is the right and left direction.

[0021] Pistons (not shown) are accommodated in the respective cylinders and each piston is connected to a crankshaft 3S (see Fig. 1) through a connecting rod (not shown). Each piston reciprocates in the cylinder to rotate the crankshaft through the connecting rod. A plurality of intake ports and a plurality of exhaust ports (not shown) are formed in the cylinder head 4.

[0022] The intake port communicates with the respective cylinders to introduce an intake air therein. An exhaust manifold communicates with the plurality of cylinders through the exhaust ports, collects an exhaust gas discharged from the plurality of cylinders, and discharges the collected exhaust gas from an exhaust outlet to a catalytic converter (not shown).

[0023] As shown in Fig. 3, an intake cam shaft 11 and an exhaust cam shaft 12 are installed on the cylinder head 4. The intake cam shaft 11 and the exhaust cam shaft 12 are rotatably supported to the cylinder head 4 by a bearing cap 13.

[0024] The intake cam shaft 11 and the exhaust cam shaft 12 are arranged side by side in the front and rear direction so that axes 11a and 12a thereof extend in parallel in the vehicle width direction.

[0025] The intake cam shaft 11 includes a plurality of intake cams 11A (one of them is shown in the drawing) arranged side by side in the direction of the axis 11a of the intake cam shaft 11. Hereinafter, the direction of the axis 11a of the intake cam shaft 11 is referred to as the axial direction.

[0026] For example, pairs of the intake cams 11A are used for the respective cylinders (i.e., two among the intake cams 11A are used for one cylinder). An intake valve (not shown) is provided in the intake port, and the intake cam 11A operates the intake valve to open and close the intake port and to permit and prohibit the communication between the cylinder and the intake port.

[0027] The exhaust cam shaft 12 includes a plurality of exhaust cams 12A (one of them is shown in the drawing) arranged side by side in the direction of the axis 12a of the exhaust cam shaft 12. Hereinafter, the direction of the axis 12a of the exhaust cam shaft 12 is referred to as the axial direction.

[0028] Further, the axial directions of the intake cam shaft 11 and the exhaust cam shaft 12 are parallel to each other and thus, may be simply referred to as the axial direction of the intake cam shaft 11 for convenience of explanation.

[0029] For example, pairs of the exhaust cams 12A are used for the respective cylinders (i.e., two among the exhaust cams 12A are used for one cylinder). An exhaust valve (not shown) is provided in the exhaust port, and the exhaust cam 12A operates the exhaust valve to open and close the exhaust port to permit and prohibit the communication between the cylinder and the exhaust port.

[0030] An intake variable valve device 15 is attached to the right end portion (one end portion) of the intake cam shaft 11 in the axial direction. The intake variable valve device 15 includes an intake side housing member 23 of which the

outer peripheral portion is provided with an intake sprocket 23 S.

[0031] An exhaust variable valve device 16 is attached to the right end portion (one end portion) of the exhaust cam shaft 12 in the axial direction. The exhaust variable valve device 16 includes an exhaust side housing member 25 of which the outer peripheral portion is provided with an exhaust sprocket 25S.

[0032] As shown in Fig. 1, a crank sprocket 3A is provided at the right end portion of the crankshaft 3S. A timing chain 19 is wound around the crank sprocket 3A, the intake sprocket 23S, and the exhaust sprocket 25S. The timing chain 19 of this embodiment constitutes a transmission member.

[0033] The power of the crankshaft 3S is transmitted to the intake cam shaft 11 and the exhaust cam shaft 12 through the timing chain 19. Due thereto, the intake cam 11A rotates to open or close the intake valve and the exhaust cam 12A rotates to open or close the exhaust valve.

[0034] The intake variable valve device 15 changes the relative rotation phase of the intake cam shaft 11 with respect to the crankshaft 3S, and the exhaust variable valve device 16 changes the relative rotation phase of the exhaust cam shaft 12 with respect to the crankshaft 3S.

[0035] A chain cover 20 is attached to the right end portion of the cylinder block 3 and the right end portion of the cylinder head 4. Specifically, a flange portion 20F is formed on the outer peripheral edge of the chain cover 20 and is fastened to the right end portions of the cylinder block 3 and the cylinder head 4 by a plurality of bolts 33A.

[0036] The chain cover 20 accommodates the timing chain 19 (see Fig. 1). That is, the timing chain 19 is installed in a space 30 (see Fig. 4) which is surrounded by the cylinder block 3, the cylinder head 4, and the chain cover 20. The chain cover 20 of this embodiment constitutes a cover member.

[0037] As shown in Figs. 3 and 4, a mount attachment portion 21 is provided on an upper portion of a right side surface 20r of the chain cover 20. The mount attachment portion 21 bulges toward the right side from the right side surface 20r of the chain cover 20 (i.e., the mount attachment portion 21 bulges from the right side surface 20r to be away from the engine body 2).

[0038] As shown in Fig. 4, a right side member 7 separated from the engine 1 is installed at the right side of the engine 1 and extends in the front and rear direction of the vehicle. Amount member 22 is attached to the mount attachment portion 21.

[0039] The mount member 22 includes a mount bracket 22A of which a left end portion is fixed to the mount attachment portion 21 by a bolt (not shown).

[0040] The mount member 22 further includes a vibration absorbing member 22B attached to the right side member 7. The right end portion of the mount bracket 22A is attached to the vibration absorbing member 22B, and the mount attachment portion 21 is elastically supported by the right side member 7 through the mount member 22.

[0041] Accordingly, the vibration of the engine 1 can be absorbed by the mount member 22 and the vibration transmitted from the engine 1 to the right side member 7 can be reduced. The transmission is elastically supported to a left side member (not shown) by a mount member (not shown). The right side member 7 of this embodiment constitutes a vehicle body.

[0042] As shown in Fig. 4, a bulging portion 20E is provided on the chain cover 20. The bulging portion 20E bulges toward the left side of the right side surface 20r of the chain cover 20 (i.e., toward the engine body 2) above the mount attachment portion 21 and covers the front side of the intake variable valve device 15 and the rear side of the exhaust variable valve device 16.

[0043] As shown in Fig. 3, the dimension of the exhaust variable valve device 16 in the axial direction of the exhaust cam shaft 12 is shorter than the dimension of the intake variable valve device 15 in the axial direction of the intake cam shaft 11.

[0044] As shown in Fig. 5(a), the intake variable valve device 15 includes the intake side housing member 23 to which the power of the crankshaft 3S is transmitted through the timing chain 19.

[0045] An intake side vane rotor 24 is accommodated in the intake side housing member 23 and includes a rotor 24A and three vanes 24B. The intake side housing member 23 and the intake side vane rotor 24 of this embodiment constitutes a housing member and a vane rotor respectively.

[0046] The rotor 24A is connected to the right end portion of the intake cam shaft 11 and rotates together with the intake cam shaft 11. The vanes 24B protrude radially outwardly from the rotor 24A and divide the inside of the intake side housing member 23 into a plurality of advance chambers 23A and a plurality of retard chambers 23B.

[0047] Advance angle side oil passages 24a and retard angle side oil passages 24b are formed in the rotor 24A.

[0048] An oil pump (not shown) is provided on the engine 1, and the supply path is switched by an intake solenoid 31 (will be described later) so that an oil supplied from the oil pump is supplied to any one of the advance angle side oil passage 24a and the retard angle side oil passage 24b.

[0049] When the supply path is switched to the advance angle side oil passage 24a by the intake solenoid 31, an oil is supplied from the advance angle side oil passage 24a to the advance chamber 23A.

[0050] When an oil is introduced to the advance chamber 23A, the intake side vane rotor 24 relatively rotates with respect to the intake side housing member 23 to thereby change the relative rotation phase of the intake cam shaft 11

with respect to the crankshaft 3S to the advance side and change the opening and closing timing of the exhaust valve to the advance side.

[0051] When the supply path is switched to the retard angle side oil passage 24b by the intake solenoid 31, an oil is to be supplied from the retard angle side oil passage 24b to the retard chamber 23B.

[0052] When an oil is introduced to the retard chamber 23B, the relative rotation phase of the intake cam shaft 11 with respect to the crankshaft 3 S is to be changed to the retard side and the opening and closing timing of the exhaust valve is to be changed to the retard side.

[0053] As shown in Fig. 5(b), the exhaust variable valve device 16 includes the exhaust side housing member 25 to which the power of the crankshaft 3S is transmitted through the timing chain 19.

[0054] As shown in Fig. 3, the dimension of the exhaust side housing member 25 in the axial direction of the exhaust cam shaft 12 is shorter than the dimension of the intake side housing member 23 in the axial direction of the intake cam shaft 11.

[0055] Specifically, the length of the exhaust side housing member 25 in the axial direction of the exhaust cam shaft 12 is substantially a half of the length of the intake side housing member 23 in the axial direction of the intake cam shaft 11.

[0056] As shown in Fig. 5(b), an exhaust side vane rotor 26 is accommodated in the exhaust side housing member 25 and includes a rotor 26A and four vanes 26B. The exhaust side housing member 25 and the exhaust side vane rotor 26 of this embodiment constitute a housing member and a vane rotor respectively.

[0057] The rotor 26A is connected to the right end portion of the exhaust cam shaft 12 and rotates together with the exhaust cam shaft 12. The vanes 26B protrude radially outwardly from the rotor 26A and divide the inside of the exhaust side housing member 25 into a plurality of advance chambers 25A and a plurality of retard chambers 25B.

[0058] Advance angle side oil passages 26a and retard angle side oil passages 26b are formed in the rotor 26A.

[0059] The supply path is switched by an exhaust solenoid 32 (will be described later) so that an oil supplied from the oil pump is supplied to any one of the advance angle side oil passage 26a and the retard angle side oil passage 26b.

[0060] When the supply path is switched to the advance angle side oil passage 26a by the exhaust solenoid 32, an oil is to be supplied from the advance angle side oil passage 26a to the advance chamber 25A.

[0061] When oil is introduced to the advance chamber 25A, the exhaust side vane rotor 26 relatively rotates with respect to the exhaust side housing member 25 to thereby change the relative rotation phase of the exhaust cam shaft 12 with respect to the crankshaft 3S to the advance side and change the opening and closing timing of the exhaust valve to the advance side.

[0062] When the supply path is switched to the retard angle side oil passage 26b by the exhaust solenoid 32, an oil is to be supplied from the retard angle side oil passage 26b to the retard chamber 25B.

[0063] When an oil is introduced to the retard chamber 25B, the relative rotation phase of the exhaust cam shaft 12 with respect to the crankshaft 3S is to be changed to the retard side and the opening and closing timing of the exhaust valve is to be changed to the retard side.

[0064] An operation angle α_1 of the vane 24B of the exhaust variable valve device 16 is smaller than an operation angle α_2 of the vane 26B of the intake variable valve device 15. That is, the operation range of the relative rotation angle of the intake side vane rotor 24 with respect to the intake side housing member 23 is larger than the operation range of the relative rotation angle of the exhaust side vane rotor 26 with respect to the exhaust side housing member 25.

[0065] As shown in Fig. 3, the intake variable valve device 15 and the exhaust variable valve device 16 are installed so that the right end surface of the exhaust variable valve device 16 is located to be closer to the engine main body 2 in the axial direction of the intake cam shaft 11 than the right end surface of the intake variable valve device 15 is.

[0066] Specifically, the intake variable valve device 15 and the exhaust variable valve device 16 are installed so that a right end surface 25r of the exhaust side housing member 25 is located to be closer to the engine main body 2 in the axial direction of the intake cam shaft 11 than a right end surface 23r of the intake side housing member 23 is.

[0067] The right end surface 23r of the intake side housing member 23 of this embodiment constitutes an end surface of the intake variable valve device, and the right end surface 25r of the exhaust side housing member 25 of this embodiment constitutes an end surface of the exhaust variable valve device.

[0068] As shown in Fig. 3, the chain cover 20 includes an intake side wall portion 20A which faces the intake variable valve device 15 in the axial direction of the intake cam shaft 11 and an exhaust side wall portion 20B which faces the exhaust variable valve device 16 in the axial direction of the exhaust cam shaft 12.

[0069] The exhaust side wall portion 20B is continuously connected to the intake side wall portion 20A and is recessed toward the engine main body 2. That is, the exhaust side wall portion 20B is recessed to be closer to the engine main body 2 than the intake side wall portion 20A is, and the intake side wall portion 20A bulges to be farther away from the engine main body 2 than the exhaust side wall portion 20B is.

[0070] The intake side wall portion 20A and the exhaust side wall portion 20B are interconnected by a step portion 20C in a direction (front and rear direction) orthogonal to the axial direction of the intake cam shaft 11. In Fig. 2, the range in the front and rear direction of the step portion 20C is indicated by an arrow.

[0071] As shown in Fig. 2, the mount attachment portion 21 is continuously provided on the intake side wall portion

20A, the exhaust side wall portion 20B, and the step portion 20C. Specifically, the mount attachment portion 21 bulges toward the right side from the intake side wall portion 20A, the exhaust side wall portion 20B, and the step portion 20C to be away from the engine body 2.

[0072] As shown in Figs. 1 and 3, the intake solenoid 31 and the exhaust solenoid 32 are provided on the chain cover 20.

[0073] As shown in Fig. 2, the intake side wall portion 20A includes an intake side opening 20a into which the intake solenoid 31 is inserted, and an intake side annular portion 20b which protrudes to the right side (outside) from the chain cover 20 to surround the intake side opening 20a and to which the intake solenoid 31 is fixed by a bolt (not shown).

[0074] The exhaust side wall portion 20B includes an exhaust side opening 20c into which the exhaust solenoid 32 is inserted, and an exhaust side annular portion 20d which protrudes to the right side (outside) from the chain cover 20 to surround the exhaust side opening 20c and to which the exhaust solenoid 32 is fixed by a bolt 33B (see Fig. 1).

[0075] As shown in Fig. 2, the front end portion of the intake side annular portion 20b and the rear end portion of the exhaust side annular portion 20d are connected to the step portion 20C.

[0076] The intake solenoid 31 is provided coaxially with the axis 11a of the intake cam shaft 11 and operates the intake variable valve device 15.

[0077] Specifically, the intake solenoid 31 includes a plunger portion (not shown) connected to the intake variable valve device 15 through the intake side opening 20a.

[0078] The intake solenoid 31 switches the supply path to which an oil is supplied from the oil pump to any one of the advance angle side oil passage 24a and the retard angle side oil passage 24b in such a manner that the plunger portion moves in the vehicle width direction (right and left direction).

[0079] Additionally, the fact that the intake solenoid 31 is provided coaxially with the axis 11a of the intake cam shaft 11 means that the intake solenoid 31 is located on the axis 11a of the intake cam shaft 11.

[0080] The exhaust solenoid 32 is provided coaxially with the axis 12a of the exhaust cam shaft 12 and operates the exhaust variable valve device 16. Specifically, the exhaust solenoid 32 includes a plunger portion (not shown), and the plunger portion is connected to the exhaust variable valve device 16 through the exhaust side opening 20c.

[0081] The exhaust solenoid 32 switches the supply path to which oil is supplied from the oil pump to any one of the advance angle side oil passage 26a and the retard angle side oil passage 26b in such a manner that the plunger portion moves in the vehicle width direction.

[0082] Additionally, the fact that the exhaust solenoid 32 is provided coaxially with the axis 12a of the exhaust cam shaft 12 means that the exhaust solenoid 32 is located on the axis 12a of the exhaust cam shaft 12.

[0083] As shown in Figs. 1 and 2, a boss portion 20D is provided on the step portion 20C of the chain cover 20.

[0084] As shown in Fig. 4, the boss portion 20D is provided on the bulging portion 20E and the rear end of the bulging portion 20E comes into contact with the cylinder head 4. A bolt fastening groove 4A is provided in the cylinder head 4 and the bolt fastening groove 4A faces the boss portion 20D in the vehicle width direction.

[0085] In the chain cover 20, the step portion 20C is fastened to the cylinder head 4 in such a manner that a bolt 33C is inserted through the boss portion 20D and the bolt 33C is fastened to the bolt fastening groove 4A of the cylinder head 4. The boss portion 20D and the bolt 33C of this embodiment constitute a fastening portion of this invention.

[0086] Next, the effect of the engine 1 of this embodiment will be described.

[0087] The engine 1 of this embodiment includes the intake cam shaft 11 and the exhaust cam shaft 12 which are rotatably provided in the engine main body 2 so that the axes 11a and 12a are parallel to each other and the power of the crankshaft 3S is transmitted thereto through the timing chain 19.

[0088] Further, the engine 1 includes the intake variable valve device 15 which is provided at the right end portion (one end portion) of the intake cam shaft 11 in the axial direction and changes the relative rotation phase of the intake cam shaft 11 with respect to the crankshaft 3S and the exhaust variable valve device 16 which is provided at the right end portion (one end portion) of the exhaust cam shaft 12 in the axial direction and changes the relative rotation phase of the exhaust cam shaft 12 with respect to the crankshaft 3S.

[0089] Further, the engine 1 includes the chain cover 20 which is attached to the right end portions (one end portions) of the cylinder block 3 and the cylinder head 4 and accommodates the timing chain 19 and the mount attachment portion 21 which is formed on the chain cover 20 and to which the mount member 22 supporting the engine main body 2 to the right side member 7 is attached.

[0090] The chain cover 20 includes the intake side wall portion 20A which faces the intake variable valve device 15 in the axial direction of the intake cam shaft 11 and the exhaust side wall portion 20B which faces the exhaust variable valve device 16 in the axial direction of the exhaust cam shaft 12.

[0091] The intake variable valve device 15 and the exhaust variable valve device 16 are arranged so that the right end surface of the exhaust variable valve device 16 (the right end surface 25r of the exhaust side housing member 25) facing the chain cover 20 is located to be closer to the engine main body 2 in the axial direction of the intake cam shaft 11 than the right end surface of the intake variable valve device 15 (the right end surface 23r of the intake side housing member 23) is.

[0092] In addition, the exhaust side wall portion 20B of the chain cover 20 is recessed to be closer to the engine main

body 2 in the axial direction than the intake side wall portion 20A is, and the mount attachment portion 21 is continuously provided on the intake side wall portion 20A, the exhaust side wall portion 20B, and the step portion 20C interconnecting the intake side wall portion 20A and the exhaust side wall portion 20B. That is, the mount attachment portion 21 extends from the intake side wall portion 20A, the exhaust side wall portion 20B, and the step portion 20C, so as to be away from the engine body 2 in the axial direction.

[0093] In this way, since the step portion 20C is formed on the chain cover 20, the surface rigidity of the chain cover 20 at the attachment position of the mount attachment portion 21 can be increased and the vibration of the mount attachment portion 21 due to the vibration of the engine 1 can be suppressed. As a result, the support rigidity of the engine 1 can be increased.

[0094] Further, according to the engine 1 of this embodiment, the dimension of the exhaust variable valve device 16 in the axial direction of the intake cam shaft 11 is shorter than that of the intake variable valve device 15.

[0095] Accordingly, the shaft length of the exhaust cam shaft 12 can be shorter than the shaft length of the intake cam shaft 11 and the installation space of the exhaust cam shaft 12 with respect to the cylinder head 4 can be reduced.

[0096] Additionally, in the engine 1, the intake variable valve device 15 and the exhaust variable valve device 16 may be installed so that the right end surface of the intake variable valve device 15 (the right end surface 23r of the intake side housing member 23) facing the chain cover 20 is located on the side of the engine main body 2 in the axial direction of the intake cam shaft 11 in relation to the right end surface of the exhaust variable valve device 16 (the right end surface 25r of the exhaust side housing member 25).

[0097] Further, in the chain cover 20, instead of the exhaust side wall portion 20B, the intake side wall portion 20A may be recessed toward the engine main body 2.

[0098] Furthermore, the dimension of the intake variable valve device 15 in the axial direction of the intake cam shaft 11 may be shorter than that of the exhaust variable valve device 16.

[0099] Further, according to the engine 1 of this embodiment, the intake variable valve device 15 includes the intake side vane rotor 24 which is accommodated in the intake side housing member 23.

[0100] The intake side vane rotor 24 includes the rotor 24A which is connected to the intake cam shaft 11 and the plurality of vanes 24B which protrude radially outward from the rotor 24A and divides the inside of the intake side housing member 23 into the plurality of advance chambers 23A and the plurality of retard chambers 23B and relatively rotates with respect to the intake side housing member 23 by the operating hydraulic pressure introduced into the advance chamber 23A or the retard chamber 23B.

[0101] Further, the exhaust variable valve device 16 includes the exhaust side vane rotor 26 which is accommodated in the exhaust side housing member 25.

[0102] The exhaust side vane rotor 26 includes the rotor 26A which is connected to the exhaust cam shaft 12 and the plurality of vanes 26B which protrude radially outward from the rotor 26A and divide the inside of the exhaust side housing member 25 into the plurality of advance chambers 25A and the plurality of retard chambers 25B and relatively rotates with respect to the exhaust side housing member 25 by the operating hydraulic pressure introduced into the advance chamber 25A or the retard chamber 25B.

[0103] Then, the number of the vanes 26B provided in the exhaust variable valve device 16 is larger than the number of the vanes 24B provided in the intake variable valve device 15.

[0104] Accordingly, since the number of the vanes 26B increases instead of a decrease in the area of the vane 26B when the shaft length of the exhaust variable valve device 16 is made short, the responsiveness of the opening and closing timing of the exhaust valve can be maintained.

[0105] Specifically, the theoretical drive torque of the variable valve device is obtained by the following formula (1).

[0106] Here, the theoretical drive torque is the torque that the vane can withstand when the torque is received from the intake and exhaust valves, as shown below.

$$\text{Theoretical drive torque (Nmm)} = \text{hydraulic pressure acting on vane} \times \text{number of vanes} \times \text{pressure area of vane} \quad (1)$$

[0107] In the formula (1) above, since the pressure area of the vane 26B can be decreased as the number of the vanes 26B of the exhaust variable valve device 16 increases when the same drive torque is ensured for the intake variable valve device 15 and the exhaust variable valve device 16, the responsiveness of the opening and closing timing of the exhaust valve can be maintained even when the axial dimension of the exhaust variable valve device 16 is short.

[0108] Additionally, the number of the vanes 24B and 26B of the intake variable valve device 15 and the exhaust variable valve device 16 is not limited to three and four, respectively.

[0109] Further, according to the engine 1 of this embodiment, the intake variable valve device 15 and the exhaust variable valve device 16 are installed so that the right end surface of the exhaust variable valve device 16 facing the chain cover 20 is located on the side of the engine main body 2 in the axial direction of the intake cam shaft 11 in relation

to the right end surface of the intake variable valve device 15.

[0110] In addition, in the chain cover 20, the exhaust side wall portion 20B is recessed toward the engine main body 2 to be closer thereto than the intake side wall portion 20A is.

[0111] Accordingly, when the number of the vanes 26B of the exhaust variable valve device 16 is four in order to shorten the shaft length of the exhaust variable valve device 16, the operation angle α_1 of the vane 26B becomes smaller than the operation angle α_2 of the vane 24B of the intake variable valve device 15 (see Fig. 5).

[0112] However, since the exhaust variable valve device 16 provided on the exhaust side has less influence on the operability of the engine 1 than the intake variable valve device 15 even when the operation angle α_1 of the vane 26B of the exhaust variable valve device 16 is smaller than the operation angle α_2 of the vane 24B of the intake variable valve device 15, the shaft length of the exhaust variable valve device 16 can be reliably made short.

[0113] Additionally, since the shaft length of the exhaust variable valve device 16 can be shorter than the shaft length of the intake variable valve device 15, the shaft lengths of the intake cam shaft 11 and the exhaust cam shaft 12 may be the same. In this case, the shaft length of the exhaust cam shaft 12 including the exhaust variable valve device 16 can be shorter than the shaft length of the intake cam shaft 11 including the intake variable valve device 15.

[0114] Further, according to the engine 1 of this embodiment, the intake solenoid 31 is provided coaxially with the axis 11a of the intake cam shaft 11 to operate the intake variable valve device 15 and the exhaust solenoid 32 is provided coaxially with the axis 12a of the exhaust cam shaft 12 to operate the exhaust variable valve device 16.

[0115] The intake side wall portion 20A includes the intake side opening 20a into which the intake solenoid 31 is inserted and the intake side annular portion 20b which protrudes to the right side from the chain cover 20 to surround the intake side opening 20a and to which the intake solenoid 31 is fixed.

[0116] The exhaust side wall portion 20B includes the exhaust side opening 20c into which the exhaust solenoid 32 is inserted and the exhaust side annular portion 20d which protrudes to the right side from the chain cover 20 to surround the exhaust side opening 20c and to which the exhaust solenoid 32 is fixed.

[0117] In addition, the intake side annular portion 20b and the exhaust side annular portion 20d are connected to the step portion 20C.

[0118] Accordingly, the rigidity of the step portion 20C can be further increased by the intake side annular portion 20b and the exhaust side annular portion 20d having high rigidity and the surface rigidity of the chain cover 20 at the attachment position of the mount attachment portion 21 can be more effectively increased.

[0119] Therefore, the vibration of the mount attachment portion 21 due to the vibration of the engine 1 can be more effectively suppressed and the support rigidity of the engine 1 can be further increased.

[0120] Further, according to the engine 1 of this embodiment, the chain cover 20 includes the boss portion 20D and the bolt 33C which fasten the chain cover 20 to the cylinder head 4 and the boss portion 20D and the bolt 33C are provided on the step portion 20C.

[0121] Accordingly, the rigidity of the step portion 20C can be further increased by fastening the step portion 20C to the cylinder head 4 with the bolt 33C.

[0122] Therefore, the surface rigidity of the chain cover 20 at the attachment position of the mount attachment portion 21 can be more effectively increased and the vibration of the mount attachment portion 21 due to the vibration of the engine 1 can be more effectively suppressed. As a result, the support rigidity of the engine 1 can be further increased.

[0123] Additionally, the mount attachment portion 21 of this embodiment may be provided on the intake side wall portion 20A and the step portion 20C, may be provided on the exhaust side wall portion 20B and the step portion 20C, or may be provided only in the step portion 20C.

[DESCRIPTION OF REFERENCE NUMERALS]

[0124] 1 ... Engine (internal combustion engine), 2 ... Engine main body (internal combustion engine main body), 3S ... Crankshaft, 7 ... Right side member (vehicle body), 11 ... Intake cam shaft, 11a ... Axis (axis of intake cam shaft), 12 ... Exhaust cam shaft, 12a ... Axis (axis of exhaust cam shaft), 15 ... Intake variable valve device, 16 ... Exhaust variable valve device, 19 ... Timing chain (Transmission member), 20 ... Chain cover (cover member), 20A ... Intake side wall portion, 20a ... Intake side opening, 20B ... Exhaust side wall portion, 20b ... Intake side annular portion, 20C ... Step portion, 20c ... Exhaust side opening, 20D ... Boss portion (fastening portion), 20d ... Exhaust side annular portion, 21 ... Mount attachment portion, 22 ... Mount member, 23 ... Intake side housing member (housing member), 23A, 25A ... Advance chamber, 23B, 25B ... Retard chamber, 23r ... Right end surface (end surface of intake variable valve device), 24 ... Intake side vane rotor (vane rotor), 24A ... Rotor, 24B ... Vane, 25 ... Exhaust side housing member (housing member), 25r ... Right end surface (end surface of exhaust variable valve device), 26 ... Exhaust side vane rotor (vane rotor), 26A ... Rotor, 26B ... Vane, 31 ... Intake solenoid, 32 ... Exhaust solenoid, 33C ... Bolt (fastening portion)

Claims

1. An internal combustion engine comprising:

5 an intake cam shaft (11) and an exhaust cam shaft (12) rotatably provided in an internal combustion engine main body (2) so that mutual axes are parallel to each other, to which power of a crankshaft (3S) is transmitted through a transmission member (19);
 an intake variable valve device (15) provided at an axial end portion of the intake cam shaft (11) and configured to change a relative rotation phase of the intake cam shaft (11) with respect to the crankshaft (3S);
 10 an exhaust variable valve device (16) provided at an axial end portion of the exhaust cam shaft (12) and configured to change a relative rotation phase of the exhaust cam shaft (12) with respect to the crankshaft (3S);
 a cover member (20) with a mount attachment portion (21), the cover member being attached to an end portion of the internal combustion engine main body (2) and accommodating the transmission member (19), the mount attachment portion (21) configured to be attached with a mount member (22) supporting the internal combustion engine main body to a vehicle body (7),
 15 wherein the cover member (20) includes an intake side wall portion (20A) facing the intake variable valve device (15) in the axial direction of the intake cam shaft (11), and an exhaust side wall portion (20B) facing the exhaust variable valve device (16) in the axial direction of the exhaust cam shaft (12),
 wherein the intake and exhaust variable valve devices (15,16) are arranged so that an end surface (23r,25r) of one of the intake and exhaust variable valve devices (15,16), facing the cover member (20), is located to be closer to the internal combustion engine main body (2) in the axial direction than that of the other is,
 20 wherein one of the intake and exhaust side wall portions (20A,20B) is recessed to be closer to the internal combustion engine main body (2) in the axial direction than the other of the intake and exhaust side wall portions (20A,20B) is, and the other of the intake and exhaust side wall portions (20A,20B) bulges to be farther away from the internal combustion engine main body (2) than the one of the intake and exhaust side wall portions (20A,20B) is, and
 wherein the mount attachment portion (21) is provided on a step portion (20C) interconnecting the intake and exhaust side wall portions (20A,20B);
 an intake solenoid (31) arranged coaxially with the intake cam shaft (11) and configured to operate the intake variable valve device (15); and
 30 an exhaust solenoid (32) arranged coaxially with the exhaust cam shaft (12) and configured to operate the exhaust variable valve device (16),
 wherein the intake side wall portion (20A) includes an intake side opening (20a) allowing the intake solenoid (31) to be inserted therein, and an intake side annular portion (20b) protruding outward from the cover member (20) to surround the intake side opening (20a) and allowing the intake solenoid (31) to be fixed thereto,
 35 wherein the exhaust side wall portion (20B) includes an exhaust side opening (20c) allowing the exhaust solenoid (32) to be inserted therein, and an exhaust side annular portion (20d) protruding outward from the cover member (20) to surround the exhaust side opening (20c) and allowing the exhaust solenoid (32) to be fixed thereto, and
 40 wherein the intake side annular portion (20b) and the exhaust side annular portion (20d) are connected to the step portion (20C).

2. The internal combustion engine as claimed in claim 1,

45 wherein a dimension of the one variable valve device (16) in the axial direction is shorter than that of the other variable valve device (15).

3. The internal combustion engine as claimed in claim 1 or 2,

50 wherein each of the intake variable valve device (15) and the exhaust variable valve device (16) includes a housing member (23,25) to which power of the crankshaft (3S) is transmitted through the transmission member (19), and a vane rotor (24,26) accommodated in the housing member (23,25),
 wherein each vane rotor (24,26) includes a rotor (24A,26A) connected to a corresponding one of the intake and exhaust cam shafts (11,12), and a plurality of vanes (24B,26B) protruding radially outwardly from the rotor (24A,26A) and dividing the inside of the housing member (23,25) into a plurality of advance chambers (23A,25A) and a plurality of retard chambers (23B,25B), the vane rotor (24,26) relatively rotating with respect to the housing member (23,25) by an operating hydraulic pressure introduced into the advance chamber (23A,25A) or the retard chamber (23B,25B), and
 55 wherein the number of the vanes (24B,26B) of the one variable valve device (16) is larger than that of the other

variable valve device (15).

4. The internal combustion engine as claimed in any one of claims 1 to 3,

5 wherein the one variable valve device is the exhaust variable valve device (16), and
wherein the one side wall portion is the exhaust side wall portion (20B).

5. The internal combustion engine as claimed in any one of claims 1 to 4,

10 wherein the cover member (20) includes a fastening portion (20D,33C) provided on the step portion (20C) and
fastening the cover member (20) to the internal combustion engine main body (2).

Patentansprüche

15 1. Eine Brennkraftmaschine, die aufweist:

eine Einlassnockenwelle (11) und eine Auslassnockenwelle (12), die drehbar in einem Brennkraftmaschinen-Hauptkörper (2) vorgesehen sind, so dass die gegenseitigen Achsen parallel zueinander sind, auf die die Leistung einer Kurbelwelle (3S) durch ein Übertragungselement (19) übertragen wird;

20 eine variable Einlassventilvorrichtung (15), die an einem axialen Endabschnitt der Einlassnockenwelle (11) vorgesehen und konfiguriert ist, um eine relative Drehphase der Einlassnockenwelle (11) bezüglich der Kurbelwelle (3S) zu ändern;

eine variable Auslassventilvorrichtung (16), die an einem axialen Endabschnitt der Auslassnockenwelle (12) vorgesehen und konfiguriert ist, um eine relative Rotationsphase der Auslassnockenwelle (12) bezüglich der Kurbelwelle (3S) zu ändern;

25 ein Abdeckungselement (20) mit einem Befestigungsanbringungsabschnitt (21), wobei das Abdeckungselement an einem Endabschnitt des Brennkraftmaschinen-Hauptkörpers (2) angebracht ist und das Übertragungselement (19) aufnimmt, wobei der Befestigungsanbringungsabschnitt (21) konfiguriert ist, um mit einem Befestigungselement (22) angebracht zu werden, das den Brennkraftmaschinen-Hauptkörper an einer Fahrzeugkarosserie (7) trägt,

30 wobei das Abdeckungsteil (20) einen einlassseitigen Wandabschnitt (20A) umfasst, der der variablen Einlassventilvorrichtung (15) in der Axialrichtung der Einlassnockenwelle (11) zugewandt ist, und einen auslassseitigen Abschnitt (20B), der der variablen Auslassventilvorrichtung (16) in der Axialrichtung der Auslassnockenwelle (12) zugewandt ist,

35 wobei die variablen Einlass- und Auslassventilvorrichtungen (15, 16) so angeordnet sind, dass eine Endoberfläche (23r, 25r) von einer der variablen Einlass- und Auslassventilvorrichtungen (15, 16), die dem Abdeckungskörper (20) zugewandt ist, so angeordnet ist, dass sie in der Axialrichtung näher an dem Brennkraftmaschinen-Hauptkörper (2) angeordnet ist als die der anderen,

40 wobei einer der Einlass- und Auslassseitenwandabschnitte (20A, 20B) so ausgenommen ist, dass er sich in der Axialrichtung näher an dem Brennkraftmaschinen-Hauptkörper (2) befindet als der andere der Einlass- und Auslassseitenwandabschnitte (20A, 20B), und der andere der Einlass- und Auslassseitenwandabschnitte (20A, 20B) so ausgewölbt ist, dass er sich weiter von dem Brennkraftmaschinen-Hauptkörper (2) entfernt befindet als der eine der Einlass- und Auslassseitenwandabschnitte (20A, 20B), und

45 wobei der Befestigungsanbringungsabschnitt (21) an einem Stufenabschnitt (20C) vorgesehen ist, der die Einlass- und Auslassseitenwandabschnitte (20A, 20B) miteinander verbindet;

einen Einlassmagnet (31) koaxial mit der Einlassnockenwelle (11) angeordnet und konfiguriert ist, um die variable Einlassventilvorrichtung (15) zu betreiben; und

ein Auslassmagnet (32) koaxial mit der Auslassnockenwelle (12) angeordnet und konfiguriert ist, um die variable Auslassventilvorrichtung (16) zu betreiben,

50 wobei der einlassseitige Wandabschnitt (20A) eine einlassseitige Öffnung (20a) umfasst, die es dem Einlassmagneten (31) ermöglicht, darin eingesetzt zu werden, und einen einlassseitigen ringförmigen Abschnitt (20b), der von dem Abdeckungsteil (20) nach außen vorsteht, um die einlassseitige Öffnung (20a) zu umgeben, und es dem Einlassmagneten (31) ermöglicht, daran befestigt zu werden,

55 wobei der auslassseitige Wandabschnitt (20B) eine auslassseitige Öffnung (20c) umfasst, die es ermöglicht, das Auslassmagnetventil (32) darin einzusetzen, und einen auslassseitigen ringförmigen Abschnitt (20d), der von dem Abdeckungsteil (20) nach außen vorsteht, um die auslassseitige Öffnung (20c) zu umgeben, und es ermöglicht, den Auslassmagnet (32) daran zu befestigen, und

wobei der einlassseitige ringförmige Abschnitt (20b) und der auslassseitige ringförmige Abschnitt (20d) mit dem

Stufenabschnitt (20C) verbunden sind.

2. Die Brennkraftmaschine gemäß Anspruch 1, wobei eine Abmessung der einen variablen Ventilvorrichtung (16) in der Axialrichtung kürzer ist als die der anderen variablen Ventilvorrichtung (15).

3. Die Brennkraftmaschine gemäß Anspruch 1 oder 2,

wobei die variable Auslassventilvorrichtung (16) und die variable Einlassventilvorrichtung (15) jeweils ein Gehäuseelement (23, 25) umfassen, auf das die Leistung der Kurbelwelle (3S) durch das Übertragungselement (19) übertragen wird, und einen Flügelrotor (24, 26), der in dem Gehäuseelement (23, 25) aufgenommen ist, wobei jeder Flügelrotor (24, 26) einen Rotor (24A, 26A) umfasst, der mit einer entsprechenden der Einlass- und Auslassnockenwellen (11, 12) verbunden ist, und eine Mehrzahl von Flügeln (24B, 26B), die von dem Rotor (24A, 26A) radial nach außen vorstehen und das Innere des Gehäuseelements (23, 25) in eine Mehrzahl von Vorschubkammern (23A, 25A) und eine Mehrzahl von Verzögerungskammern (23B, 25B) unterteilt, wobei der Flügelrotor (24, 26) relativ zu dem Gehäuseelement (23, 25) durch einen in die Vorschubkammer (23A, 25A) oder die Verzögerungskammer (23B, 25B) eingeleiteten hydraulischen Betriebsdruck rotiert, und wobei die Anzahl der Flügel (24B, 26B) der einen variablen Ventilvorrichtung (16) größer ist als die der anderen variablen Ventilvorrichtung (15).

4. Die Brennkraftmaschine nach einem der Ansprüche 1 bis 3,

wobei die eine variable Ventilvorrichtung die variable Auslassventilvorrichtung (16) ist, und wobei der eine Seitenwandabschnitt der Auslassseitenwandabschnitt (20B) ist.

5. Die Brennkraftmaschine gemäß einem der Ansprüche 1 bis 4, wobei das Abdeckelement (20) einen Befestigungsabschnitt (20D, 33C) umfasst, der an dem Stufenabschnitt (20C) vorgesehen ist und das Abdeckelement (20) an dem Brennkraftmaschinen-Hauptkörper (2) der Brennkraftmaschine befestigt.

Revendications

1. Moteur à combustion interne comprenant :

un arbre (11) à cames d'admission et un arbre (12) à cames d'échappement montés à rotation dans un carter (2) principal de moteur à combustion interne, de manière à ce que des axes mutuels soient parallèles entre eux, auxquels de la puissance d'un vilebrequin (3S) est transmise en passant par un élément (19) de transmission ;

un dispositif (15) de soupape variable d'admission prévu à un tronçon d'extrémité axial de l'arbre (11) à cames d'admission et configuré pour changer une phase en rotation relative de l'arbre (11) à cames d'admission par rapport au vilebrequin (3S) ;

un dispositif (16) de soupape variable d'échappement prévu à un tronçon d'extrémité axial de l'arbre (12) à cames d'échappement et configuré pour changer une phase en rotation relative de l'arbre (12) à cames d'échappement par rapport au vilebrequin (3S) ;

un élément (20) de coiffe ayant une partie (21) de fixation de support, l'élément de coiffe étant fixé à une partie d'extrémité du carter (2) principal de moteur à combustion interne et logeant l'élément (19) de transmission, la partie (21) de fixation de support étant configurée pour être fixée à un élément (22) de support supportant le carter principal de moteur à combustion interne sur une carrosserie (7) de véhicule,

dans lequel l'élément (20) de coiffe comprend une partie (20A) de paroi latérale d'admission faisant face au dispositif (15) de soupape variable d'admission dans la direction axiale de l'arbre (11) à cames d'admission, et une partie (20B) de paroi latérale d'échappement faisant face au dispositif (16) de soupape variable d'échappement dans la direction axiale de l'arbre (12) à cames d'échappement,

dans lequel les dispositifs (15, 16) de soupape variable d'admission et d'échappement sont disposés de manière à ce qu'une surface (23r, 25r) d'extrémité de l'un des dispositifs (15, 16) de soupape variable d'admission et d'échappement, faisant face à l'élément (20) de coiffe, soit disposé plus près du carter (2) principal de moteur de combustion interne dans la direction axiale que l'autre,

dans lequel l'une des parties (20A, 20B) de paroi latérales d'admission et d'échappement est en retrait pour être plus près du carter (2) principal de moteur à combustion interne dans la direction axiale que l'autre des

parties (20A, 20B) de paroi latérales d'admission et d'échappement, et l'autre des parties (20A, 20B) de paroi latérales d'admission et d'échappement est bombée pour être plus loin du carter (2) principal de moteur à combustion interne que l'autre des parties (20A, 20B) de paroi latérale d'admission et d'échappement, et dans lequel la partie (21) de fixation de support est prévue sur une partie (20C) en gradin reliant les parties (20A, 20B) de paroi latérales d'admission et d'échappement ;
 un électroaimant (31) d'admission disposé coaxialement à l'arbre (11) à cames d'admission et configuré pour faire fonctionner le dispositif (15) de soupape variable d'admission ; et
 un électroaimant (32) d'échappement disposé coaxialement à l'arbre (12) à cames d'échappement et configuré pour faire fonctionner le dispositif (16) de soupape variable d'échappement,
 dans lequel la partie (20A) de paroi latérale d'admission comprend une ouverture (20a) latérale d'admission permettant à l'électroaimant (31) d'admission d'y être inséré et une partie (20b) annulaire latérale d'admission faisant saillie vers l'extérieur à partir de l'élément (20) de coiffe pour entourer l'ouverture (20a) latérale d'admission et permettant à l'électroaimant (31) d'admission d'y être fixé,
 dans lequel la partie (20B) de paroi latérale d'échappement comprend une ouverture (20c) latérale d'échappement permettant à l'électroaimant (32) d'échappement d'y être inséré et une partie (20d) annulaire latérale d'échappement faisant saillie vers l'extérieur à partir de l'élément (20) de coiffe pour entourer l'ouverture (20c) latérale d'échappement et permettant à l'électroaimant (32) d'échappement d'y être fixé, et
 dans lequel la partie (20b) annulaire latérale d'admission et la partie (20d) annulaire latérale d'échappement sont reliées à la partie (20C) en gradin.

2. Moteur à combustion interne suivant la revendication 1,
 dans lequel une dimension du un dispositif (16) de soupape variable dans la direction axiale est plus courte que celle de l'autre dispositif (15) de soupape variable.

3. Moteur à combustion interne suivant la revendication 1 ou 2,

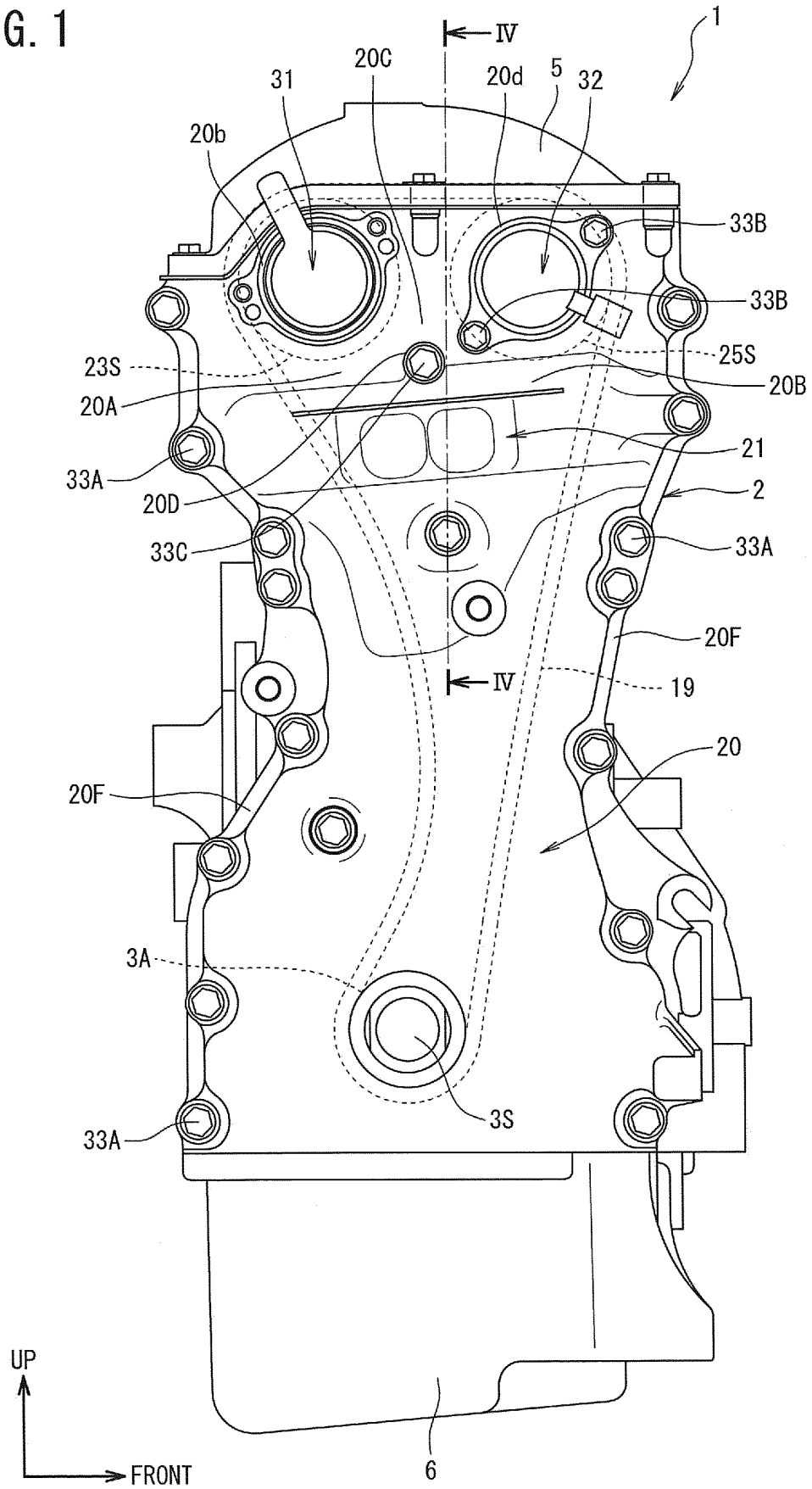
dans lequel chacun du dispositif (15) de soupape variable d'admission et du dispositif (16) de soupape variable d'échappement comprend un élément (23, 25) d'enveloppe, auquel de la puissance du vilebrequin (3S) est transmise en passant par l'élément (19) de transmission, et un rotor (24, 26) à palettes logé dans l'élément (23, 25) d'enveloppe,
 dans lequel chaque rotor (24, 26) à palettes comprend un rotor (24A, 26A), relié à l'un correspondant des arbres (11, 12) à cames d'admission et d'échappement, et une pluralité de palettes (24B, 26B) faisant saillie radialement vers l'extérieur à partir du rotor (24A, 26A) et subdivisant l'intérieur de l'élément (23, 25) d'enveloppe en une pluralité de chambres (23A, 25A) d'avance et en une pluralité de chambres (23B, 25B) de retard, le rotor (24, 26) à palettes tournant relativement par rapport à l'élément (23, 25) d'enveloppe par une pression hydraulique de fonctionnement introduite dans la chambre (23A, 25A) d'avance ou dans la chambre (23B, 25B) de retard, et dans lequel le nombre des palettes (24B, 26B) du un dispositif (16) de soupape variable est plus grand que celui de l'autre dispositif (15) de soupape variable.

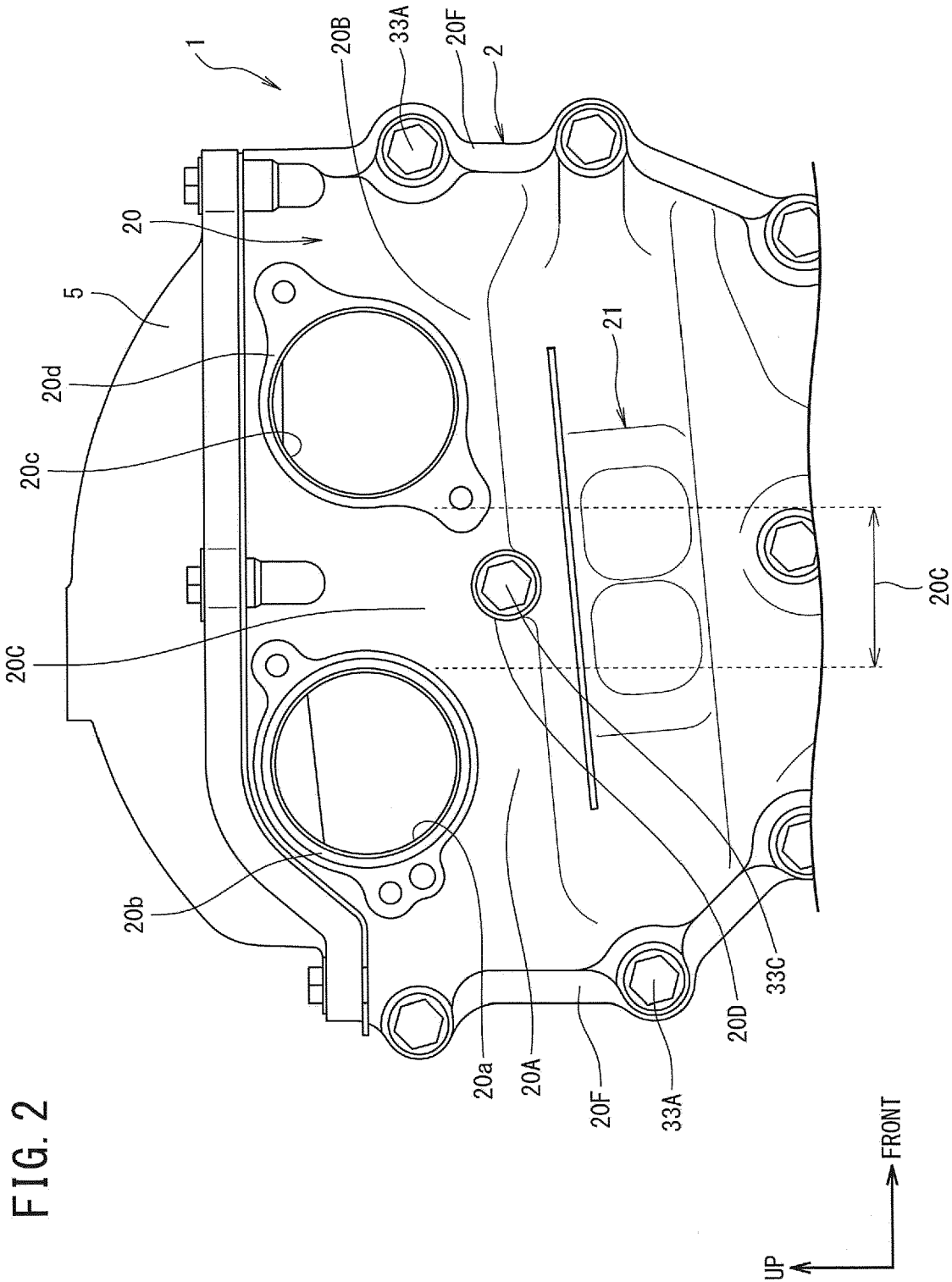
4. Moteur à combustion interne suivant l'une quelconque des revendications 1 à 3,

dans lequel le un dispositif de soupape variable est le dispositif (16) de soupape variable d'échappement, et dans lequel la une partie de paroi latérale est la partie (20B) de paroi latérale d'échappement.

5. Moteur à combustion interne suivant l'une quelconque des revendications 1 à 4,
 dans lequel l'élément (20) de coiffe comprend une partie (20D, 33C) de fixation prévue sur la partie (20C) en gradin et fixant l'élément (20) de coiffe au carter (2) principal de moteur à combustion interne.

FIG. 1





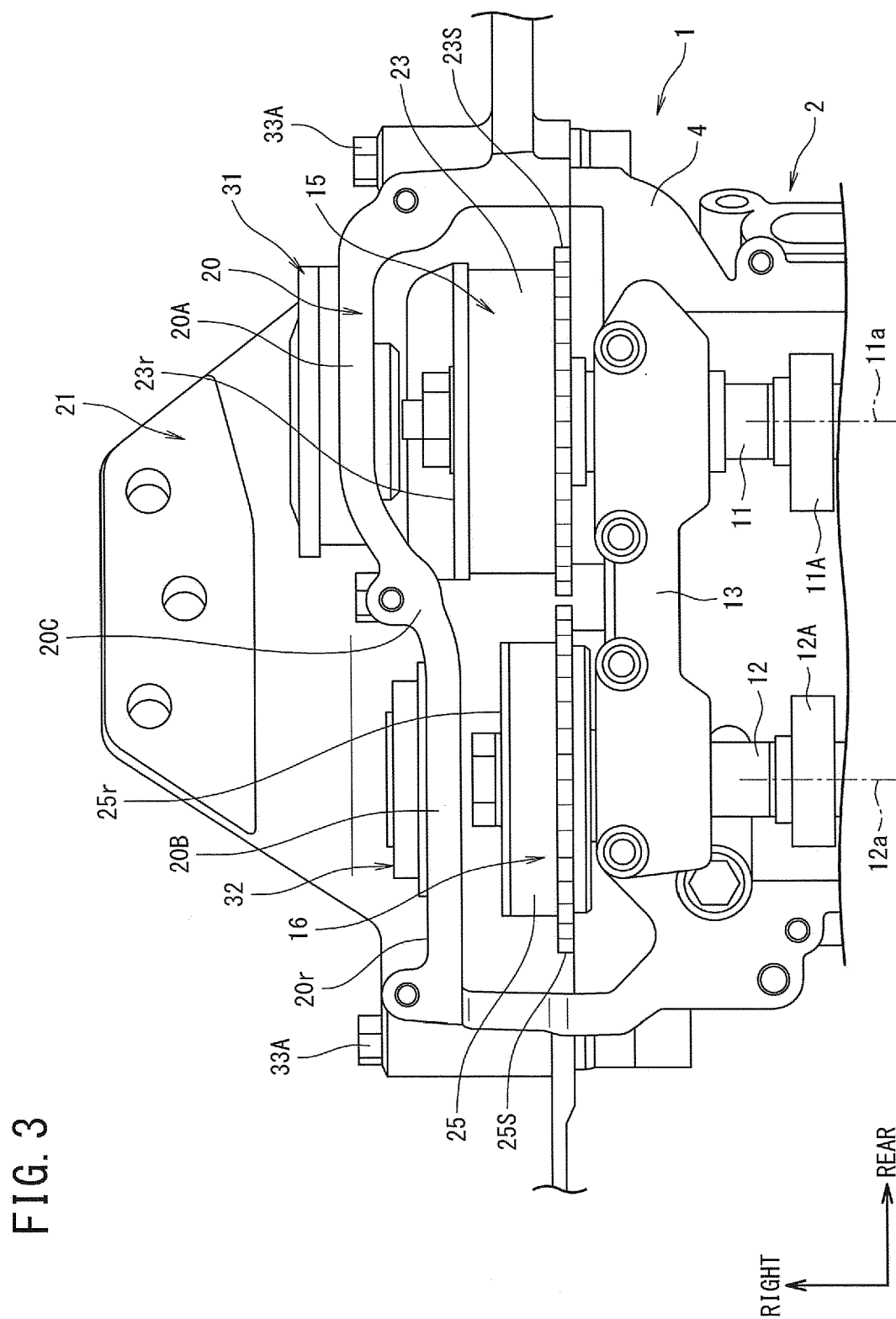
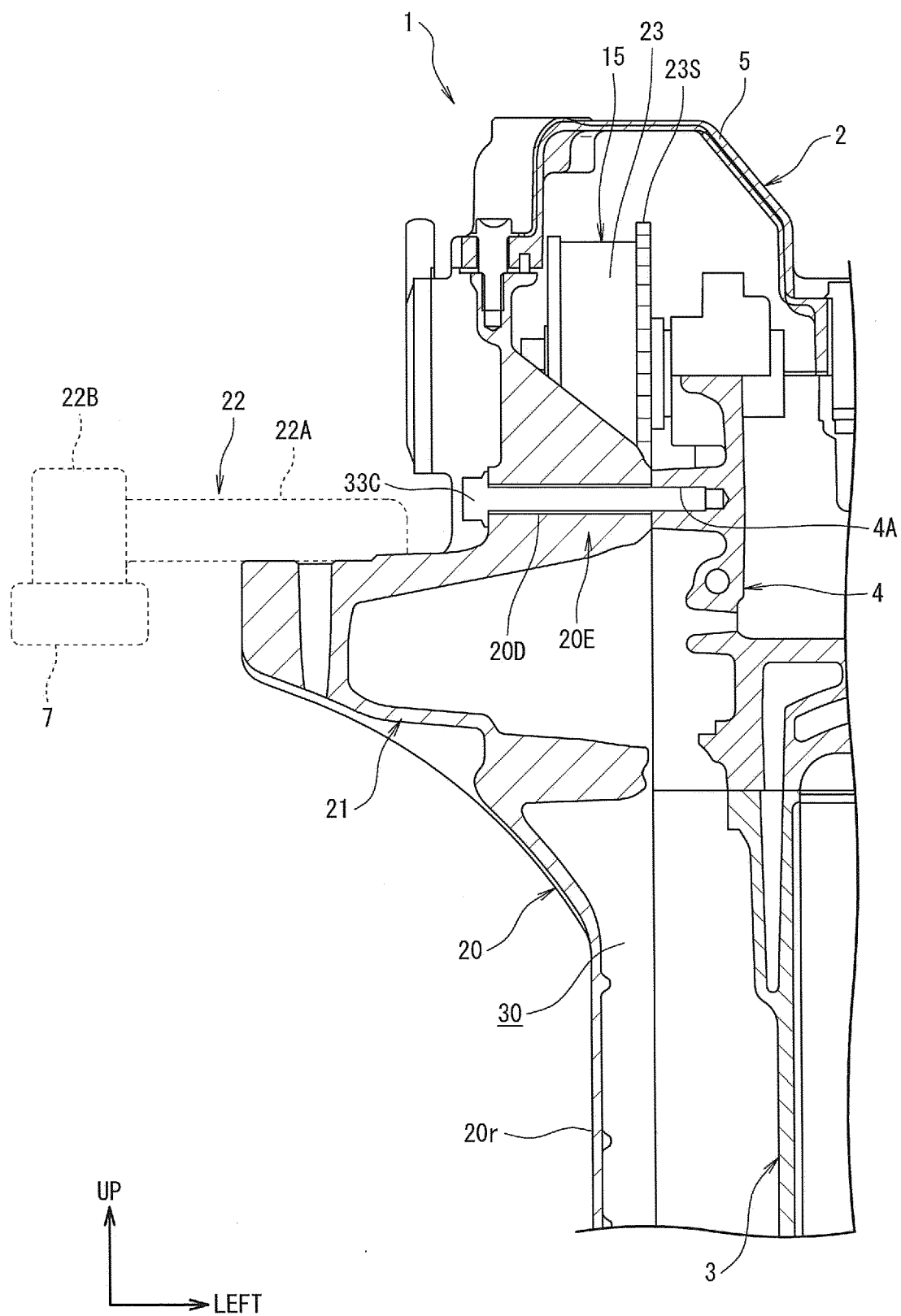
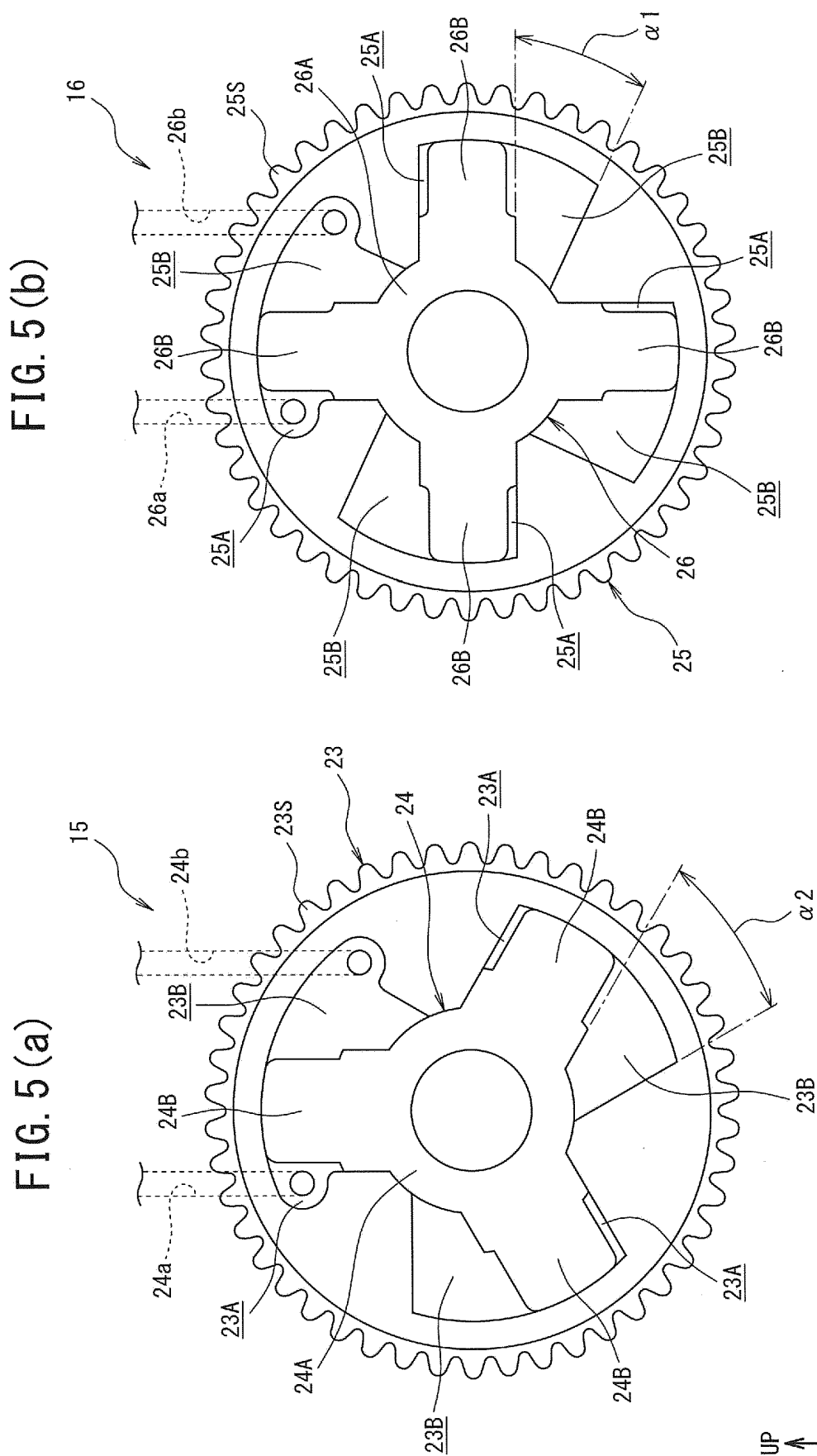


FIG. 4





REFERENCES CITED IN THE DESCRIPTION

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