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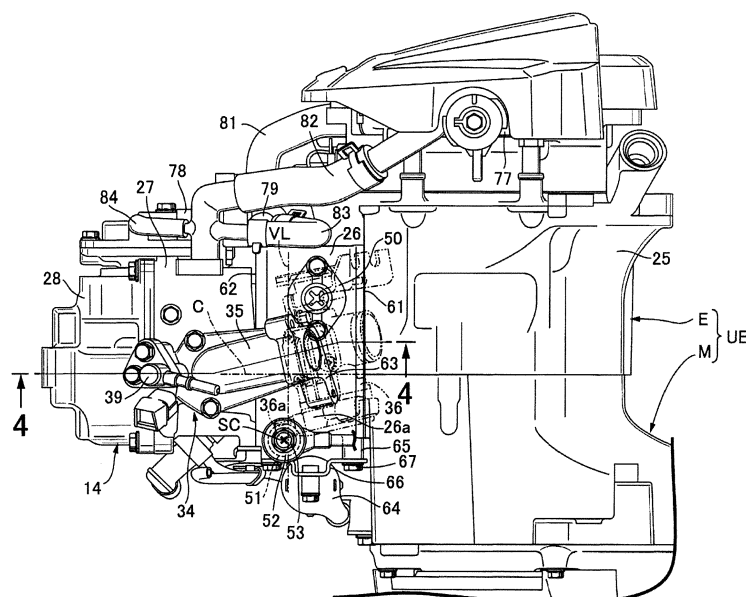
(54) **KNOCK SENSOR MOUNTING STRUCTURE IN UNIT SWING ENGINE**

(57) To enable attachment/detachment work of a knock sensor to be facilitated and an intake system to be disposed at a low position in a unit swing engine in which: an intake pipe that stands upward from a cylinder head of an engine main unit, swingably supported by a frame body with a cylinder axis tilting forward, and extends rearward above the cylinder head and a cylinder block is con-

nected to an upper wall of the cylinder head; and a knock sensor is fastened, with a screw member, to a mounting boss formed on an upper wall of the cylinder block.

A mounting boss 51 is formed on an upper wall 26a of a cylinder block 26 at such a position as to avoid overlapping with an intake pipe 35 as seen in a direction along a screw axis SC of a screw member 53.

Fig.3



## Description

### [Technical Field]

**[0001]** The present invention relates to a unit swing engine in which: an engine main unit including a crankcase, a cylinder block coupled to a front portion of the crankcase with a cylinder axis tilting forward, and a cylinder head coupled to a front portion of the cylinder block is swingably supported by a frame body; an intake pipe connected to an upper wall of the cylinder head stands upward from the cylinder head and bends rearward to extend rearward above the cylinder head and the cylinder block; and a knock sensor to detect knocking is fastened, with a screw member, to a mounting boss formed on an upper wall of the cylinder block, and particularly relates to the improvement of a knock sensor mounting structure.

### [Background of the Invention]

**[0002]** It is known from Patent Document 1 that, in a unit swing engine for a straddle-type vehicle in which an engine main unit having a cylinder axis tilting forward to become substantially horizontal is swingably supported by a frame body, a knock sensor to detect vibrations due to knocking is mounted on an upper wall of a cylinder block, constituting a part of the engine main unit, in order to prevent as much as possible stones, dirt, water, and the like flying from the ground from affecting the knock sensor.

### [Description of the Prior Art]

### [Patent Document]

**[0003]** [Patent Document 1] Japanese Patent Application Publication No. 2013-24100

### [Summary of Invention]

### [Problem to be Solved by the Invention]

**[0004]** Meanwhile, in the unit swing engine for a straddle-type vehicle in which the cylinder axis tilts forward to become substantially horizontal, an intake pipe which is connected to an upper wall of a cylinder head so as to stand upward from the cylinder head extends rearward above the cylinder head and the cylinder block and, in the engine disclosed in Patent Document 1, the knock sensor is disposed immediately below an intake system including the intake pipe. For this reason, attachment/detachment work of the knock sensor becomes complicated, and not only that, problems peculiar to the unit swing engine arise such as increase in the height of a riding seat disposed above the intake pipe in the case where the intake pipe is disposed at a higher position to prevent the knock sensor protruding upward from the cylinder block from interfering with the intake pipe.

**[0005]** The present invention has been made in view of such circumstances, and it is an object of the present invention to provide a knock sensor mounting structure in a unit swing engine which enables attachment/detachment work of a knock sensor to be facilitated and an intake pipe to be disposed at a low position even in the case where the knock sensor is mounted on an upper wall of a cylinder block.

### 10 [Means for Solving the Problem]

**[0006]** In order to achieve the above object, a first aspect of the present invention is characterized in that, in a unit swing engine in which: an engine main unit including a crankcase, a cylinder block coupled to a front portion of the crankcase with a cylinder axis tilting forward, and a cylinder head coupled to a front portion of the cylinder block is swingably supported by a frame body; an intake pipe connected to an upper wall of the cylinder head stands upward from the cylinder head and bends rearward to extend rearward above the cylinder head and the cylinder block; and a knock sensor to detect knocking is fastened, with a screw member, to a mounting boss formed on an upper wall of the cylinder block, the mounting boss is formed on the upper wall of the cylinder block at such a position as to avoid overlapping with the intake pipe as seen in a direction along a screw axis of the screw member.

**[0007]** Moreover, in addition to the configuration according to the first aspect, a second aspect of the present invention is characterized in that at least a part of the intake pipe is disposed at a position overlapping with the cylinder axis as seen in the direction along the screw axis of the screw member, the cylinder block and the cylinder head are coupled to the front portion of the crankcase with multiple stud bolts, and the mounting boss is formed on the cylinder block so that, as seen in the direction along the screw axis of the screw member, at least a part of the mounting boss overlaps with a specific one of the stud bolts which is disposed at a position offset either to the left or right with respect to the cylinder axis.

**[0008]** In addition to the configuration according to the first or second aspect, a third aspect of the present invention is characterized in that a cam chain passage in which a cam chain passes through is formed in the cylinder block so as to be disposed at one side in a vehicle widthwise direction of a vertical plane including the cylinder axis, and the mounting boss is formed on the cylinder block so as to be disposed at the other side in the vehicle widthwise direction of the vertical plane.

**[0009]** In addition to the configuration according to any one of the first to third aspects, a fourth aspect of the present invention is characterized in that the mounting boss is formed on the cylinder block so that the screw axis of the screw member is disposed at a position offset in the vehicle widthwise direction with respect to an axis of the specific stud bolt.

**[0010]** In addition to the configuration according to the

fourth aspect, a fifth aspect of the present invention is characterized in that the screw member is screwed into the mounting boss so that a part thereof overlaps with the specific stud bolt as viewed in a side view.

**[0011]** In addition to the configuration according to the fourth or fifth aspect, a sixth aspect of the present invention is characterized in that the mounting boss is formed on the cylinder block so that the screw axis of the screw member is disposed at a position offset outward in the vehicle widthwise direction with respect to the axis of the specific stud bolt.

**[0012]** In addition to the configuration according to the sixth aspect, a seventh aspect of the present invention is characterized in that the knock sensor is mounted on the mounting boss so that, as seen in the direction along the screw axis of the screw member, a part of the knock sensor projects further outward in the vehicle widthwise direction than a side wall of the cylinder block on one side thereof where the knock sensor is arranged, with respect to the vertical plane including the cylinder axis, and an electrical unit disposed below the knock sensor is supported on the side wall of the cylinder block.

**[0013]** In addition to the configuration according to any one of the first to seventh aspects, an eighth aspect of the present invention is characterized in that the mounting boss is formed on the cylinder block so that the screw axis of the screw member is located outward in the vehicle widthwise direction with respect to a cylinder bore of the cylinder block as seen in the direction along the screw axis of the screw member.

**[0014]** In addition to the configuration according to any one of the first to eighth aspects, a ninth aspect of the present invention is characterized in that the mounting boss is formed on the cylinder block so that the screw axis of the screw member is located closer to the cylinder head side than is a central portion, in a direction along the cylinder axis, of mating surfaces configured respectively between the cylinder block and the crankcase and between the cylinder block and the cylinder head.

**[0015]** In addition to the configuration according to any one of the first to ninth aspects, a tenth aspect of the present invention is characterized in that the mounting boss is formed on the cylinder block so that, as seen in the direction along the screw axis of the screw member, the screw axis is located ahead of a connecting surface which is formed in an upstream end portion of the intake pipe to connect a throttle body or a carburetor thereto.

**[0016]** In addition to the configuration according to any one of the first to tenth aspects, an eleventh aspect of the present invention is characterized in that a threaded hole provided in the mounting boss to screw the screw member therein is disposed at such a position as to avoid overlapping with a water jacket formed in the cylinder block as seen in the direction along the screw axis of the screw member.

**[0017]** In addition to the configuration according to any one of the first to tenth aspects, a twelfth aspect of the present invention is characterized in that a threaded hole

provided in the mounting boss to screw the screw member therein is disposed at such a position as to avoid overlapping with a water jacket formed in the cylinder block as seen in the direction along the cylinder axis.

**[0018]** Further, in addition to the configuration according to any one of the first to twelfth aspects, a thirteenth aspect of the present invention is characterized in that coolant pipes are disposed on one side of the cylinder block in the vehicle widthwise direction, and the mounting boss is formed on the upper wall of the cylinder block on the other side thereof in the vehicle widthwise direction.

#### [Effect of the Invention]

**[0019]** According to the first aspect of the present invention, the mounting boss is disposed on the upper wall of the cylinder block at a position not overlapping with the intake pipe as seen in the direction along the screw axis of the screw member for fastening the knock sensor to the mounting boss. Accordingly, the intake pipe is less likely to get in the way at the time of attachment/detachment work of the knock sensor to/from the mounting boss, whereby attachment/detachment work of the knock sensor can be facilitated and workability can be improved. Moreover, since it is no longer necessary to place the intake pipe up high to avoid interference with the knock sensor, there is no more influence on the seat height and the like due to the intake pipe, thus making it possible to achieve an advantageous configuration for the unit swing engine.

**[0020]** In addition, according to the second aspect of the present invention, as seen in the direction along the screw axis of the screw member, at least a part of the intake pipe is disposed at a position overlapping with the cylinder axis, whereas at least a part of the mounting boss overlaps with the specific stud bolt, out of the multiple stud bolts coupling the cylinder block and the cylinder head to the front portion of the crankcase, which is located at a position offset either to the left or right with respect to the cylinder axis. Hence, even in the configuration where the knock sensor is mounted to the cylinder block at a position slightly away from the combustion chamber, vibrations transmitted from the combustion chamber via the cylinder head and the specific stud bolt can be detected effectively, whereby knocking can be detected accurately.

**[0021]** According to the third aspect of the present invention, the cam chain passage is disposed at one side in the vehicle widthwise direction of the vertical plane including the cylinder axis as viewed in a plan view, whereas the mounting boss is disposed at the other side in the vehicle widthwise direction of the vertical plane. This makes it possible to prevent as much as possible cam chain noise, caused by the vibrations of the cam chain passing through in the cam chain passage, from affecting the knock sensor and thereby further improve knocking detection accuracy.

**[0022]** According to the fourth aspect of the present

invention, since the screw axis of the screw member is disposed offset in the vehicle widthwise direction with respect to the axis of the specific stud bolt, the protruding amount of the mounting boss from the upper wall of the cylinder block can be reduced.

**[0023]** According to the fifth aspect of the present invention, as viewed in a side view, a part of the screw member overlaps with the specific stud bolt when the screw axis of the screw member is made offset in the vehicle widthwise direction with respect to the axis of the specific stud bolt. Thus, the screw member and the specific stud bolt are disposed close to each other, whereby vibrations due to knocking can be detected easily and the protruding amount of the mounting boss from the upper wall of the cylinder block can be further reduced.

**[0024]** According to the sixth aspect of the present invention, the screw axis of the screw member is made offset outward in the vehicle widthwise direction with respect to the axis of the specific stud bolt. Thereby, the interference of the knock sensor and the intake pipe with each other can be prevented further effectively and the knock sensor becomes more accessible from the outer side in the vehicle widthwise direction, whereby attachment/detachment workability of the knock sensor can be further improved.

**[0025]** According to the seventh aspect of the present invention, as seen in the direction along the screw axis of the screw member, the part of the knock sensor projects further outward in the vehicle widthwise direction than the side wall of the cylinder block on one side thereof where the knock sensor is arranged, with respect to the vertical plane including the cylinder axis. Accordingly, the interference of the knock sensor and the intake pipe with each other can be suppressed further effectively, and the upward protruding amount of the mounting boss and the knock sensor from the upper wall of the cylinder block can be easily reduced. Besides, since the electrical unit disposed below the knock sensor is supported on the side wall of the cylinder block, the knock sensor can be protected from bottom even in the structure where the part of the knock sensor projects outward from the cylinder block in the vehicle widthwise direction.

**[0026]** According to the eighth aspect of the present invention, the screw axis of the screw member is disposed outward in the vehicle widthwise direction with respect to the cylinder bore of the cylinder block as seen in the direction along the screw axis of the screw member. Hence, it is possible to suppress the influence of vibration noise, associated with the sliding movement of the piston in the cylinder bore, on the knock sensor and thereby further improve knocking detection accuracy.

**[0027]** According to the ninth aspect of the present invention, the screw axis of the screw member is disposed closer to the cylinder head side than is the central portion, in the direction along the cylinder axis, of the mating surfaces respectively between the cylinder block and the crankcase and between the cylinder block and the cylinder head. Thus, the knock sensor is arranged near the

combustion chamber, whereby knocking detection accuracy can be further improved.

**[0028]** According to the tenth aspect of the present invention, as seen in the direction along the screw axis of the screw member, the screw axis exists ahead of the connecting surface which is located in the upstream end portion of the intake pipe for connecting the throttle body or the carbureter thereto. Thereby, the knock sensor is arranged at a position away from the throttle body or the carbureter, whereby attachment/detachment workability of the knock sensor can be further improved.

**[0029]** According to the eleventh aspect of the present invention, the threaded hole provided in the mounting boss to screw the screw member therein does not overlap with the water jacket of the cylinder block as seen in the direction along the screw axis of the screw member. Hence, the interference of the knock sensor and the water jacket with each other is avoided when the knock sensor is mounted to the cylinder block, whereby sufficient cooling performance of the water jacket can be secured. Besides, a relief structure for the threaded hole does not need to be formed on the water jacket side, which can simplify the structure of the water jacket.

**[0030]** According to the twelfth aspect of the present invention, the threaded hole provided in the mounting boss to screw the screw member therein does not overlap with the water jacket of the cylinder block as seen in the direction along the cylinder axis. Thus, the interference of the knock sensor and the water jacket with each other is avoided when the knock sensor is mounted to the cylinder block, whereby sufficient cooling performance of the water jacket can be secured. Besides, a relief structure for the threaded hole does not need to be formed on the water jacket side, which can simplify the structure of the water jacket.

**[0031]** Further, according to the thirteenth aspect of the present invention, the coolant pipes are disposed on one side of the cylinder block in the vehicle widthwise direction, whereas the mounting boss is formed on the cylinder block on the other side thereof in the vehicle widthwise direction. Thus, the knock sensor is disposed without interfering with the coolant pipes, whereby attachment/detachment workability of the knock sensor can be improved.

[Brief Description of the Drawings]

**[0032]**

Fig. 1 is a left-side view of a motorcycle of a first embodiment.

Fig. 2 is an essential side view of an engine main unit.

Fig. 3 is a view in the direction of arrow 3 of Fig. 2 (a view seen in a direction along the screw axis of a sensor mounting bolt).

Fig. 4 is a sectional view taken along the line 4-4 of Fig. 3.

Fig. 5 is a sectional view taken along the line 5-5 of

Fig. 4 (a view seen in a direction along a cylinder axis).

Fig. 6 is a view in the direction of arrow 6 of Fig. 5 (a view seen in the direction along the screw axis of the sensor mounting bolt).

Fig. 7 is a sectional view corresponding to Fig. 5 and showing a cylinder block of a second embodiment.

Fig. 8 is a view in the direction of arrow 8 of Fig. 7 (a view seen in the direction along the screw axis of the sensor mounting bolt).

Fig. 9 is a sectional view corresponding to Fig. 5 and showing a cylinder block of a third embodiment, and is a sectional view taken along the line 9-9 of Fig. 10.

Fig. 10 is a view in the direction of arrow 10 of Fig. 9 (a view seen in the direction along the screw axis of the sensor mounting bolt).

#### [Best Mode for Carrying Out the Invention]

**[0033]** Hereinbelow, embodiments of the present invention will be described with reference to the accompanying drawings. Note that, in the following description, the terms "front-rear," "left-right," and "top-bottom" respectively refer to directions seen by a rider riding a motorcycle.

**[0034]** A first embodiment of the present invention will be described with reference to Figs. 1 to 6. Firstly, in Fig. 1, a frame body F of a scooter-type motorcycle includes, at its front end, a head pipe 13 steerably supporting a pair of front forks 11 axially supporting a front wheel WF and steering handlebar 12 connected to the front forks 11, and a unit swing engine UE to exert power to drive a rear wheel WR is vertically swingably supported at an intermediate portion of the frame body F in the front-rear direction.

**[0035]** The unit swing engine UE is constructed of an engine E disposed ahead of the rear wheel WR and a transmission M to transmit power from the engine E to the rear wheel WR. The transmission M is housed in a transmission case 15 which is arranged continuously with an engine main unit 14 of the engine E and extends to the left side of the rear wheel WR, and a rear cushion unit 16 is provided between a rear portion of the transmission case 15 and a rear portion of the frame body F.

**[0036]** The frame body F and a part of the unit swing engine UE are covered with a body cover 17 which has a pair of left and right footrest parts 18 for a rider to put his/her feet on and a floor tunnel part 19 raised upward between both footrest parts 18, and the body cover 17 is attached to the frame body F. In addition, a storage box 20 disposed behind the floor tunnel part 19 and above the unit swing engine UE is housed inside a rear portion of the body cover 17, and a rider's seat 21 and a passenger seat 22 disposed behind the rider's seat 21 are arranged on the body cover 17 so as to be disposed above the storage box 20.

**[0037]** Referring to Figs. 2 to 4, the engine main unit 14 of the engine E includes: a crankcase 25 rotatably

supporting a crankshaft 24 (see Fig. 1) which has an axis extending in a vehicle widthwise direction; a cylinder block 26 having a cylinder bore 30, into which a piston 29 is slidably fitted, and coupled to a front portion of the crankcase 25; a cylinder head 27 coupled to a front portion of the cylinder block 26; and a head cover 28 coupled to the cylinder head 27. A cylinder axis C of the engine main unit 14, i.e., the axis of the cylinder bore 30 tilts forward to become substantially horizontal, and the piston 29 is connected to the crankshaft 24.

**[0038]** A combustion chamber 31 which the top of the piston 29 faces is formed between the cylinder block 26 and the cylinder head 27, a water jacket 32 surrounding the cylinder bore 30 is formed in a part of the cylinder block 26 on the cylinder head 27 side, and a water jacket 33 communicating with the water jacket 32 is formed in the cylinder head 27 so as to surround the combustion chamber 31.

**[0039]** An intake system 34 for feeding the air into the combustion chamber 31 is disposed so as to extend longitudinally below the storage box 20. It includes: an intake pipe 35 connected to an upper wall 27a of the cylinder head 27, and rising upward from the cylinder head 27 and bending rearward to extend rearward above the cylinder head 27 and the cylinder block 26; a throttle body 36 coupled to an upstream end portion of the intake pipe 35; an air cleaner 37 disposed at the left side of the rear wheel WR and above the transmission case 15, and supported by the transmission case 15; and a connecting tube 38 (see Fig. 1) connecting the throttle body 36 and the air cleaner 37, and a fuel injection valve 39 to inject fuel toward the inside of the cylinder head 27 is mounted on the intake pipe 35.

**[0040]** As shown in Fig. 1, an exhaust system 40 for discharging exhaust gas out of the combustion chamber 31 is connected to a lower side wall of the cylinder head 27, and the exhaust system 40 includes an exhaust pipe 41 extending rearward below the engine main unit 14 from the lower side wall of the cylinder head 27 and an exhaust muffler (not shown in the drawings) disposed at the right side of the rear wheel WR so as to be connected to a downstream end of the exhaust pipe 41.

**[0041]** Focusing on Fig. 4, an intake valve 43 to control intake gas from the intake system 34 to the combustion chamber 31 and an exhaust valve 44 to control exhaust gas from the combustion chamber 31 to the exhaust system 40 are openably/closably arranged in the cylinder head 27, and a valve train 46 to drive the intake valve 43 and the exhaust valve 44 to open or close is housed in a valve chamber 45 formed between the cylinder head 27 and the head cover 28.

**[0042]** The valve train 46 includes: a camshaft 47 having an axis parallel with that of the crankshaft 24, disposed between the intake valve 43 and the exhaust valve 44, and rotatably supported by the cylinder head 27; an intake-side rocker arm 48 capable of pivoting around an axis thereof parallel with that of the camshaft 47 and provided between the camshaft 47 and the intake valve 43;

and an exhaust-side rocker arm 49 capable of pivoting around an axis thereof parallel with that of the camshaft 47 and provided between the camshaft 47 and the exhaust valve 44, and rotational power from the crankshaft 24 is transmitted to the camshaft 47 while being reduced at a reduction ratio of 1/2.

**[0043]** Referring to Figs. 5 and 6, a mounting boss 51 is formed on an upper wall 26a of the cylinder block 26 of the engine main unit 14, and a knock sensor 52 to detect knocking is fastened to the mounting boss 51 with a sensor mounting bolt 53 as a screw member.

**[0044]** Incidentally, it is conceivable that the knock sensor 52 is mounted on a lower wall of the cylinder block 26; however, in this case, a problem arises in which external influence such as stones, dirt, and water flying from the ground tends to act on the knock sensor 52. Alternatively, it is also conceivable that the knock sensor 52 is mounted to the cylinder head 27 which is close to the combustion chamber 31 because knocking generally occurs in the combustion chamber 31; however, the flexibility in the layout of the knock sensor 52 is limited because the intake pipe 35 is connected to the cylinder head 27, and it is difficult to detect knocking accurately because the cylinder head 27 is susceptible to the vibrations of the valve train 46 inside it.

**[0045]** The mounting boss 51 is formed on the upper wall 26a of the cylinder block 26 while facing upward, and the sensor mounting bolt 53 having a screw axis SC extending in the vertical direction penetrates, from above, the knock sensor 52 placed on the mounting boss 51 and is screwed into the mounting boss 51.

**[0046]** Meanwhile, as shown in Fig. 3, at least a part of the intake pipe 35, in this embodiment a downstream part of the intake pipe 35 is disposed at a position overlapping with the cylinder axis C as seen in a direction along the screw axis SC of the sensor mounting bolt 53, i.e., as seen from above, and the mounting boss 51 is formed on the upper wall 26a of the cylinder block 26 at such a position as to avoid overlapping with the intake pipe 35 as seen in the direction along the screw axis SC of the sensor mounting bolt 53.

**[0047]** In addition, the cylinder block 26 and the cylinder head 27 are coupled to the front portion of the crankcase 25 with multiple (four in this embodiment) stud bolts 54, 55, 56, and 57, and the mounting boss 51 is formed on the cylinder block 26 so that, as seen in the direction along the screw axis SC of the sensor mounting bolt 53, at least a part of the mounting boss 51, in this embodiment a part thereof overlaps with the specific stud bolt 54 out of the stud bolts 54 to 57 which is disposed at a position offset either to the left or right with respect to the cylinder axis C.

**[0048]** Meanwhile, a cam chain passage 59 in which a cam chain 58 passes through to transmit rotational power from the crankshaft 24 to the camshaft 47 is formed in the cylinder block 26 so as to be disposed at one side in the vehicle widthwise direction (right side in this embodiment) of a vertical plane PV including the cylinder

axis C, and the mounting boss 51 is formed on the cylinder block 26 so as to be disposed at the other side in the vehicle widthwise direction (left side in this embodiment) of the vertical plane PV. In addition, a tensioner mounting boss 60 for mounting a cam chain tensioner 50 thereon is integrally provided in an upward protruding manner on the upper wall 26a of the cylinder block 26 on one side thereof where the cam chain passage 59 exists, with respect to the vertical plane PV,.

**[0049]** Moreover, the mounting boss 51 is formed on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is disposed at a position offset in the vehicle widthwise direction with respect to an axis BC of the specific stud bolt 54, and in this embodiment, it is formed on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is disposed at a position offset outward in the vehicle widthwise direction with respect to the axis BC of the specific stud bolt 54.

**[0050]** Further, the mounting boss 51 is formed on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is located outward in the vehicle widthwise direction with respect to the cylinder bore 30 of the cylinder block 26 as seen in the direction along the screw axis SC of the sensor mounting bolt 53.

**[0051]** Furthermore, the mounting boss 51 is formed on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is located closer to the cylinder head 27 side than is a central portion, in a direction along the cylinder axis C, of mating surfaces 61 and 62 configured respectively between the cylinder block 26 and the crankcase 25 and between the cylinder block and the cylinder head 27. In other words, the mounting boss 51 is formed on the cylinder block 26 so as to be located closer to the cylinder head 27 side than is a plane PC which is orthogonal to the cylinder axis C at a position spaced apart from each of the mating surfaces 61 and 62 by the same distance L1 in the direction along the cylinder axis C.

**[0052]** A connecting surface 63 for connecting the throttle body 36 thereto is formed in an upstream end portion of the intake pipe 35 and, as seen in the direction along the screw axis SC of the sensor mounting bolt 53, the mounting boss 51 is formed on the cylinder block 26 so that the screw axis SC is located ahead of the connecting surface 63. In other words, as shown in Fig. 3, the screw axis SC of the sensor mounting bolt 53 is disposed ahead of an imaginary straight line VL which is orthogonal to the cylinder axis C and passes through the front end of the connecting surface 63 as viewed in a plan view.

**[0053]** Here, in this embodiment, a part of a coupler part 36a of the throttle body 36 exists above the sensor mounting bolt 53 of the knock sensor 52 in the state where the throttle body 36 is coupled to the intake pipe 35; thus, the sensor mounting bolt 53 may be accessed from obliquely above or sideways at the time of accessing it for attachment/detachment of the knock sensor 52, or furthermore, it is possible to further improve attachment/de-

tachment workability by turning the coupler part 36a so that the coupler part 36a will not exist above the sensor mounting bolt 53 of the knock sensor 52.

**[0054]** In addition, the sensor mounting bolt 53 is screwed into the mounting boss 51 so that a part thereof overlaps with the specific stud bolt 54 as viewed in a side view. Specifically, as shown in Fig. 5, an inner end portion 53a of the sensor mounting bolt 53 in the state of being screwed to the mounting boss 51 is located downward of the upper end of the specific stud bolt 54 by a distance L2.

**[0055]** Further, the knock sensor 52 is mounted on the mounting boss 51 so that, as seen in the direction along the screw axis SC of the sensor mounting bolt 53, a part 52a of the knock sensor 52 projects further outward in the vehicle widthwise direction than a side wall 26b of the cylinder block 26 on one side thereof where the knock sensor 52 is arranged, with respect to the vertical plane PV including the cylinder axis C. In other words, the mounting boss 51 is formed in a bulging manner so as to project outward in the vehicle widthwise direction from the side wall 26b of the cylinder block 26. In the meantime, an ignition coil 64 as an electrical unit disposed below the knock sensor 52 is supported on the side wall 26b of the cylinder block 26. The ignition coil 64 is mounted on a stay 66 which is fastened, with stay mounting bolts 67, to multiple stay mounting bosses 65 provided on the side wall 26b of the cylinder block 26, and that means not only the ignition coil 64 but also the stay 66 and the multiple stay mounting bosses 65 are disposed below the knock sensor 52.

**[0056]** Furthermore, a spark plug 68 and an oxygen sensor 69 are mounted on a side wall 27a of the cylinder head 27 on the same side as the side wall 26b of the cylinder block 26, a holder 71 which holds an intermediate portion of a plug cord 70 connecting the spark plug 68 and the ignition coil 64 is supported by a support arm 72 fixedly secured to the stay 66, and two holders 74 and 75 which hold an intermediate portion of a conductor 73 extending to the oxygen sensor 69 are supported by the stay 66.

**[0057]** Meanwhile, the water jacket 32 is formed in the cylinder block 26, and a threaded hole 76 provided in the mounting boss 51 to screw the sensor mounting bolt 53 therein is disposed at such a position as to avoid overlapping with the water jacket 32 as seen in the direction along the screw axis SC of the sensor mounting bolt 53, as shown in Fig. 6.

**[0058]** Further, a radiator 77, a water pump 78, and a thermostat 79 for circulating and cooling coolant inside the water jacket 32 are disposed on one side of the engine main unit 14 in the vehicle widthwise direction (on the right side in the vehicle widthwise direction in this embodiment), coolant pipes 81, 82, 83, and 84 for distributing coolant throughout the water jacket 32, the radiator 77, the water pump 78, and the thermostat 79 are disposed on one side of the cylinder block 26 in the engine main unit 14 in the vehicle widthwise direction, and the

mounting boss 51 is formed on the upper wall 26a of the cylinder block 26 on the other side thereof in the vehicle widthwise direction (on the left side in the vehicle widthwise direction in this embodiment).

**[0059]** Next, the operation of the first embodiment will be described. The knock sensor 52 to detect knocking is fastened, with the sensor mounting bolt 53, to the mounting boss 51 formed on the upper wall 26a of the cylinder block 26 and, as seen in the direction along the screw axis SC of the sensor mounting bolt 53, the mounting boss 51 is formed on the upper wall 26a of the cylinder block 26 at such a position as to avoid overlapping with the intake pipe 35 extending rearward from the cylinder head 27 above the cylinder head 27 and the cylinder block 26. Accordingly, the intake pipe 35 is less likely to get in the way at the time of attachment/detachment work of the knock sensor 52 to/from the mounting boss 51, whereby attachment/detachment work of the knock sensor 52 can be facilitated and workability can be improved. Moreover, since it is no longer necessary to place the intake pipe 35 up high to avoid interference with the knock sensor 52, there is no more influence on the seat height and the like due to the intake pipe 35, thus making it possible to achieve an advantageous configuration for the unit swing engine UE.

**[0060]** In addition, at least a part of the intake pipe 35 is disposed at a position overlapping with the cylinder axis C as seen in the direction along the screw axis SC of the sensor mounting bolt 53, and the mounting boss 51 is formed on the cylinder block 26 so that, as seen in the direction along the screw axis SC of the sensor mounting bolt 53, at least a part of the mounting boss 51 overlaps with the specific stud bolt 54, out of the four stud bolts 54 to 57 coupling the cylinder block 26 and the cylinder head 27 to the front portion of the crankcase 25, which is disposed at a position offset either to the left or right with respect to the cylinder axis C as seen in the direction along the screw axis SC of the sensor mounting bolt 53. Hence, even in the configuration where the knock sensor 52 is mounted to the cylinder block 26 at a position slightly away from the combustion chamber 31, vibrations transmitted from the combustion chamber 31 via the cylinder head 27 and the specific stud bolt 54 can be detected effectively, whereby knocking can be detected accurately.

**[0061]** Moreover, the cam chain passage 59 in which the cam chain 58 passes through is formed in the cylinder block 26 so as to be disposed at one side in the vehicle widthwise direction of the vertical plane PV including the cylinder axis C, and the mounting boss 51 is formed on the cylinder block 26 so as to be disposed at the other side in the vehicle widthwise direction of the vertical plane PV. This makes it possible to prevent as much as possible cam chain noise, caused by the vibrations of the cam chain 58 passing through in the cam chain passage 59, from affecting the knock sensor 52 and thereby further improve knocking detection accuracy.

**[0062]** Further, since the mounting boss 51 is formed

on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is disposed at a position offset in the vehicle widthwise direction with respect to the axis BC of the specific stud bolt 54, the protruding amount of the mounting boss 51 from the upper wall 26a of the cylinder block 26 can be reduced.

**[0063]** Furthermore, the sensor mounting bolt 53 is screwed into the mounting boss 51 so that a part thereof overlaps with the specific stud bolt 54 as viewed in a side view. Thus, the sensor mounting bolt 53 and the specific stud bolt 54 are disposed close to each other, whereby vibrations due to knocking can be detected easily and the protruding amount of the mounting boss 51 from the upper wall 26a of the cylinder block 26 can be further reduced.

**[0064]** In addition, the mounting boss 51 is formed on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is disposed at a position offset outward in the vehicle widthwise direction with respect to the axis BC of the specific stud bolt 54. Thereby, the interference of the knock sensor 52 and the intake pipe 35 with each other can be prevented further effectively and the knock sensor 52 becomes more accessible from the outer side in the vehicle widthwise direction, whereby attachment/detachment workability of the knock sensor 52 can be further improved.

**[0065]** Moreover, as seen in the direction along the screw axis SC of the sensor mounting bolt 53, the knock sensor 52 is mounted on the mounting boss 51 so that, as seen in the direction along the screw axis SC of the sensor mounting bolt 53, the part 52a of the knock sensor 52 projects further outward in the vehicle widthwise direction than the side wall 26b of the cylinder block 26 on one side thereof where the knock sensor 52 is arranged, with respect to the vertical plane PV including the cylinder axis C. Accordingly, the interference of the knock sensor 52 and the intake pipe 35 with each other can be suppressed further effectively, and the upward protruding amount of the mounting boss 51 and the knock sensor 52 from the upper wall 26a of the cylinder block 26 can be easily reduced. Besides, the ignition coil 64 disposed below the knock sensor 52 is supported on the side wall 26b of the cylinder block 26, and in this embodiment, in addition to the ignition coil 64, the stay 66 supporting the ignition coil 64 and the stay mounting bosses 65 provided on the side wall 26b of the cylinder block 26 for fastening the stay 66 thereto are disposed below the knock sensor 52. Thereby, the knock sensor 52 can be protected from bottom even in the structure where the part 52a of the knock sensor 52 projects outward from the cylinder block 26 in the vehicle widthwise direction.

**[0066]** Further, the mounting boss 51 is formed on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is located outward in the vehicle widthwise direction with respect to the cylinder bore 30 of the cylinder block 26 as seen in the direction along the screw axis SC of the sensor mounting bolt 53. Hence, it is possible to suppress the influence of vibration noise, asso-

ciated with the sliding movement of the piston 29 in the cylinder bore 30, on the knock sensor 52 and thereby further improve knocking detection accuracy.

**[0067]** Furthermore, the mounting boss 51 is formed on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is located closer to the cylinder head 27 side than is the central portion in the front-rear direction of the mating surfaces 61 and 62 configured respectively between the cylinder block 26 and the crankcase 25 and between the cylinder block and the cylinder head 27. Thus, the knock sensor 52 is arranged near the combustion chamber 31, whereby knocking detection accuracy can be further improved.

**[0068]** In addition, the mounting boss 51 is formed on the cylinder block 26 so that, as seen in the direction along the screw axis SC of the sensor mounting bolt 53, the screw axis SC is located ahead of the connecting surface 63 which is formed in the upstream end portion of the intake pipe 35 to connect the throttle body 36 thereto. Thereby, the knock sensor 52 is arranged at a position away from the throttle body 36, whereby attachment/detachment workability of the knock sensor 52 can be further improved.

**[0069]** Moreover, the threaded hole 76 provided in the mounting boss 51 to screw the sensor mounting bolt 53 therein is disposed at such a position as to avoid overlapping with the water jacket 32 formed in the cylinder block 26 as seen in the direction along the screw axis SC of the sensor mounting bolt 53. Hence, the interference of the knock sensor 52 and the water jacket 32 with each other is avoided when the knock sensor 52 is mounted to the cylinder block 26, whereby sufficient cooling performance of the water jacket 32 can be secured. Besides, a relief structure for the threaded hole 76 does not need to be formed on the water jacket 32 side, which can simplify the structure of the water jacket 32.

**[0070]** Further, the threaded hole 76 provided in the mounting boss 51 to screw the sensor mounting bolt 53 therein is disposed at such a position as to avoid overlapping with the water jacket 32 formed in the cylinder block 26 as seen in the direction along the cylinder axis C. Thus, the interference of the knock sensor 52 and the water jacket 32 with each other is avoided when the knock sensor 52 is mounted to the cylinder block 26, whereby sufficient cooling performance of the water jacket 32 can be secured. Besides, a relief structure for the threaded hole 76 does not need to be formed on the water jacket 32 side, which can simplify the structure of the water jacket 32.

**[0071]** Furthermore, the coolant pipes 81 to 84 are disposed on one side of the cylinder block 26 in the vehicle widthwise direction, and the mounting boss 51 is formed on the upper wall 26a of the cylinder block 26 on the other side thereof in the vehicle widthwise direction. Thus, the knock sensor 52 is disposed without interfering with the coolant pipes 81 to 84, whereby attachment/detachment workability of the knock sensor 52 can be improved.

**[0072]** A second embodiment of the present invention

will be described with reference to Figs. 7 and 8. Parts thereof corresponding to those of the first embodiment described with reference to Figs. 1 to 6 will be shown with the same reference characters and detailed descriptions for such parts will be omitted.

**[0073]** A mounting boss 88 is formed on the upper wall 26a of the cylinder block 26, and the knock sensor 52 is fastened to the mounting boss 88 with the sensor mounting bolt 53 having the screw axis SC extending in the vertical direction.

**[0074]** The mounting boss 88 is formed on the cylinder block 26 so that, as seen in the direction along the screw axis SC of the sensor mounting bolt 53, at least a part of the mounting boss 88 overlaps with the specific stud bolt 54, out of the stud bolts 54 to 57 for coupling the cylinder block 26 and the cylinder head 27 to the crankcase 25, which is disposed at a position offset either to the left or right with respect to the cylinder axis C, and in this embodiment, the mounting boss 88 is formed on the cylinder block 26 so that the screw axis SC of the bolt 53 is orthogonal to the axis BC of the specific stud bolt 54.

**[0075]** In addition, the cam chain passage 59 formed in the cylinder block 26 is disposed at one side in the vehicle widthwise direction (right side in this embodiment) of the vertical plane PV including the cylinder axis C, whereas the mounting boss 88 is formed on the cylinder block 26 at the other side in the vehicle widthwise direction (left side in this embodiment) of the vertical plane PV so that the screw axis SC of the sensor mounting bolt 53 is located closer to the cylinder head 27 side than is the central portion, in the direction along the cylinder axis C, of the mating surfaces 61 and 62 configured respectively between the cylinder block 26 and the crankcase 25 and between the cylinder block and the cylinder head 27.

**[0076]** Moreover, as shown in Fig. 8, the mounting boss 88 is formed on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is located outward in the vehicle widthwise direction with respect to the cylinder bore 30 of the cylinder block 26 as seen in the direction along the screw axis SC of the sensor mounting bolt 53.

**[0077]** Further, as seen in the direction along the cylinder axis C, the threaded hole 76 provided in the mounting boss 88 to screw the sensor mounting bolt 53 therein is disposed at such a position as to avoid overlapping with the water jacket 32 provided in the cylinder block 26, as shown in Fig. 7.

**[0078]** According to the second embodiment, the mounting boss 88 is formed on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is not offset in the vehicle widthwise direction with respect to the axis BC of the specific stud bolt 54. Thus, this embodiment can achieve substantially the same effect as the first embodiment while, as compared to the first embodiment, it cannot achieve the effect of reducing the protruding amount of the mounting boss 88 from the upper wall 26a of the cylinder block 26 that would be ob-

tained by making the screw axis SC of the sensor mounting bolt 53 offset in the vehicle widthwise direction with respect to the axis BC of the specific stud bolt 54.

**[0079]** A third embodiment of the present invention will be described with reference to Figs. 9 and 10. Parts thereof corresponding to those of the first embodiment described with reference to Figs. 1 to 6 will be shown with the same reference characters and detailed descriptions for such parts will be omitted.

**[0080]** A mounting boss 89 is formed on the upper wall 26a of the cylinder block 26, and the knock sensor 52 is fastened to the mounting boss 89 with the sensor mounting bolt 53 having the screw axis SC extending in the vertical direction.

**[0081]** In addition, the mounting boss 89 is formed on the cylinder block 26 so that, as seen in the direction along the screw axis SC of the sensor mounting bolt 53, at least a part of the mounting boss 89 overlaps with the specific stud bolt 54, out of the stud bolts 54 to 57 for coupling the cylinder block 26 and the cylinder head 27 (refer to the first embodiment) to the crankcase 25 (refer to the first embodiment), which is disposed at a position offset either to the left or right with respect to the cylinder axis C. Besides, the mounting boss 89 is formed on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is disposed at a position offset in the vehicle widthwise direction with respect to the axis BC of the specific stud bolt 54, and in this embodiment, it is formed on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is disposed at a position offset inward in the vehicle widthwise direction with respect to the axis BC of the specific stud bolt 54.

**[0082]** Moreover, the cam chain passage 59 formed in the cylinder block 26 is disposed at one side in the vehicle widthwise direction (right side in this embodiment) of the vertical plane PV including the cylinder axis C, whereas the mounting boss 89 is formed on the cylinder block 26 at the other side in the vehicle widthwise direction (left side in this embodiment) of the vertical plane PV.

**[0083]** Further, the sensor mounting bolt 53 is screwed into the mounting boss 89 so that a part thereof overlaps with the specific stud bolt 54 as viewed in a side view. In other words, as shown in Fig. 9, the inner end portion 53a of the sensor mounting bolt 53 in the state of being screwed to the mounting boss 89 is located downward of the upper end of the specific stud bolt 54 by a distance L3.

**[0084]** Furthermore, as shown in Fig. 10, the threaded hole 76 provided in the mounting boss 89 to screw the sensor mounting bolt 53 therein is disposed at such a position as to avoid overlapping with the water jacket 32 as seen in the direction along the screw axis SC of the sensor mounting bolt 53. Thus, the mounting boss 89 is formed on the cylinder block 26 so that the screw axis SC of the sensor mounting bolt 53 is located closer to the crankcase 25 side than is the central portion, in the direction along the cylinder axis C, of the mating surfaces 61 and 62 configured respectively between the cylinder

block 26 and the crankcase 25 and between the cylinder block and the cylinder head 27.

**[0085]** According to the third embodiment, substantially the same effect as the first embodiment can be achieved while, as compared to the first embodiment, it cannot achieve the effect that would be obtained by disposing the screw axis SC of the sensor mounting bolt 53 at a position offset outward in the vehicle widthwise direction with respect to the axis BC of the specific stud bolt 54 and disposing the screw axis SC of the sensor mounting bolt 53 closer to the cylinder head 27 side than is the central portion, in the direction along the cylinder axis C, of the mating surfaces 61 and 62 of the cylinder block 26.

**[0086]** While the embodiments of the present invention have been described above, the present invention is not limited to the above embodiments, but various design changes can be made without departing from the present invention described in the scope of claims.

**[0087]** For example, while the unit swing engine UE in the above embodiments has the configuration where the throttle body 36 is connected to the intake pipe 35, the present invention is also applicable to a unit swing engine where a carbureter is connected to the intake pipe 35.

[Description of Reference Numerals]

**[0088]**

|             |                                      |
|-------------|--------------------------------------|
| 14          | ENGINE MAIN UNIT                     |
| 25          | CRANKCASE                            |
| 26          | CYLINDER BLOCK                       |
| 26a         | UPPER WALL OF CYLINDER BLOCK         |
| 26b         | SIDE WALL OF CYLINDER BLOCK          |
| 27          | CYLINDER HEAD                        |
| 27a         | UPPER WALL OF CYLINDER HEAD          |
| 30          | CYLINDER BORE                        |
| 32          | WATER JACKET                         |
| 35          | INTAKE PIPE                          |
| 36          | THROTTLE BODY                        |
| 51,88,89    | MOUNTING BOSS                        |
| 52          | KNOCK SENSOR                         |
| 52a         | PART OF KNOCK SENSOR                 |
| 53          | SENSOR MOUNTING BOLT AS SCREW MEMBER |
| 54          | SPECIFIC STUD BOLT                   |
| 55, 56, 57  | STUD BOLT                            |
| 58          | CAM CHAIN                            |
| 59          | CAM CHAIN PASSAGE                    |
| 61, 62      | MATING SURFACE                       |
| 63          | CONNECTING SURFACE                   |
| 64          | IGNITION COIL AS ELECTRICAL UNIT     |
| 76          | THREADED HOLE                        |
| 81,82,83,84 | COOLANT PIPE                         |
| BC          | AXIS OF SPECIFIC STUD BOLT           |
| C           | CYLINDER AXIS                        |
| F           | FRAME BODY                           |
| SC          | SCREW AXIS                           |

PV

VERTICAL PLANE INCLUDING CYLINDER AXIS

**5 Claims**

1. A knock sensor mounting structure in a unit swing engine in which: an engine main unit (14) including a crankcase (25), a cylinder block (26) coupled to a front portion of said crankcase (25) with a cylinder axis (C) tilting forward, and a cylinder head (27) coupled to a front portion of the cylinder block (26) is swingably supported by a frame body (F); an intake pipe (35) connected to an upper wall (27a) of said cylinder head (27) stands upward from said cylinder head (27) and bends rearward to extend rearward above said cylinder head (27) and said cylinder block (26); and a knock sensor (52) to detect knocking is fastened, with a screw member (53), to a mounting boss (51, 88, 89) formed on an upper wall (26a) of said cylinder block (26), wherein said mounting boss (51, 88, 89) is formed on said upper wall (26a) of said cylinder block (26) at such a position as to avoid overlapping with said intake pipe (35) as seen in a direction along a screw axis (SC) of said screw member (53).
2. The knock sensor mounting structure in a unit swing engine according to claim 1, wherein at least a part of said intake pipe (35) is disposed at a position overlapping with said cylinder axis (C) as seen in the direction along the screw axis (SC) of said screw member (53), said cylinder block (26) and said cylinder head (27) are coupled to the front portion of said crankcase (25) with a plurality of stud bolts (54, 55, 56, 57), and said mounting boss (51, 88, 89) is formed on said cylinder block (26) so that, as seen in the direction along the screw axis (SC) of said screw member (53), at least a part of said mounting boss (51, 88, 89) overlaps with a specific one of the stud bolts (54) which is disposed at a position offset either to the left or right with respect to said cylinder axis (C).
3. The knock sensor mounting structure in a unit swing engine according to claim 1 or 2, wherein a cam chain passage (59) in which a cam chain (58) passes through is formed in said cylinder block (26) so as to be disposed at one side in a vehicle widthwise direction of a vertical plane (PV) including said cylinder axis (C), and said mounting boss (51, 88, 89) is formed on said cylinder block (26) so as to be disposed at the other side in the vehicle widthwise direction of said vertical plane (PV).
4. The knock sensor mounting structure in a unit swing engine according to any one of claims 1 to 3, wherein said mounting boss (51, 89) is formed on said cylin-

der block (26) so that the screw axis (SC) of said screw member (53) is disposed at a position offset in the vehicle widthwise direction with respect to an axis (BC) of said specific stud bolt (54).

5. The knock sensor mounting structure in a unit swing engine according to claim 4, wherein said screw member (53) is screwed into said mounting boss (51, 89) so that a part thereof overlaps with said specific stud bolt (54) as viewed in a side view. 5
6. The knock sensor mounting structure in a unit swing engine according to claim 4 or 5, wherein said mounting boss (51) is formed on said cylinder block (26) so that the screw axis (SC) of said screw member (53) is disposed at a position offset outward in the vehicle widthwise direction with respect to the axis of said specific stud bolt (54). 10
7. The knock sensor mounting structure in a unit swing engine according to claim 6, wherein said knock sensor (52) is mounted on said mounting boss (51) so that, as seen in the direction along the screw axis (SC) of said screw member (53), a part (52a) of said knock sensor (52) projects further outward in the vehicle widthwise direction than a side wall (26b) of said cylinder block (26) on one side thereof where said knock sensor (52) is arranged, with respect to the vertical plane (PV) including said cylinder axis (C), and an electrical unit (64) disposed below said knock sensor (52) is supported on said side wall (26b) of said cylinder block (26). 15
8. The knock sensor mounting structure in a unit swing engine according to any one of claims 1 to 7, wherein said mounting boss (51, 88) is formed on said cylinder block (26) so that the screw axis (SC) of said screw member (53) is located outward in the vehicle widthwise direction with respect to a cylinder bore (30) of said cylinder block (26) as seen in the direction along the screw axis (SC) of said screw member (53). 20
9. The knock sensor mounting structure in a unit swing engine according to any one of claims 1 to 8, wherein said mounting boss (51, 88) is formed on said cylinder block (26) so that the screw axis (SC) of said screw member (53) is located closer to said cylinder head (27) side than is a central portion, in a direction along said cylinder axis (C), of mating surfaces (61, 62) configured respectively between said cylinder block (26) and said crankcase (25) and between said cylinder block and said cylinder head (27). 25
10. The knock sensor mounting structure in a unit swing engine according to any one of claims 1 to 9, wherein said mounting boss (51, 88) is formed on said cylinder block (26) so that, as seen in the direction along 30

the screw axis (SC) of said screw member (53), the screw axis (SC) is located ahead of a connecting surface (63) which is formed in an upstream end portion of said intake pipe (35) to connect any one of a throttle body (36) and a carbureter thereto. 5

11. The knock sensor mounting structure in a unit swing engine according to any one of claims 1 to 10, wherein a threaded hole (76) provided in said mounting boss (51, 89) to screw said screw member (53) therein is disposed at such a position as to avoid overlapping with a water jacket (32) formed in said cylinder block (26) as seen in the direction along the screw axis (SC) of said screw member (53). 10
12. The knock sensor mounting structure in a unit swing engine according to any one of claims 1 to 10, wherein a threaded hole (76) provided in said mounting boss (51, 89) to screw said screw member (53) therein is disposed at such a position as to avoid overlapping with a water jacket (32) formed in said cylinder block (26) as seen in the direction along said cylinder axis (C). 15
13. The knock sensor mounting structure in a unit swing engine according to any one of claims 1 to 12, wherein coolant pipes (81, 82, 83, 84) are disposed on one side of said cylinder block (26) in the vehicle widthwise direction, and said mounting boss (51, 88, 89) is formed on said upper wall (26a) of said cylinder block (26) on the other side thereof in said vehicle widthwise direction. 20

Fig.1

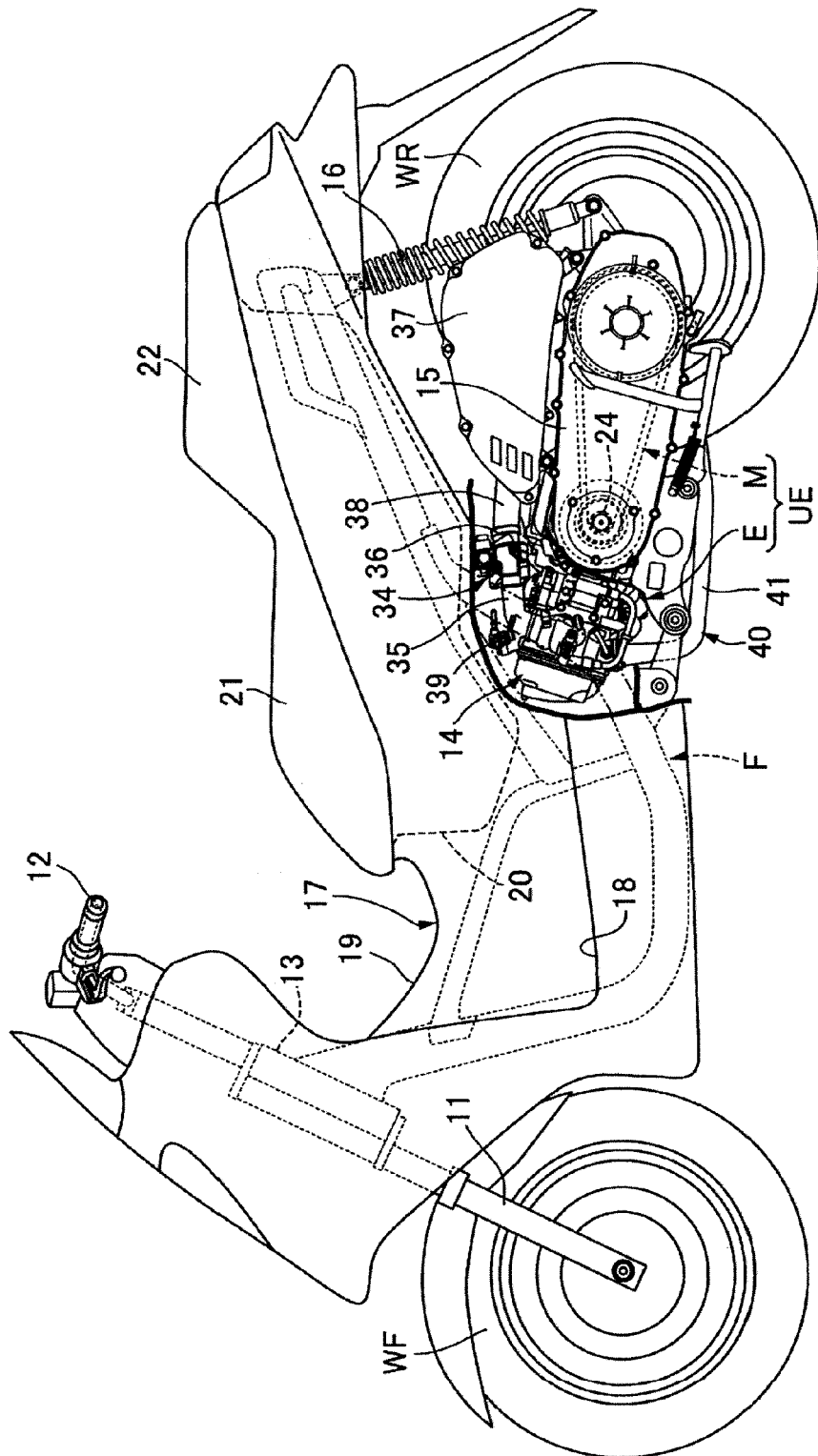


Fig.2

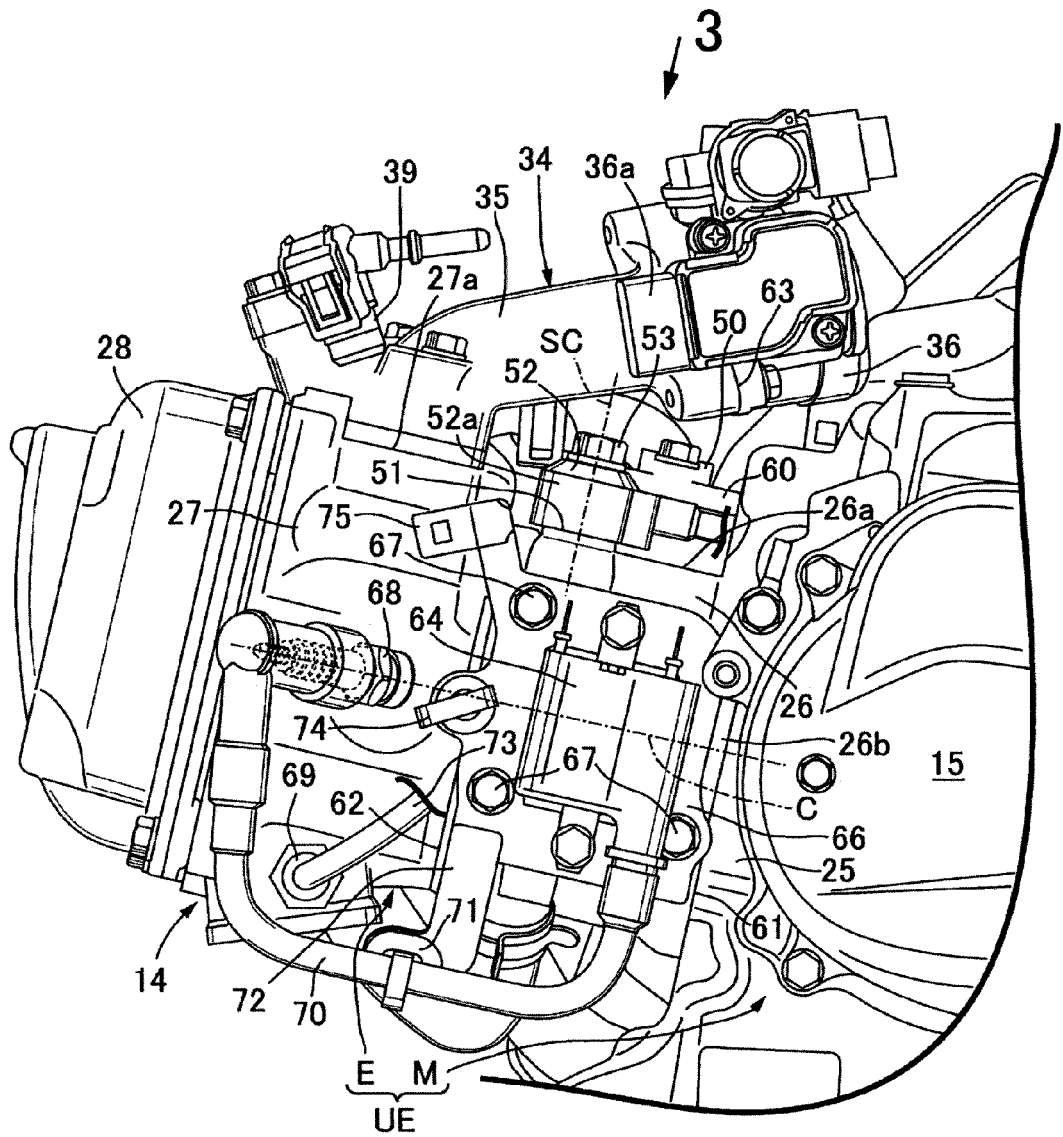


Fig.3

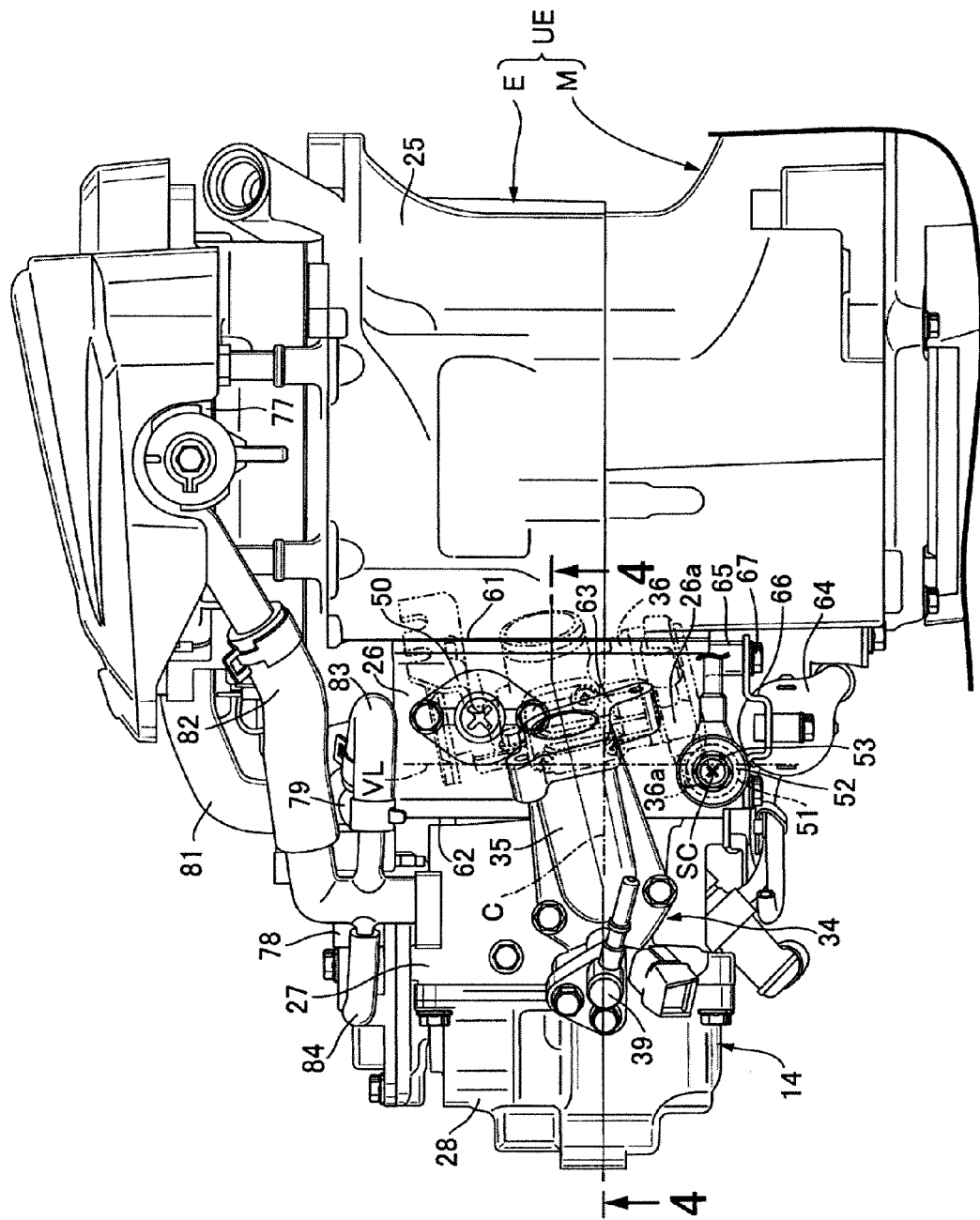


Fig.4

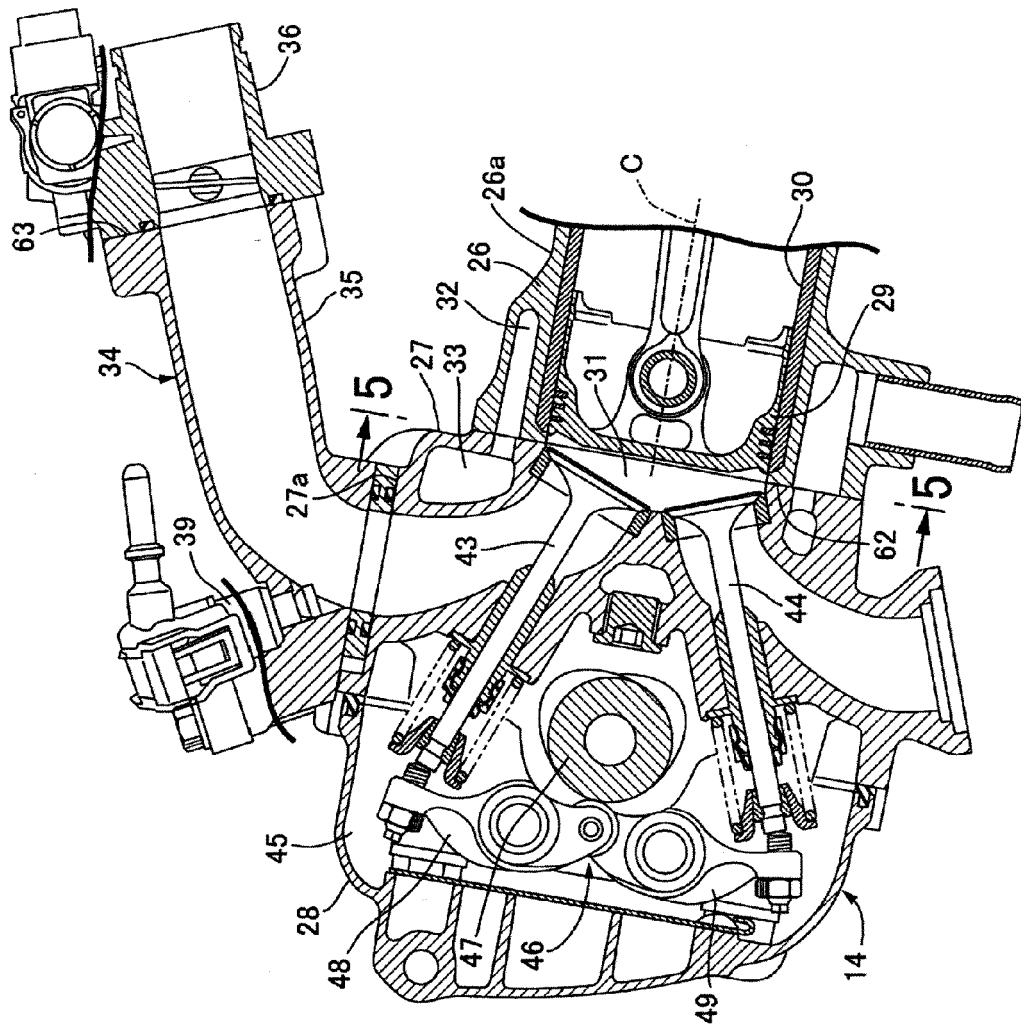


Fig.5

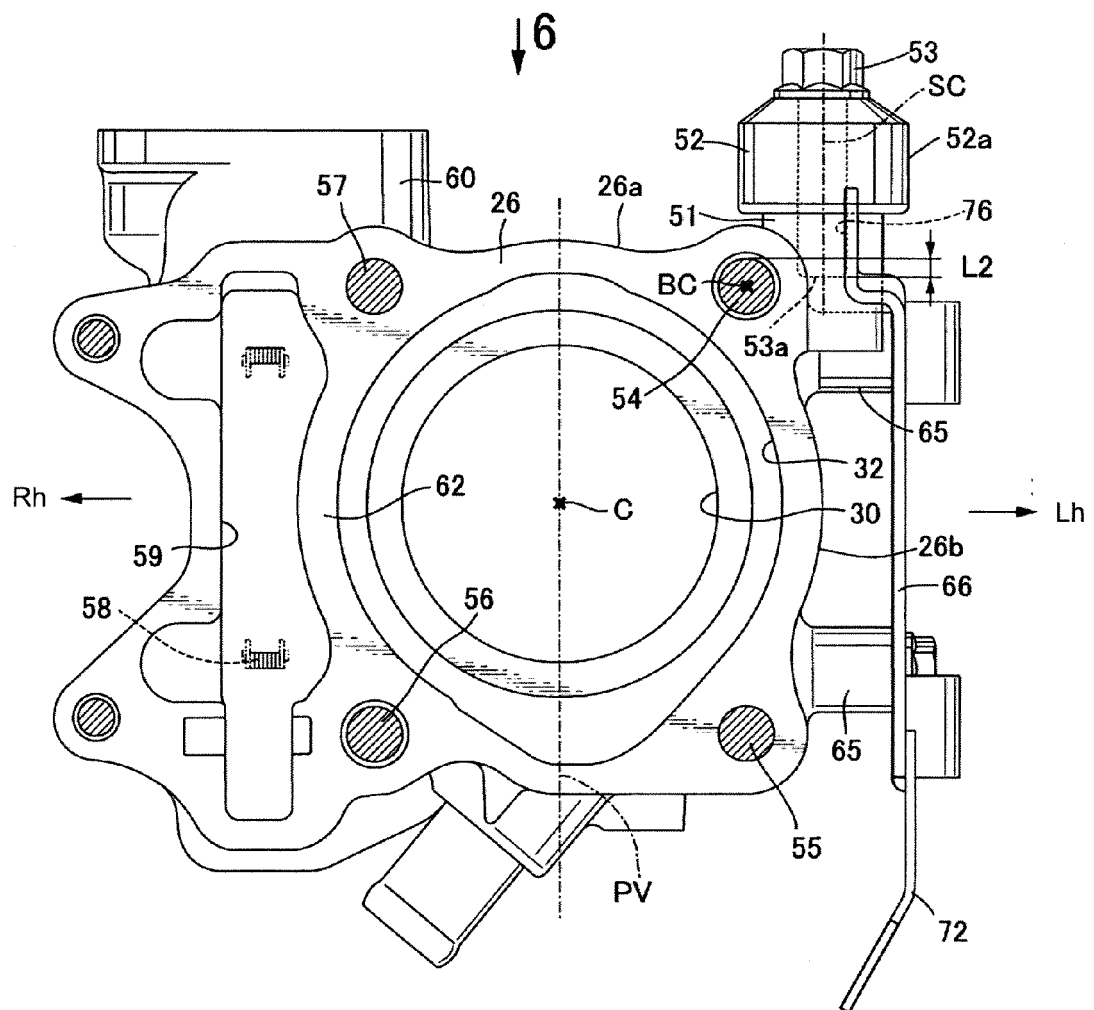


Fig. 6

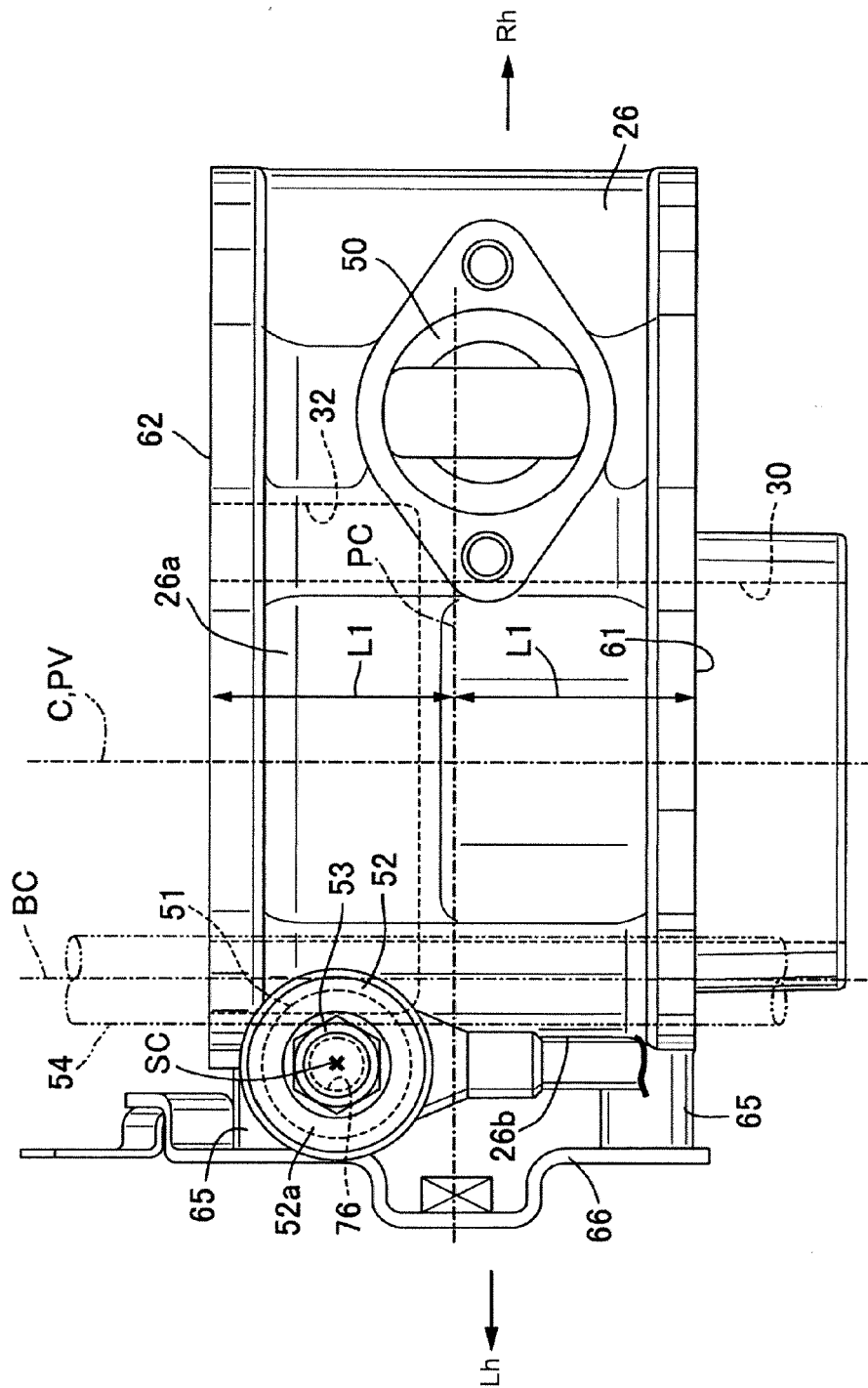


Fig.7

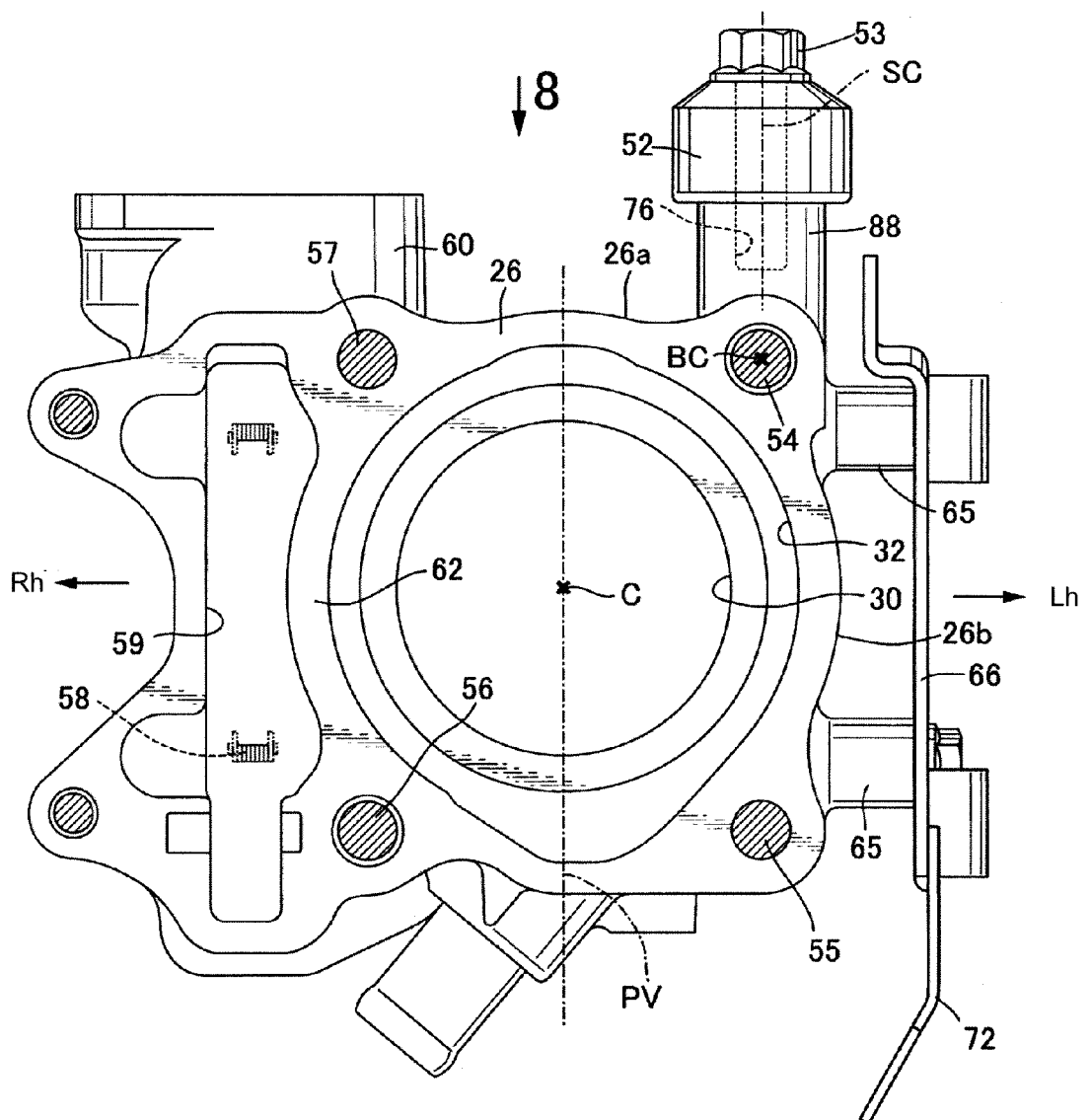


Fig. 8

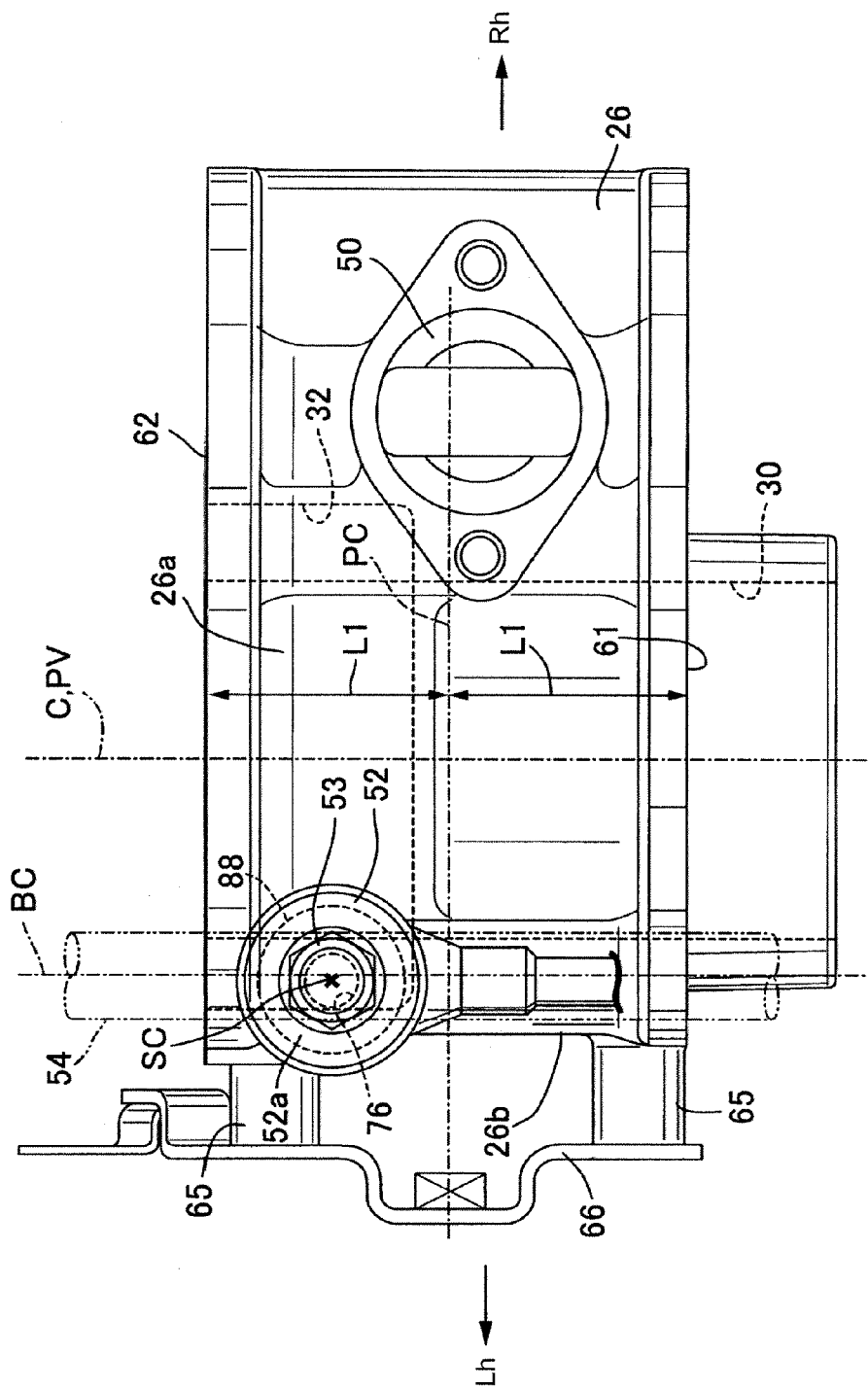


Fig.9

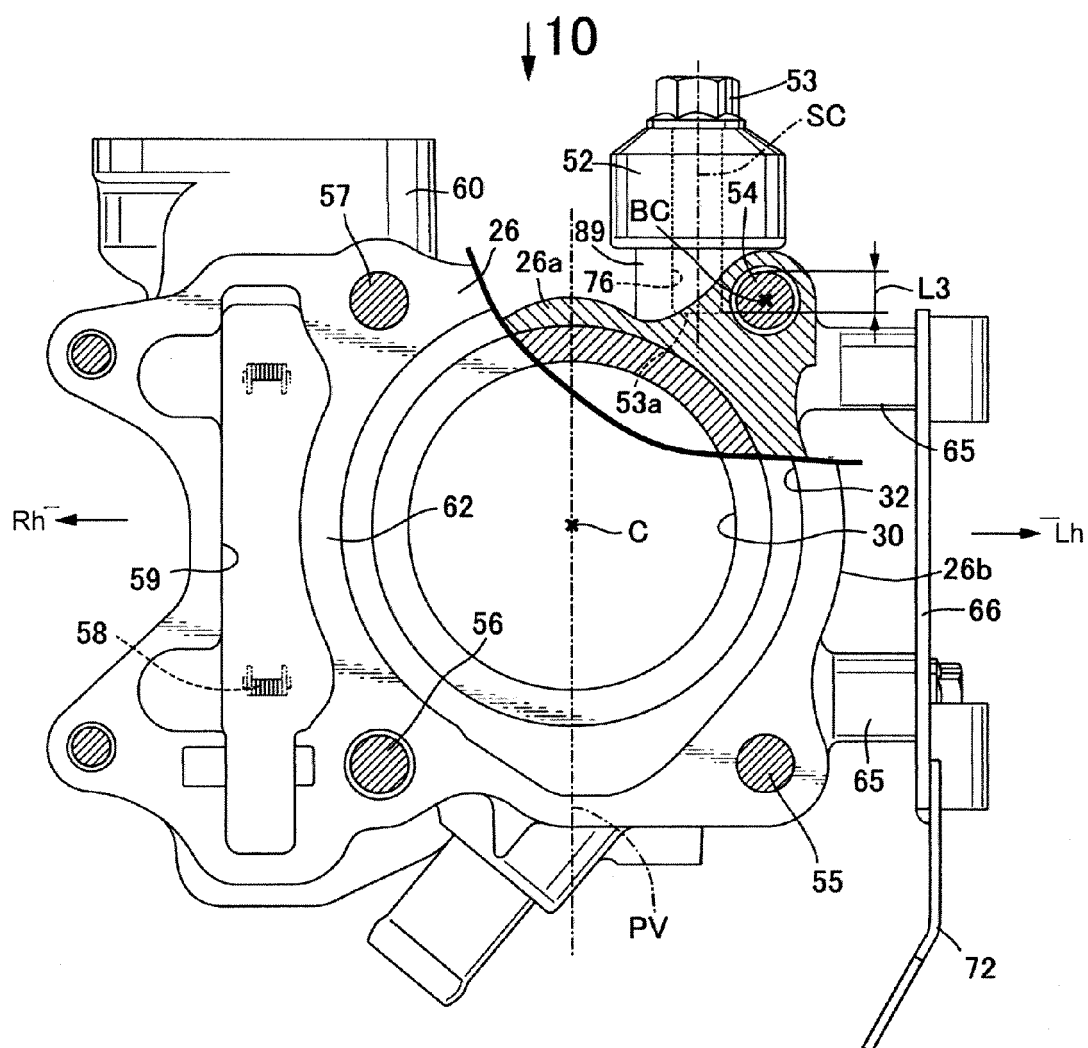
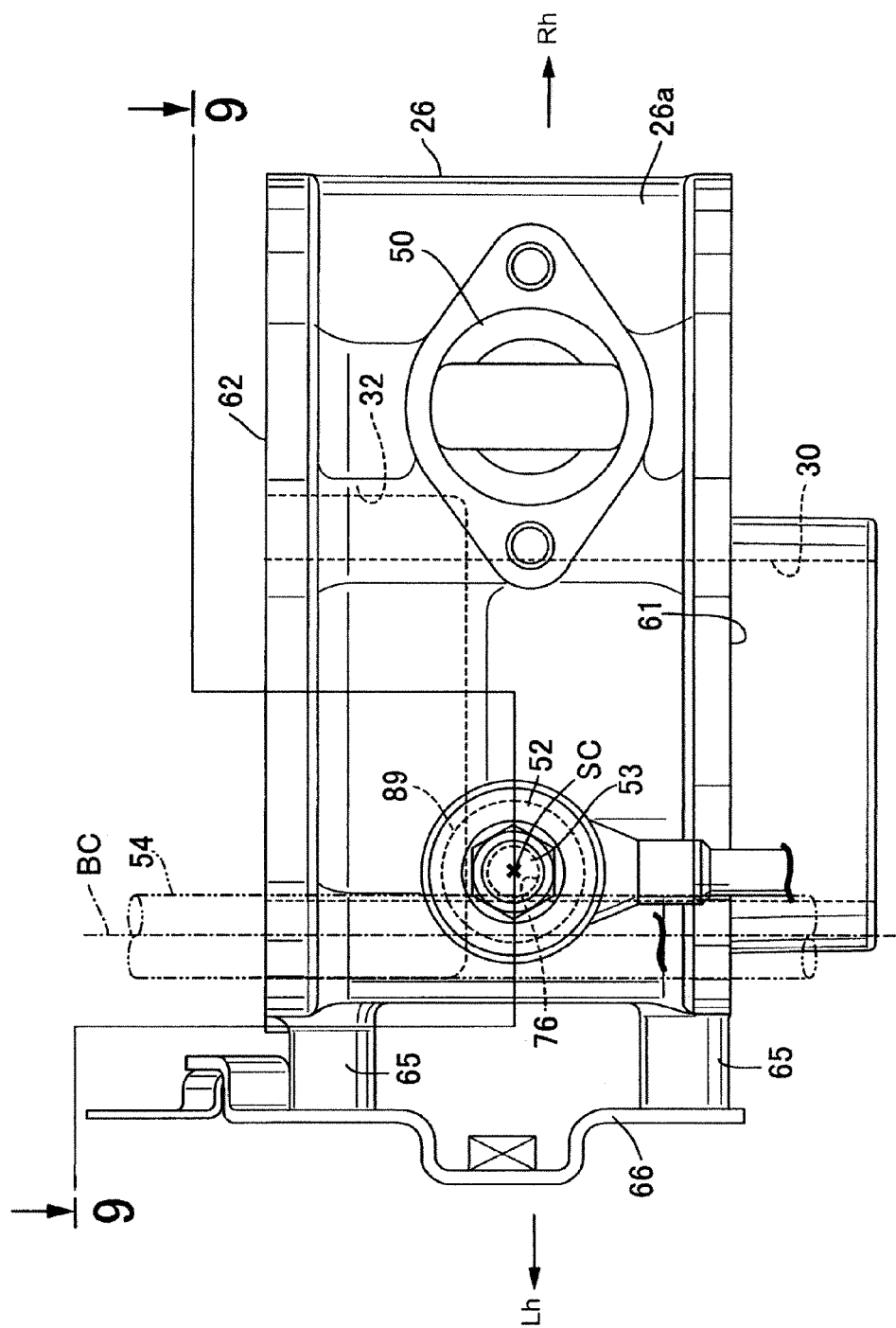


Fig. 10





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Application Number  
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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                |                                                       |                                                 |
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EPO FORM 1503 03.82 (P04C01)

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The members are as contained in the European Patent Office EDP file on  
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11-09-2015

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