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(54) **UNIT SWING ENGINE**

(57) There is provided a unit swing engine swingably supported by a vehicle body frame. The unit swing engine includes: a cylinder tilted forward horizontally or nearly horizontally; a cylinder head connected to a front surface of the cylinder; a crankcase connected to a rear surface of the cylinder; a first ignition plug disposed on a top surface of the cylinder head; and a second ignition plug disposed on a side surface of the cylinder head. The vehicle body frame includes a frame member extending in an upper-lower direction in front of the crankcase. The second ignition plug is disposed inside the frame member and in front of the frame member.

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Description

TECHNICAL FIELD

[0001] The present invention relates to a unit swing engine.

BACKGROUND ART

[0002] There is known an engine that adopts twin plugs in order to cope with an exhaust gas and improve a fuel efficiency (for example, see Patent Literature 1). In a cylinder head of an engine disclosed in Patent Literature 1, a first ignition plug is disposed such that an electrode thereof faces a center of a combustion chamber, and a second ignition plug is disposed such that an electrode thereof faces an end of the combustion chamber. Since the electrodes of the first and second ignition plugs are separated from each other in the combustion chamber, a flame spreads from the electrodes of the first and second ignition plugs, and an air-fuel mixture in the combustion chamber is efficiently combusted. By shortening a flame spreading time in the combustion chamber, a combustion speed of the air-fuel mixture is increased.

Citation list

Patent Literature

[0003] Patent Literature 1: Japanese Patent No. 6036255

SUMMARY OF INVENTION

Technical Problem

[0004] Meanwhile, in a unit swing engine swingably supported by a vehicle body frame, peripheral components such as the vehicle body frame are present around a cylinder head, and it is difficult to ensure a gap between the cylinder head and the peripheral components. Although the twin plugs as in the engine according to Patent Literature 1 can be adopted in the unit swing engine, addition of the second ignition plug has a large influence on a layout of the peripheral components. In addition, it is necessary to ensure a gap between the second ignition plug and the peripheral components in consideration of the unit swing engine swinging.

[0005] The present invention has been made in view of the above, and an object thereof is to provide a unit swing engine capable of disposing first and second ignition plugs without changing a layout of peripheral components while suppressing collision with the peripheral components.

Solution to Problem

[0006] A unit swing engine according to an aspect of the present invention is a unit swing engine swingably supported by a vehicle body frame. The unit swing engine includes: a cylinder tilted forward horizontally or nearly horizontally; a cylinder head connected to a front surface of the cylinder; a crankcase connected to a rear surface of the cylinder; a first ignition plug disposed on a top surface of the cylinder head; and a second ignition plug disposed on a side surface of the cylinder head. The vehicle body frame includes a frame member extending in an upper-lower direction in front of the crankcase, and the second ignition plug is disposed inside the frame member and in front of the frame member.

Advantageous Effects of Invention

[0007] Since the unit swing engine is supported by the vehicle body frame in a state where the cylinder according to the aspect of the present invention is tilted forward, an engine width on a front side of the engine where the cylinder and the cylinder head are present is narrower than that on a rear side of the engine where the crankcase is present. Therefore, a front side of the frame member is separated from the crankcase having a large engine width, and it is easy to ensure a gap between the second ignition plug and peripheral components. Since the second ignition plug is disposed in front of the frame member, the second ignition plug can be added to the unit swing engine without affecting a layout of the peripheral components. Even when the unit swing engine swings, the second ignition plug does not interfere with the peripheral components.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

FIG. 1 is a left side view of a straddle-type vehicle according to a present embodiment.
FIG. 2 is a perspective view of a unit swing engine according to the present embodiment.
FIG. 3 is a left side view of the unit swing engine according to the present embodiment.
FIG. 4 is a front view of a cylinder head according to the present embodiment.
FIG. 5 is a cross-sectional view of the unit swing engine in FIG. 3 taken along a line A-A.
FIG. 6 is a cross-sectional view of the unit swing engine in FIG. 3 taken along a line B-B.
FIG. 7 is a left side view of the unit swing engine and a vehicle body frame according to the present embodiment.
FIG. 8 is a front view of the unit swing engine and the vehicle body frame according to the present embodiment.
FIG. 9 is a cross-sectional view of the unit swing engine in FIG. 7 taken along a line C-C.

DESCRIPTION OF EMBODIMENT

[0009] A unit swing engine according to an aspect of the present invention is swingably supported by a vehicle body frame. A cylinder of the unit swing engine is tilted forward horizontally or nearly horizontally, a cylinder head is connected to a front surface of the cylinder, and a crankcase is connected to a rear surface of the cylinder. A first ignition plug is disposed on a top surface of the cylinder head, and a second ignition plug is disposed on a side surface of the cylinder head. Since the unit swing engine is supported by the vehicle body frame in a state where the cylinder is tilted forward, an engine width on a front side of the engine where the cylinder and the cylinder head are present is narrower than that on a rear side of the engine where the crankcase is present. Therefore, a front side of the frame member is separated from the crankcase having a large engine width, and it is easy to ensure a gap between the second ignition plug and peripheral components. The frame member of the vehicle body frame extends in an upper-lower direction in front of the crankcase, and the second ignition plug is disposed inside the frame member and in front of the frame member. Therefore, the second ignition plug can be added to the unit swing engine without affecting a layout of the peripheral components. Even when the unit swing engine swings, the second ignition plug does not interfere with the peripheral components.

Embodiment

[0010] Hereinafter, an embodiment will be described in detail with reference to the accompanying drawings. FIG. 1 is a left side view of a straddle-type vehicle according to the present embodiment. In the following description, a scooter type motorcycle will be described as an example of the straddle-type vehicle. In the following drawings, an arrow FR indicates a vehicle front side, an arrow RE indicates a vehicle rear side, an arrow L indicates a vehicle left side, and an arrow R indicates a vehicle right side.

[0011] As shown in FIG. 1, a scooter type straddle-type vehicle 1 is configured by attaching various covers as a vehicle body exterior to a vehicle body frame 10 made of steel or aluminum alloy (see FIG. 7). A front frame cover 21 is provided on a front side of the vehicle, and a leg shield 22 that protects legs of a rider is provided on a rear side of the front frame cover 21. A step board 23 extends rearward from a lower end of the leg shield 22, and a rear frame cover 24 is provided behind the step board 23. A center cover 25 connecting the leg shield 22 and the rear frame cover 24 is provided on the step board 23.

[0012] A handlebar 31 is provided on an upper side of the front frame cover 21, and a front wheel 33 is rotatably supported on a lower side of the front frame cover 21 via a pair of front forks 32. A rider seat 26 and a pillion seat 27 are provided on an upper side of the rear frame cover 24, and a continuously variable transmission (CVT) cover 44 is provided on a lower side of the rear frame cover 24. A rear wheel 34 is rotatably supported by a rear portion of the CVT cover 44. A belt type continuously variable transmission (not shown) is accommodated inside the CVT cover 44, and a driving force of a unit swing engine 40 is transmitted to the rear wheel 34 via a belt.

[0013] The unit swing engine 40 is swingably supported by the vehicle body frame 10 inside the rear frame cover 24. In the unit swing engine 40, a cylinder unit 50 is tilted forward on a front side of a crankcase 41. An air cleaner (not shown) is connected to an upper portion of the cylinder unit 50 via an intake pipe, and a muffler 35 is connected to a lower portion of the cylinder unit 50 via an exhaust pipe. The CVT cover 44 is attached to a left side of the crankcase 41. The unit swing engine 40 swings integrally with the air cleaner, the muffler 35, the CVT cover 44 and the rear wheel 34.

[0014] In such a unit swing engine 40, a method such as adding a catalyst to an exhaust system or increasing a size of the catalyst is generally used in order to clear an exhaust gas regulation. However, since a noble metal is used for the catalyst, there is a problem that a cost increases. It is conceivable to adopt twin plugs for the unit swing engine 40 as a countermeasure against an exhaust gas, but it is necessary to greatly change a layout of peripheral components of the unit swing engine 40. Therefore, in the unit swing engine 40 according to the present embodiment, an arrangement of the twin plugs is devised to minimize the change from the existing layout of the peripheral components.

[0015] Hereinafter, the unit swing engine will be described with reference to FIGS. 2 to 6. FIG. 2 is a perspective view of the unit swing engine according to the present embodiment. FIG. 3 is a left side view of the unit swing engine according to the present embodiment. FIG. 4 is a front view of the cylinder head according to the present embodiment. FIG. 5 is a cross-sectional view of the unit swing engine in FIG. 3 taken along a line A-A. FIG. 6 is a cross-sectional view of the unit swing engine in FIG. 3 taken along a line B-B. In FIGS. 2 to 6, some members are omitted from the unit swing engine.

[0016] As shown in FIGS. 2 and 3, in the unit swing engine 40, the cylinder unit 50 is disposed on the front side of the crankcase 41. The cylinder unit 50 includes a cylinder 51 extending forward from the crankcase 41, a cylinder head 52 attached to a front surface of the cylinder 51, and a cylinder head cover 53 attached to a front surface of the cylinder head 52. The cylinder 51 is tilted forward nearly horizontally, and a cylinder axial direction is directed obliquely upward. The cylinder head 52 connected to the front surface of the cylinder 51 is also tilted forward, and the crankcase 41 connected to a rear surface of the cylinder 51 is disposed substantially horizontally.

[0017] An intake side connection portion 55 to which the intake pipe is connected is formed on an upper surface of the cylinder head 52. The intake side connection

portion 55 protrudes obliquely upward to the front from the upper surface of the cylinder head 52, and an intake port 56 is formed from the intake side connection portion 55 toward inside of the cylinder head 52. An exhaust side connection portion 57 to which the exhaust pipe is connected is formed on a lower surface of the cylinder head 52. The exhaust side connection portion 57 protrudes obliquely downward to the right, and an exhaust port 58 (see FIG. 5) is formed from the exhaust side connection portion 57 toward the inside of the cylinder head 52. In this way, the intake port 56 is formed above a cylinder axis, and the exhaust port 58 is formed below the cylinder axis.

[0018] The unit swing engine 40 is a single cylinder engine of a twin plug type, a first ignition plug 61 (see FIG. 4) is disposed on the front surface of the cylinder head 52, and a second ignition plug 64 is disposed on a left side surface of the cylinder head 52. The first ignition plug 61 enters the inside of the cylinder head 52, and the second ignition plug 64 protrudes outward from the left side surface of the cylinder head 52. Although details will be described later, an attachment seat surface 65 (see FIG. 6) of the second ignition plug 64 is formed by partially recessing the left side surface of the cylinder head 52, and an amount of protrusion of the second ignition plug 64 from the left side surface of the cylinder head 52 is suppressed.

[0019] A thermostat cover 83 is attached to the left side surface of the cylinder head 52, and a connector 84 is attached to a left side surface of the cylinder 51. A thermostat 82 (see FIG. 6) that opens and closes a cooling water passage according to a cooling water temperature is attached to inside of the thermostat cover 83. An inlet pipe (pipe) 85 that sends cooling water to a radiator (not shown) is connected to the thermostat cover 83, and an outlet pipe 86 that returns the cooling water from the radiator is connected to the connector 84. A bypass pipe 87 that returns the cooling water to the connector 84 while bypassing the radiator from the cylinder head 52 is connected to the connector 84.

[0020] The crankcase 41 has a left-right split structure, and includes a left case 42 and a right case 43. The left case 42 extends more rearward than the right case 43, and a left side surface of the left case 42 is open. The CVT cover 44 is attached to the left side surface of the left case 42 to form an accommodating space for the continuously variable transmission. A right side surface of the right case 43 is open, and a magneto cover 45 is attached to the right side surface of the right case 43 to form an accommodating space for a magneto (not shown). With reference to a mating surface 46 of the left case 42 and the right case 43, a left side of the crankcase 41 bulges more outward in a vehicle width direction than a right side (see FIG. 8).

[0021] An ignition coil 67 is provided on a front surface of the left case 42. The first and second ignition plugs 61, 64 are connected to the ignition coil 67 via high tension cords 68, 69 (see FIG. 7). When a discharge voltage is applied from the ignition coil 67 to the first and second ignition plugs 61, 64, an air-fuel mixture in a combustion chamber 71 (see FIG. 4) is ignited by the first and second ignition plugs 61, 64. The ignition coil 67 may be provided not on the left case 42 but on the CVT cover 44. An engine suspension portion 47 suspended from the vehicle body frame 10 is provided on an upper portion of the crankcase 41.

[0022] As shown in FIG. 4, a valve operating chamber 72 is formed at a center of the cylinder head 52, and a cam chain chamber 73 is formed at a right end of the cylinder head 52. Four corners of the valve operating chamber 72 are fixed to the cylinder 51 via bolts 74. In a state of facing the front surface of the cylinder head 52, a pair of intake valves 75 are disposed above a plane P that crosses a center of the valve operating chamber 72 in a left-right direction, and a pair of exhaust valves 76 are disposed below the plane P. FIG. 4 shows a state where valve tappets of the intake valves 75 and the exhaust valves 76 are exposed from the bottom surface of the valve operating chamber 72. A partition wall 77 that partitions the valve operating chamber 72 in the left-right direction is formed between the pair of intake valves 75 and between the pair of exhaust valves 76.

[0023] A cylindrical accommodating portion 78 is formed at a center position of the partition wall 77 in the upper-lower direction, and the first ignition plug 61 is inserted into the accommodating portion 78 so as to aim at a center of the combustion chamber 71 (see FIG. 9). The second ignition plug 64 is inserted into the left side surface of the cylinder head 52 so as to aim at a left end of the combustion chamber 71 (see FIG. 9). The second ignition plug 64 is disposed on a side opposite to the cam chain chamber 73 with the first ignition plug 61 interposed therebetween. Therefore, it is not necessary to increase the number of components and the number of work steps in order to allow the second ignition plug 64 to pass through the cam chain chamber 73. In addition, maintenance at the time of replacement of the second ignition plug 64 is also facilitated.

[0024] The first and second ignition plugs 61, 64 are disposed on the plane P. Since axes of the first and second ignition plugs 61, 64 are in the same plane P, insertion holes 63, 66 (see FIGS. 5 and 6) of the first and second ignition plugs 61, 64 can be easily formed with respect to the cylinder head 52. The first and second ignition plugs 61, 64 are not biased toward an intake side and an exhaust side, and the axes of the first and second ignition plugs 61, 64 are separated from each other on the plane P. Therefore, the air-fuel mixture is combusted by ignition of the first and second ignition plugs 61, 64 to propagate a flame uniformly to the intake side and the exhaust side, and a flame propagation time is shortened to increase a combustion speed.

[0025] A thermostat attachment portion 81 is formed on the left side surface of the cylinder head 52. The thermostat attachment portion 81 slightly protrudes from the left side surface of the cylinder head 52, and the cooling

water passage is formed inside the thermostat attachment portion 81. The thermostat 82 (see FIG. 6) is interposed in the cooling water passage of the thermostat attachment portion 81, and a thermostat cover 83 is attached to the thermostat attachment portion 81 so as to cover the thermostat 82. The thermostat attachment portion 81 is formed above the pair of intake valves 75, and the thermostat 82 and the thermostat cover 83 are positioned above the second ignition plug 64.

[0026] As shown in FIG. 5, a bottom surface of the accommodating portion 78 of the cylinder head 52 serves as an attachment seat surface 62 of the first ignition plug 61 (see FIG. 4). The insertion hole 63 for the first ignition plug 61 is formed in the attachment seat surface 62. A water jacket 88 is formed inside the cylinder head 52 so as to surround the accommodating portion 78. A pair of openings 89 are formed in a bottom surface of the water jacket 88, and the cooling water flows into the water jacket 88 of the cylinder head 52 from a water jacket (not shown) of the cylinder 51 through the pair of openings 89. The first ignition plug 61 in the accommodating portion 78 is cooled by the cooling water in the water jacket 88.

[0027] As shown in FIG. 6, the left side surface of the cylinder head 52 is recessed to form the attachment seat surface 65 of the second ignition plug 64 (see FIG. 4). The insertion hole 66 for the second ignition plug 64 is formed in the attachment seat surface 65. The attachment seat surface 65 is located on a straight line L1 passing through centers of the left pair of bolts 74. The attachment seat surface 65 does not largely protrude from the straight line L1, and a mating surface of the cylinder head 52 and the cylinder 51 is made small, so that the cylinder unit 50 is formed compactly. The water jacket 88 is formed in vicinity of the attachment seat surface 65, and the second ignition plug 64 is cooled by the cooling water of the water jacket 88.

[0028] In this way, the second ignition plug 64 is added to the left side surface of the cylinder head 52 of the unit swing engine 40. At this time, in consideration of swing of the unit swing engine 40, the second ignition plug 64 is disposed so as not to collide with the peripheral components such as the vehicle body frame 10 (see FIG. 7). Since addition of the second ignition plug 64 does not greatly affect the layout of the peripheral components, the existing layout can be adopted for the peripheral components. Therefore, the twin plugs can be introduced into the unit swing engine 40 with a minimum design change.

[0029] A positional relationship between the second ignition plug and the peripheral components will be described with reference to FIGS. 7 to 9. FIG. 7 is a left side view of the unit swing engine and the vehicle body frame according to the present embodiment. FIG. 8 is a front view of the unit swing engine and the vehicle body frame according to the present embodiment. FIG. 9 is a cross-sectional view of the unit swing engine in FIG. 7 taken along a line C-C. In FIG. 8, the high tension cord is omitted.

[0030] As shown in FIGS. 7 and 8, the vehicle body frame 10 is formed in a cradle shape by a pair of upper frames 11, a pair of front frames (not shown), a pair of lower frames 12, and a pair of rear frames (frame members) 13. Each of the upper frames 11 extends in a vehicle front-rear direction, and each of the front frames stands obliquely rearward from a front portion of each of the upper frames 11. Each of the lower frames 12 extends toward the vehicle rear side from a lower portion of each of the front frames, and each of the rear frames 13 rises obliquely rearward from a rear portion of each of the lower frames 12. A bracket 14 for suspending the engine is provided on upper portions of the rear frames 13.

[0031] The engine suspension portion 47 of the unit swing engine 40 is supported by the bracket 14 of the vehicle body frame 10 such that the cylinder unit 50 enters inside of the cradle shape of the vehicle body frame 10. The pair of rear frames 13 extend in the upper-lower direction in front of the crankcase 41. More specifically, each of the pair of rear frames 13 rises obliquely rearward from a lower portion of the lower frame 12 so as to cross a lateral side of the cylinder 51. The cylinder head 52 having a relatively narrow engine width is present in front of the rear frame 13, and the crankcase 41 having a relatively wide engine width is present behind the rear frame 13.

[0032] The second ignition plug 64 is disposed inside the rear frame 13 and on the left side surface of the cylinder head 52 in front of the rear frame 13. Since a front side of the rear frame 13 is separated from the crankcase 41 having a large engine width, rather than a rear side of the rear frame 13, the second ignition plug 64 is easily separated from the peripheral components. Since the second ignition plug 64 is sufficiently separated from the largediameter upper frame 11 and rear frame 13, the second ignition plug 64 does not collide with the upper frame 11 and the rear frame 13 even when the unit swing engine 40 swings. Although a small-diameter frame 15 is present in vicinity of the second ignition plug 64, the small-diameter frame 15 does not come into contact with the second ignition plug 64.

[0033] The ignition coil 67 is provided on a front surface of the crankcase 41 behind the second ignition plug 64. The ignition coil 67 is disposed on a side opposite to the second ignition plug 64 with the rear frame 13 interposed therebetween. By attaching the ignition coil 67 and the first and second ignition plugs 61, 64 to the unit swing engine 40, a positional relationship between the ignition coil 67 and the first and second ignition plugs 61, 64 is fixed. Even when the unit swing engine 40 swings, the high tension cords 68, 69 connecting the ignition coil 67 and the first and second ignition plugs 61, 64 do not move.

[0034] Therefore, it is not necessary to provide a margin for a length of each of the high tension cords 68, 69, and the high tension cords 68, 69 can be shortened to suppress an influence on the layout of the peripheral components. In particular, since the ignition coil 67 and the second ignition plug 64 are attached to a left side of the unit swing engine 40, the high tension cord 69 con-

necting the ignition coil 67 and the second ignition plug 64 can be shortened. The ignition coil 67 is disposed in front of the engine suspension portion 47, and a swing range of the ignition coil 67 is suppressed, and the influence on the layout of the peripheral components is suppressed.

[0035] A long side direction of the ignition coil 67 is directed to an engine swing direction D such that the long side direction of the ignition coil 67 is along an extending direction of the rear frame 13. Thereby, a gap between the ignition coil 67 and the rear frame 13 is ensured. A strength against a gravity applied to the ignition coil 67 when the unit swing engine 40 swings is increased. The long side direction of the ignition coil 67 is not limited to a state where the long side direction of the ignition coil 67 completely coincides with the engine swing direction D, and may be deviated to such an extent that the long side direction of the ignition coil 67 can be regarded as being directed to the engine swing direction D.

[0036] As shown in FIG. 9, a dead space (space) S is formed behind the second ignition plug 64 by the crankcase 41, the cylinder 51 and the rear frame 13. The ignition coil 67 is disposed in the dead space S, and the dead space S is effectively utilized as an arrangement space for the ignition coil 67. Since the ignition coil 67 is disposed inside the crankcase 41, the cylinder 51 and the rear frame 13, the ignition coil 67 is effectively protected from flying objects from a lateral side or a rear side of the unit swing engine 40.

[0037] With reference back to FIGS. 7 and 8, the thermostat attachment portion 81 slightly protruding from the left side surface of the cylinder head 52 is formed above the second ignition plug 64. The thermostat cover 83 that covers the thermostat 82 (see FIG. 6) is attached to the thermostat attachment portion 81. The second ignition plug 64 and the thermostat cover 83 are both provided on the left side surface of the cylinder head 52, and the second ignition plug 64 is located more inward than the thermostat cover 83 in an engine width direction. Since the second ignition plug 64 does not protrude outward (leftward) from the thermostat cover 83, a gap between the second ignition plug 64 and the peripheral components is ensured.

[0038] In this way, the engine width does not increase due to the addition of the second ignition plug 64 to the unit swing engine 40. Since the thermostat cover 83 and the second ignition plug 64 are arranged in the upper-lower direction, a dimension of the cylinder head 52 in the front-rear direction is reduced, and the unit swing engine 40 is made compact. Although the thermostat cover 83 protrudes from the left side surface of the cylinder head 52, the thermostat cover 83 does not collide with the rear frame 13 or the like since the thermostat cover 83 is disposed inside the rear frame 13 and in front of the rear frame 13 similarly to the second ignition plug 64.

[0039] The inlet pipe 85 extends downward from the thermostat cover 83, and the inlet pipe 85 partially overlaps with the second ignition plug 64 in a side view. The inlet pipe 85 effectively protects the second ignition plug 64 from flying objects from the lateral side. Since the inlet pipe 85 passes through outside of the second ignition plug 64, installation of the inlet pipe 85 is not hindered by the second ignition plug 64. Since the second ignition plug 64 does not protrude outward (leftward) from the inlet pipe 85, the gap between the second ignition plug 64 and the peripheral components is ensured.

[0040] The high tension cords 68, 69 are connected to the ignition coil 67 from the first and second ignition plugs 61, 64 through outside of the inlet pipe 85. Therefore, installation of the high tension cords 68, 69 is not hindered by the inlet pipe 85. The exhaust side connection portion 57 protrudes obliquely downward to the right from the lower surface of the cylinder head 52, and the exhaust pipe (not shown) connected to the exhaust side connection portion 57 extends rearward through a right side of the unit swing engine 40. The second ignition plug 64 and the ignition coil 67 are disposed on the left side of the unit swing engine 40, which is a side opposite to the exhaust pipe, so as to ensure a passage of the exhaust pipe.

[0041] As described above, according to the present embodiment, the unit swing engine 40 is supported by the vehicle body frame 10 in a state where the cylinder unit 50 is tilted forward. The engine width on the front side of the engine where the cylinder 51 and the cylinder head 52 are present is narrower than that on the rear side of the engine where the crankcase 41 is present. Therefore, the front side of the rear frame 13 is separated from the crankcase 41 having the large engine width, and it is easy to ensure the gap between the second ignition plug 64 and the peripheral components. Since the second ignition plug 64 is disposed in front of the rear frame 13, the second ignition plug 64 can be added to the unit swing engine 40 without affecting the layout of the peripheral components. Even when the unit swing engine 40 swings, the second ignition plug 64 does not interfere with the peripheral components.

[0042] In the present embodiment, the second ignition plug, the ignition coil and the thermostat cover are provided on the left side of the unit swing engine, but the second ignition plug, the ignition coil and the thermostat cover may be provided on the right side of the unit swing engine.

[0043] In the present embodiment, the vehicle body frame is formed in the cradle shape, but the vehicle body frame is not limited to the cradle shape, as long as the vehicle body frame includes a frame member extending in the upper-lower direction in front of the crankcase.

[0044] In the present embodiment, the long side direction of the ignition coil is directed to the engine swing direction, but the long side direction of the ignition coil may not be directed to the engine swing direction as long as the long side direction of the ignition coil is along the extending direction of the frame member.

[0045] In the present embodiment, the cylinder head

is provided with the thermostat and the thermostat cover, but the cylinder may be provided with the thermostat and the thermostat cover.

[0046] The unit swing engine according to the present embodiment may be adopted, not limited to the straddle-type vehicle shown in the drawings, in other types of straddle-type vehicles. The straddle-type vehicle is not limited to general vehicles in which a rider rides in a posture of straddling a seat, and also includes a small-sized scooter type vehicle in which a rider rides without straddling a seat.

[0047] As described above, a unit swing engine (40) according to the present embodiment is a unit swing engine swingably supported by a vehicle body frame (10), and the unit swing engine includes: a cylinder (51) tilted forward horizontally or nearly horizontally; a cylinder head (50) connected to a front surface of the cylinder; a crankcase (41) connected to a rear surface of the cylinder; a first ignition plug (61) disposed on a top surface of the cylinder head; and a second ignition plug (64) disposed on a side surface of the cylinder head. The vehicle body frame includes a frame member (rear frame 13) extending in an upper-lower direction in front of the crankcase, and the second ignition plug is disposed inside the frame member and in front of the frame member. According to this configuration, since the unit swing engine is supported by the vehicle body frame in a state where the cylinder is tilted forward, an engine width on a front side of the engine where the cylinder and the cylinder head are present is narrower than that on a rear side of the engine where the crankcase is present. Therefore, a front side of the frame member is separated from the crankcase having a large engine width, and it is easy to ensure a gap between the second ignition plug and peripheral components. Since the second ignition plug is disposed in front of the frame member, the second ignition plug can be added to the unit swing engine without affecting a layout of the peripheral components. Even when the unit swing engine swings, the second ignition plug does not interfere with the peripheral components.

[0048] The unit swing engine according to the present embodiment further includes: an ignition coil (67) configured to apply a discharge voltage to the first ignition plug and the second ignition plug. The ignition coil is disposed behind the second ignition plug on an engine outer surface on one side in an engine width direction as the second ignition plug. According to this configuration, a positional relationship between the ignition coil and the first and second ignition plugs is fixed by attaching the ignition coil to the unit swing engine. It is not necessary to provide a margin for a length of a high tension code, and the high tension code can be shortened to suppress an influence on the layout of the peripheral components. In particular, since the ignition coil and the second ignition plug are attached to the one side of the unit swing engine in the engine width direction, the high tension cord connecting the ignition coil and the second ignition plug can be shortened. A dead space is formed behind the second ignition plug by the cylinder and the crankcase, and the dead space can be effectively used as an arrangement space for the ignition coil.

[0049] In the unit swing engine according to the present embodiment, an engine suspension portion (47) is provided on an upper surface of the crankcase, and the ignition coil is disposed in a space surrounded by the crankcase, the cylinder and the frame member in front of the engine suspension portion. According to this configuration, by disposing the ignition coil near the engine suspension portion, it is possible to suppress a swing range of the ignition coil and suppress the influence on the layout of the peripheral components. The dead space in front of the crankcase is effectively utilized, and the ignition coil is effectively protected from flying objects.

[0050] In the unit swing engine according to the present embodiment, a long side direction of the ignition coil is directed to an engine swing direction (D) such that the long side direction of the ignition coil is along the frame member. According to this configuration, a gap between the ignition coil and the frame member can be ensured. In addition, a strength against a gravity applied to the ignition coil when the unit swing engine swings is increased.

[0051] The unit swing engine according to the present embodiment further includes: a thermostat (82) configured to open and close a cooling water passage according to a cooling water temperature; and a thermostat cover (83) configured to cover the thermostat. The thermostat cover is attached to a side surface of the cylinder or the cylinder head on an one side in an engine width direction as the second ignition plug, and the second ignition plug is located more inward than the thermostat cover in the engine width direction. According to this configuration, since the second ignition plug does not protrude outward from the thermostat cover, the gap between the second ignition plug and the peripheral components is ensured. In addition, the engine width does not increase due to addition of the second ignition plug to the unit swing engine.

[0052] In the unit swing engine according to the present embodiment, the thermostat cover is attached to the cylinder head above the second ignition plug. According to this configuration, cooling water flows in vicinity of the second ignition plug to cool the second ignition plug. Since the thermostat and the second ignition plug are arranged in the upper-lower direction, a dimension of the cylinder head in a front-rear direction can be reduced.

[0053] In the unit swing engine according to the present embodiment, a pipe (inlet pipe 85) is attached to the thermostat cover, and the pipe overlaps with the second ignition plug in a side view. According to this configuration, the pipe protects the second ignition plug from flying objects from a lateral side. Since the pipe passes through the lateral side of the second ignition plug, installation of the pipe is not hindered by the second ignition plug. Since the second ignition plug does not protrude outward from the pipe, the gap between the second ignition plug and

the peripheral components is ensured.

[0054] Although the present embodiment has been described, the above-described embodiment and modifications may be combined entirely or partially as other embodiment.

[0055] The technique of the present invention is not limited to the above-described embodiment, and various changes, substitutions and modifications may be made without departing from the spirit of the technical concept of the present invention. Further, the present invention may be implemented using other methods as long as the technical idea can be implemented by the methods through advance of the technique or other derivative technique. Accordingly, the claims cover all embodiments that may be included within the scope of the technical idea.

Reference Signs List

[0056]

10: Vehicle body frame
13: Rear frame
40: Unit swing engine
41: Crankcase
47: Engine suspension portion
51: Cylinder
52: Cylinder head
61: First ignition plug
64: Second ignition plug
67: Ignition coil
82: Thermostat
83: Thermostat cover
85: Inlet pipe (Pipe)
D: Engine swing direction
S: Dead space (Space)

Claims

1. A unit swing engine (40) swingably supported by a vehicle body frame (10), the unit swing engine (40) comprising:

a cylinder (51) tilted forward horizontally or nearly horizontally;
a cylinder head (52) connected to a front surface of the cylinder (51);
a crankcase (41) connected to a rear surface of the cylinder (51);
a first ignition plug (61) disposed on a top surface of the cylinder head (52); and
a second ignition plug (64) disposed on a side surface of the cylinder head (52),
wherein the vehicle body frame (10) includes a frame member extending in an upper-lower direction in front of the crankcase (41), and
wherein the second ignition plug (64) is disposed inside the frame member and in front of the frame member.

2. The unit swing engine (40) according to claim 1, further comprising:

an ignition coil (67) configured to apply a discharge voltage to the first ignition plug (61) and the second ignition plug (64),
wherein the ignition coil (67) is disposed behind the second ignition plug (64) on an engine outer surface on one side in an engine width direction as the second ignition plug (64).

3. The unit swing engine (40) according to claim 2,

wherein an engine suspension portion (47) is provided on an upper surface of the crankcase (41), and
wherein the ignition coil (67) is disposed in a space surrounded by the crankcase (41), the cylinder (51) and the frame member in front of the engine suspension portion (47).

4. The unit swing engine (40) according to claim 2 or 3, wherein a long side direction of the ignition coil (67) is directed to an engine swing direction (D) such that the long side direction of the ignition coil (67) is along the frame member.

5. The unit swing engine (40) according to any one of claims 1 to 4, further comprising:

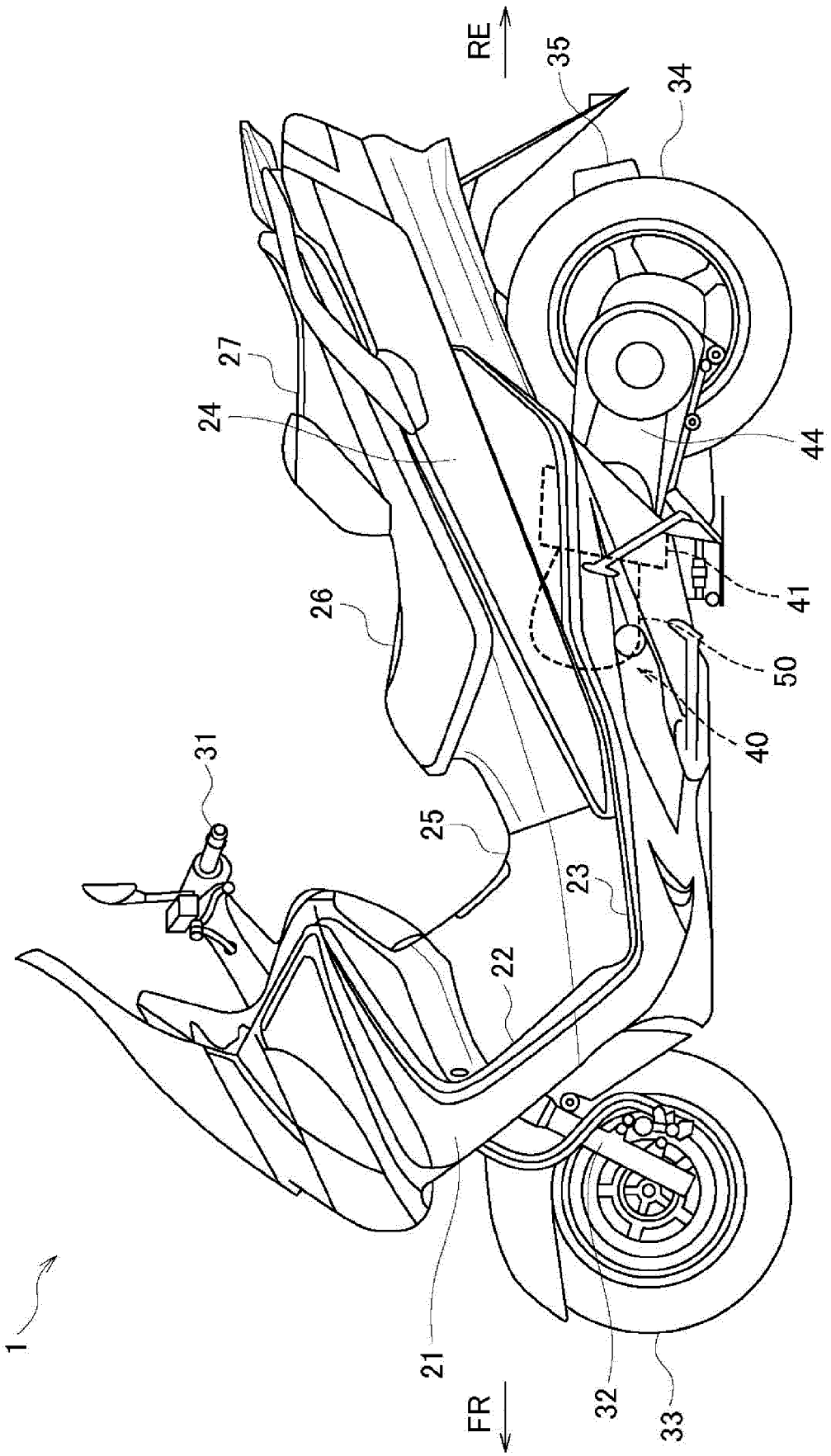
a thermostat (82) configured to open and close a cooling water passage according to a cooling water temperature; and
a thermostat cover (83) configured to cover the thermostat (82),
wherein the thermostat cover (83) is attached to a side surface of the cylinder (51) or the cylinder head (52) on an one side in an engine width direction as the second ignition plug (64), and
wherein the second ignition plug (64) is located more inward than the thermostat cover (83) in the engine width direction.

6. The unit swing engine (40) according to claim 5, wherein the thermostat cover (83) is attached to the cylinder head (52) above the second ignition plug (64).

7. The unit swing engine (40) according to claim 6,

wherein a pipe (85) is attached to the thermostat cover (83), and
wherein the pipe (85) overlaps with the second ignition plug (64) in a side view.

FIG. 1



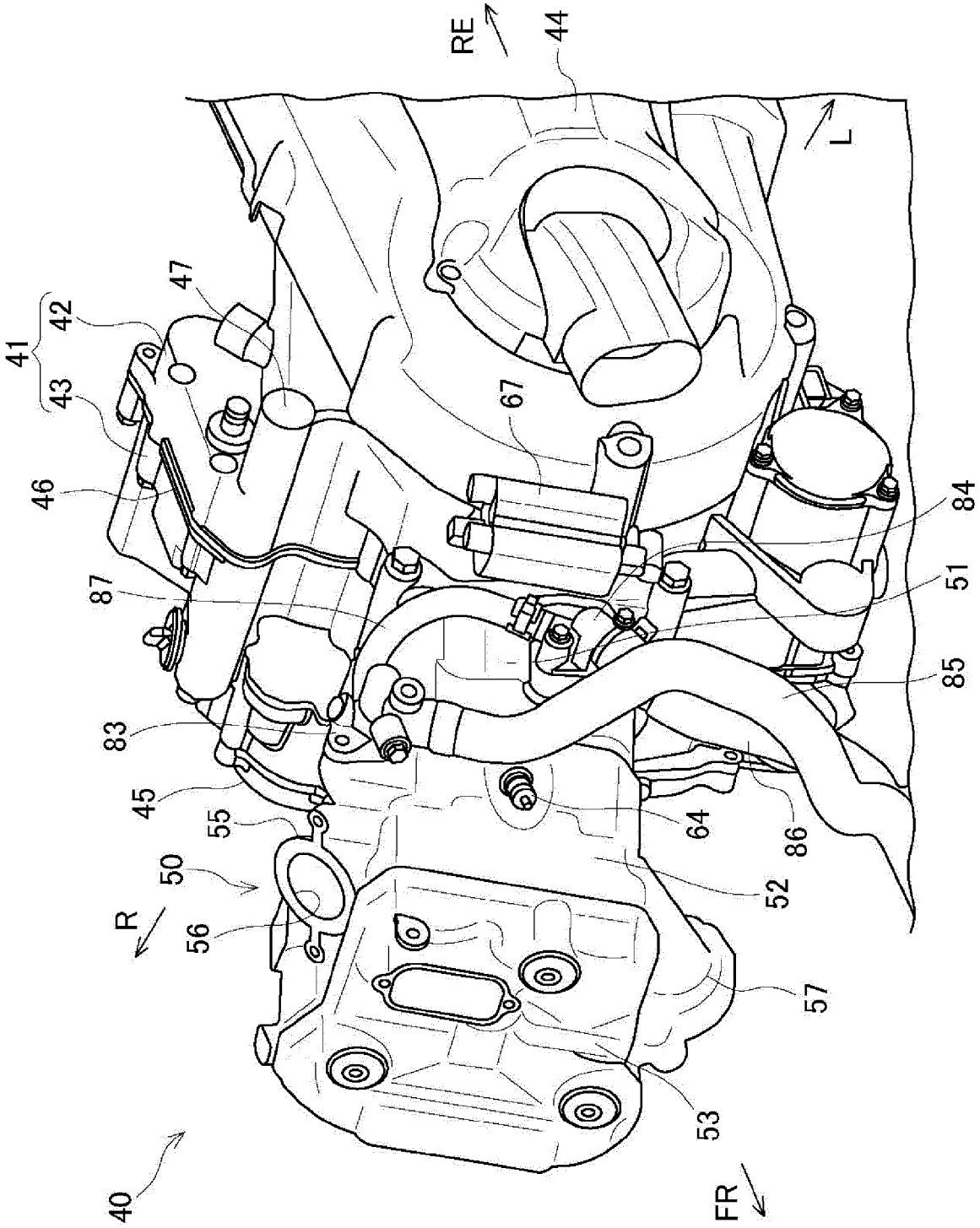

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FIG. 2

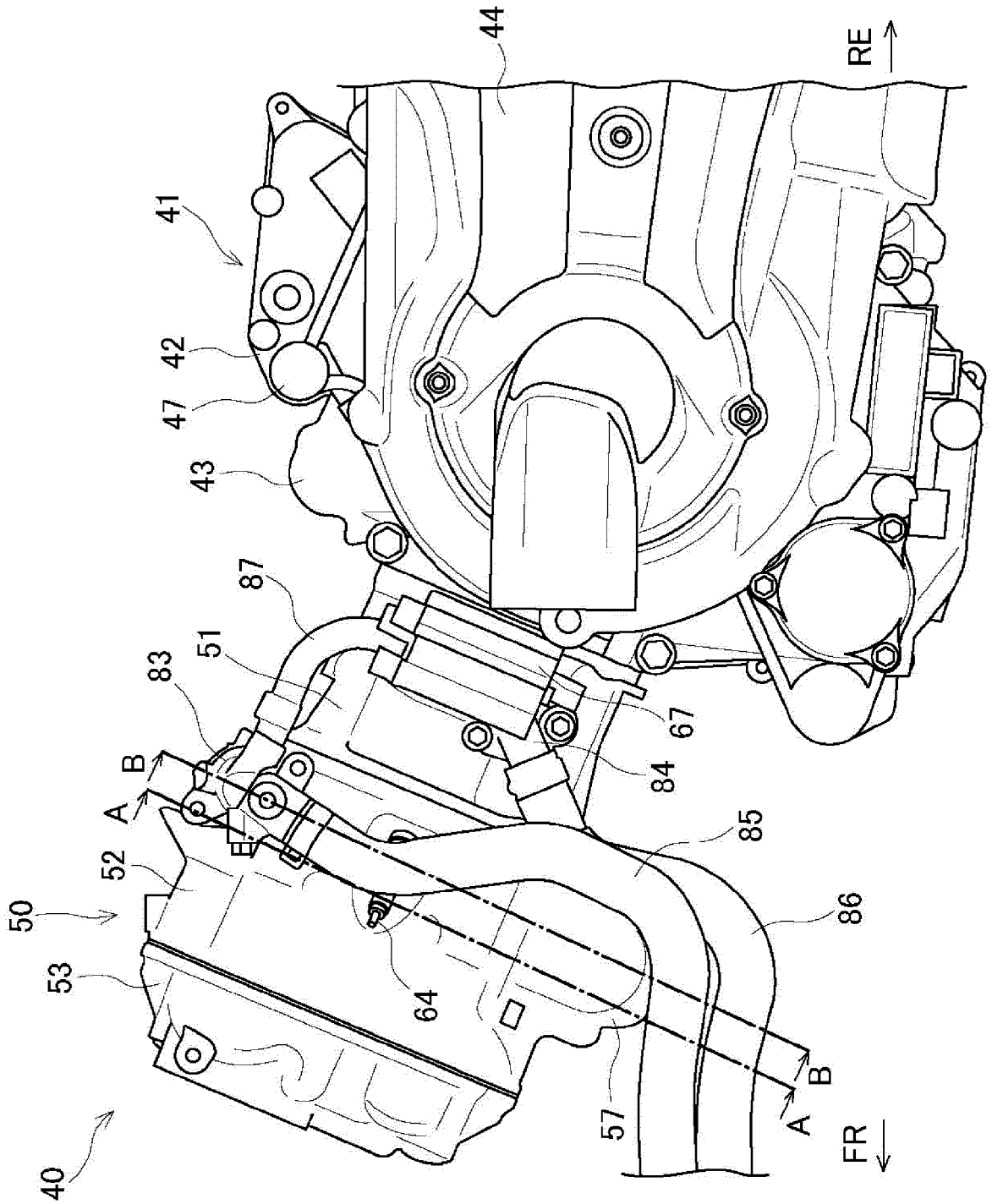
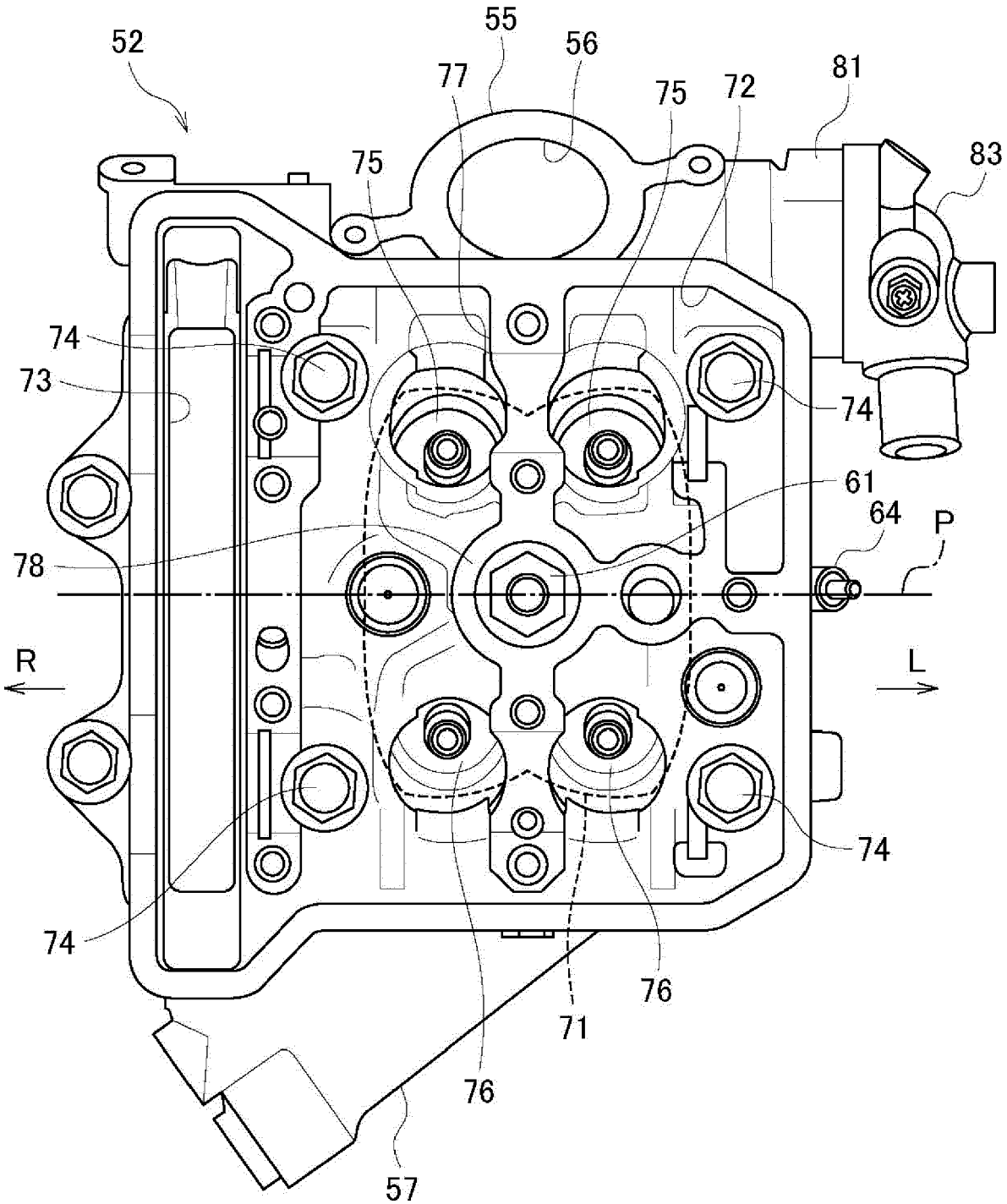


FIG. 3

FIG. 4



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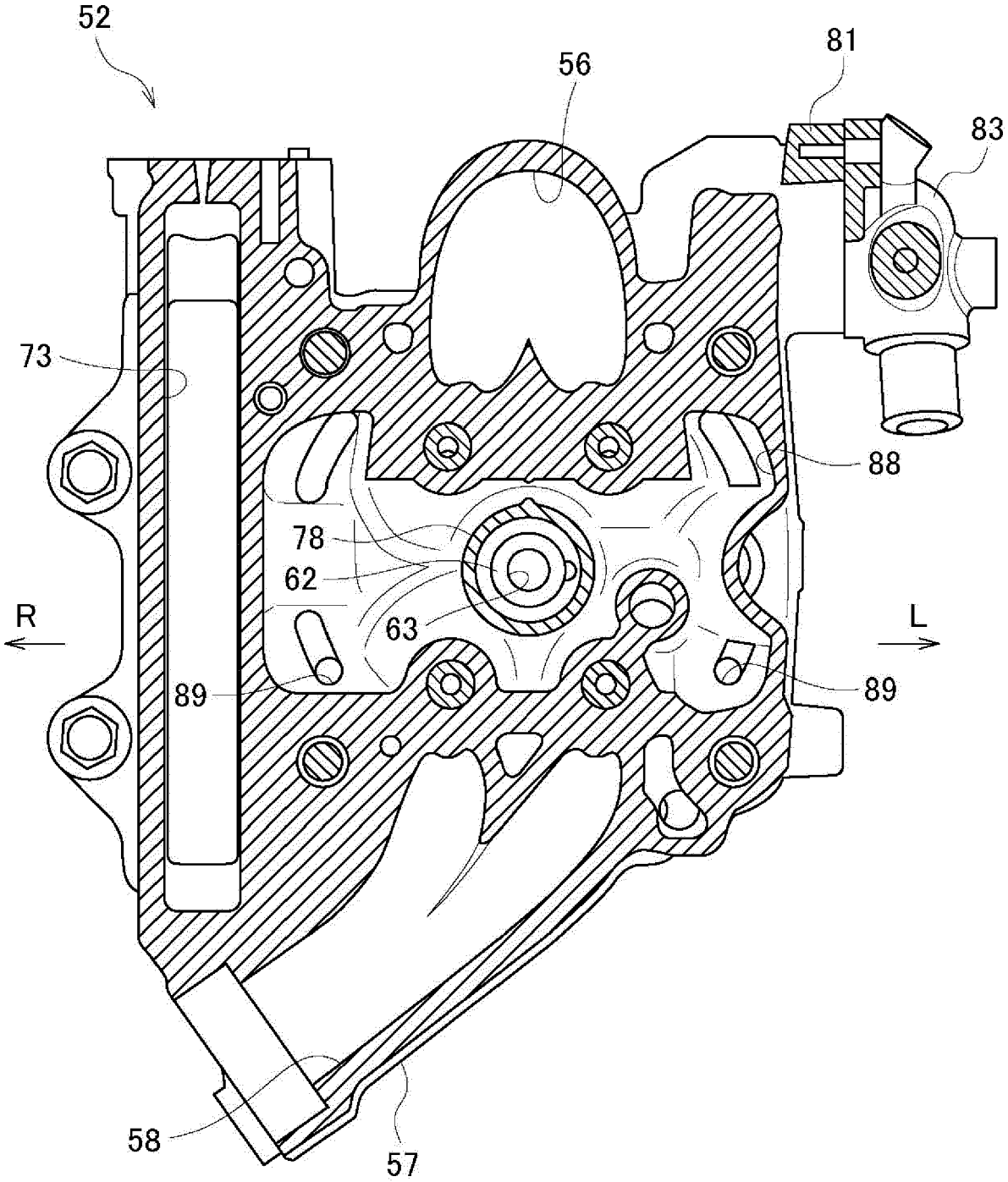

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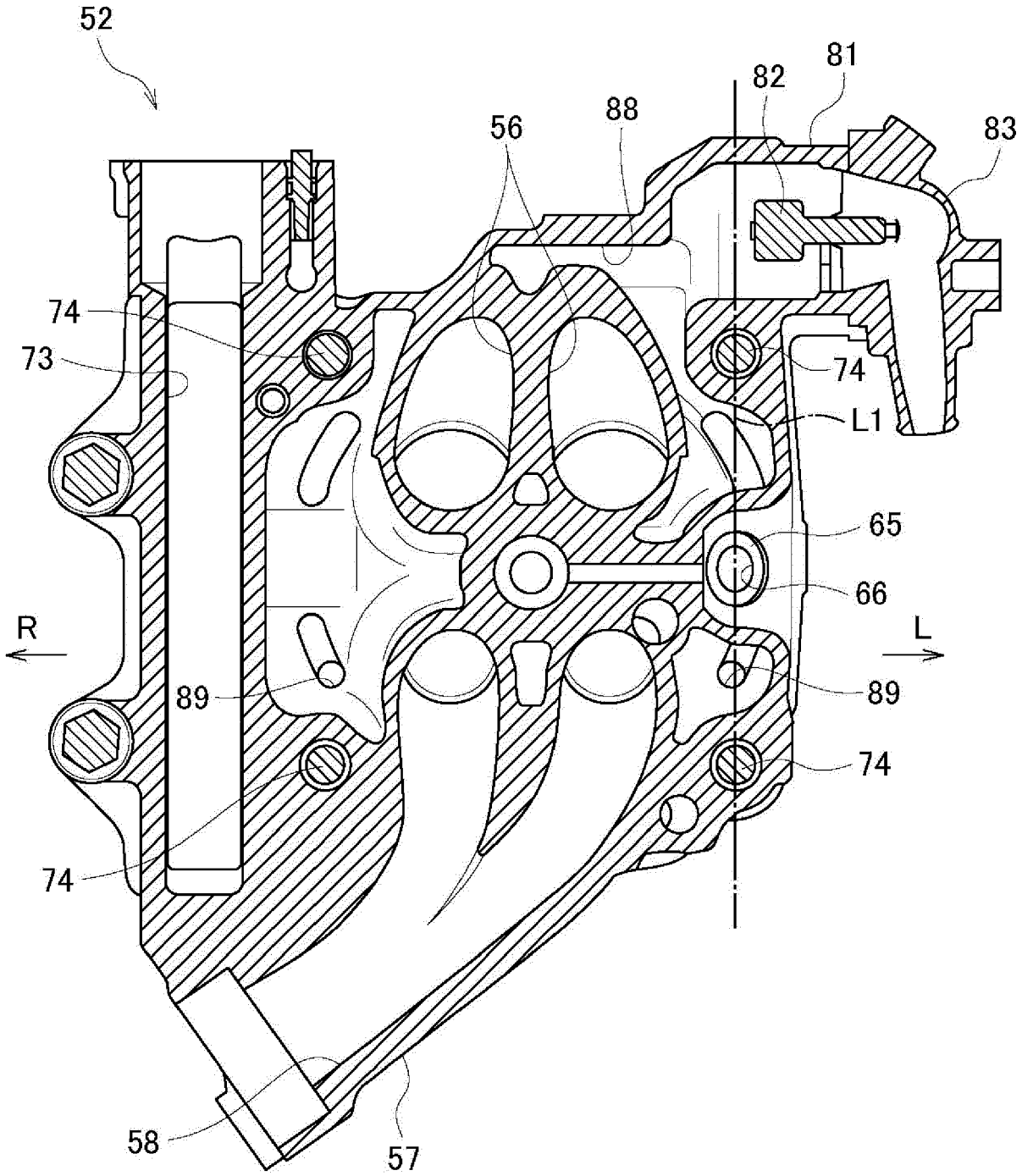

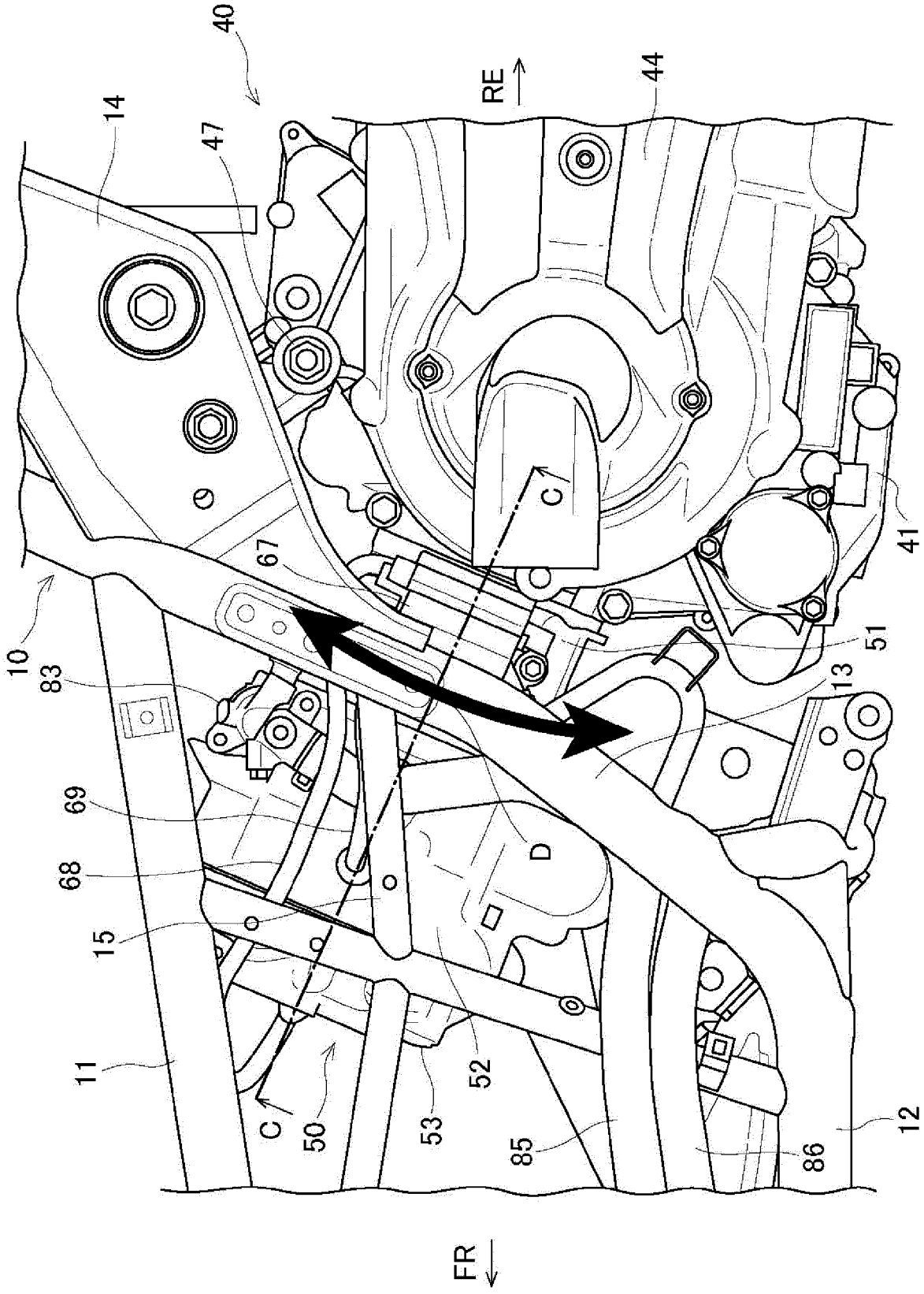

FIG. 7

FIG. 8

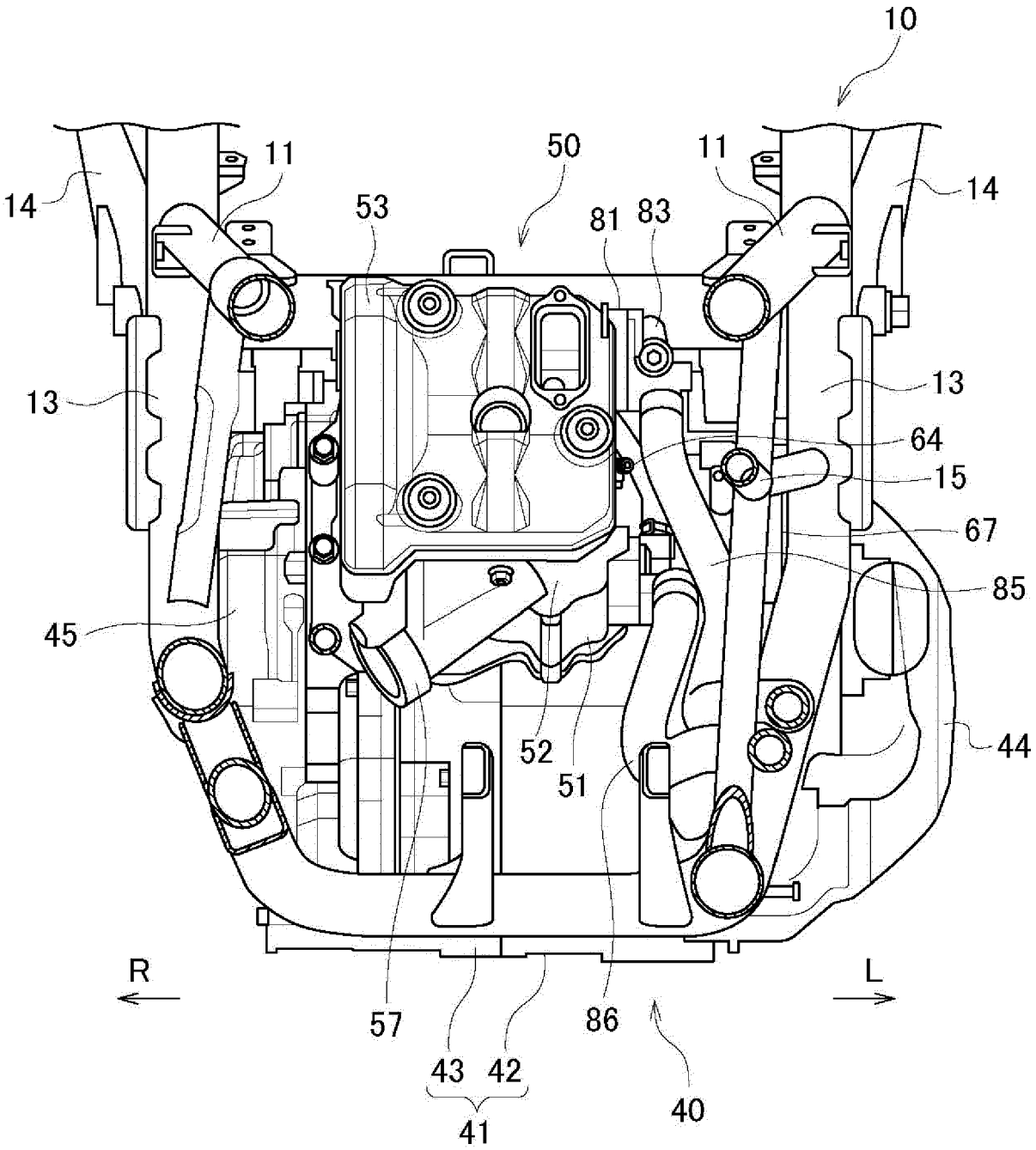
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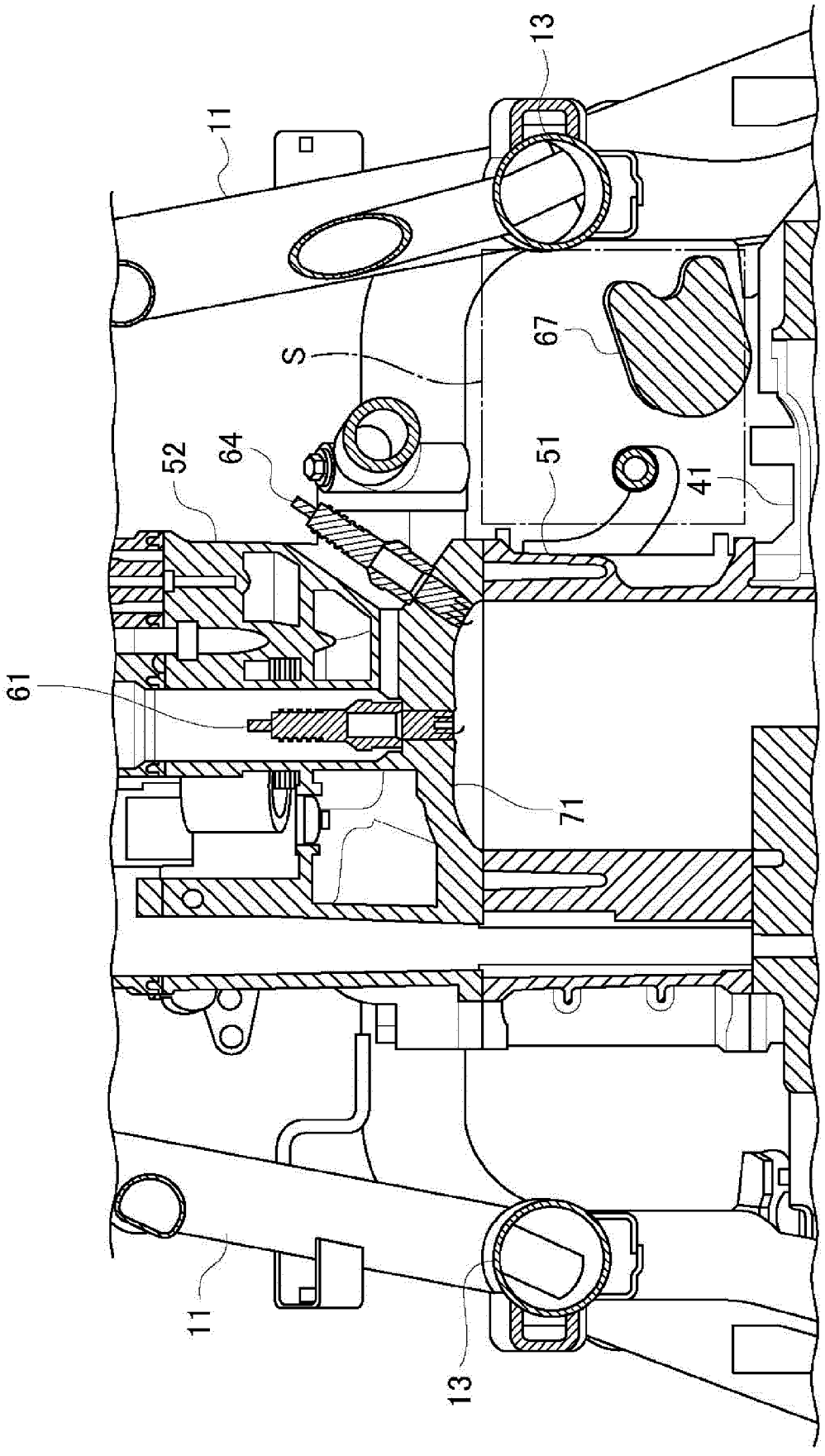
FIG. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 3249

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 4 689474 B2 (HONDA MOTOR CO LTD) 25 May 2011 (2011-05-25) * the whole document *	1-7	INV. F02B61/02 F02P15/08
A	JP 4 550018 B2 (HONDA MOTOR CO LTD) 22 September 2010 (2010-09-22) * the whole document *	1-7	
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1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 March 2022	Paulson, Bo

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