



(11) **EP 2 573 353 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.03.2013 Bulletin 2013/13

(51) Int Cl.:
F01P 7/16 (2006.01) **F02D 33/00** (2006.01)

(21) Application number: **12185122.4**

(22) Date of filing: **20.09.2012**

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

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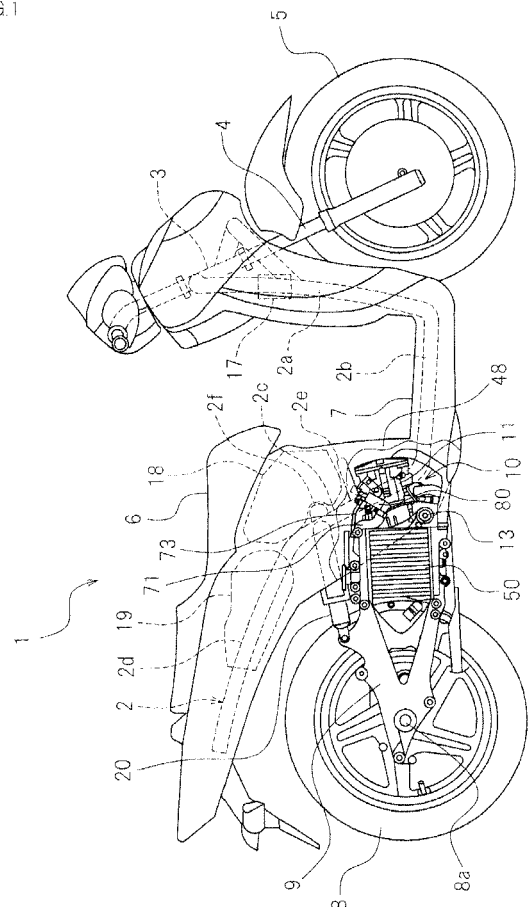
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(30) Priority: **22.09.2011 JP 2011207305**

(54) **Saddle type vehicle**

(57) The thermostat device 80 is attached to a lateral surface of the cylinder head 24 of the engine 11. The thermostat device 80 includes a thermostat 83 located in a housing 82, a water temperature sensor 84 located in the housing 82 above the thermostat 83, and an air discharge hole 87. The air discharge hole 87 and at least a portion of the water temperature sensor 84 are located above a cooling water flow outlet 42 of the engine 11. At least a portion of the thermostat is located below the cooling water flow outlet 42 of the engine 11.

FIG. 1



Description

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION:

[0001] The present invention relates to a saddle type vehicle including a water-cooled engine.

2. DESCRIPTION OF THE RELATED ART:

[0002] Conventionally in a saddle type vehicle including a water-cooled engine, a thermostat is provided in a circulation path for cooling water for cooling the engine. The thermostat adjusts the flow of the cooling water in accordance with change of the temperature of the cooling water. As a result, the temperature of the cooling water is automatically adjusted.

[0003] Another known saddle type vehicle includes a temperature sensor for detecting the temperature of the cooling water (hereinafter, referred to as a "water temperature sensor"), and controls the engine based on the temperature of the cooling water detected by the water temperature sensor.

[0004] It is conceived to provide the saddle type vehicle with both of a thermostat and a water temperature sensor in order to control the engine by use of the water temperature sensor while using a function of the thermostat of automatically adjusting the temperature of the cooling water. However, in the case where the thermostat and the water temperature sensor are provided separately, the number of components of the saddle type vehicle is increased, and a work of attaching the thermostat and the water temperature sensor requires time and labor. As a result, the cost is raised.

[0005] A thermostat device having a thermostat and a water temperature sensor integrated with each other has been proposed (see, for example, Japanese Laid-Open Patent Publication No. 2003-222264). By applying such a thermostat device, the number of components can be decreased and the cost can be reduced.

SUMMARY OF THE INVENTION

[0006] In the case where the thermostat and the water temperature sensor are provided separately, the thermostat and the water temperature sensor can be independently located at appropriate positions with appropriate attaching postures relatively freely. A detection value of the water temperature sensor is used for controlling the engine. Therefore, the water temperature sensor is preferably located in the vicinity of a cooling water exit of the engine so as to detect a temperature which is closest possible to the actual water temperature in the engine. However, in the case where the water temperature sensor integrated with the thermostat is located in the vicinity of the cooling water exit, the following problems arise.

[0007] An integrated thermostat/water temperature

sensor (hereinafter, referred to as a "thermostat device") has a larger volume than that of an independent thermostat by the volume of the water temperature sensor. In a saddle type vehicle, there is a strict limit on a space for installing vehicle components, and therefore the entirety of the vehicle components is strongly required to be reduced in size. When a thermostat device is located in substantially the same manner as the conventional thermostat separate from the water temperature sensor, the engine may not be reduced in size.

[0008] As a result of active studies, the present inventor found that depending on the positions of the water temperature sensor and the thermostat in the thermostat device, the position of the thermostat device with respect to the engine, the attaching posture of the thermostat device or the like, the detection precision of the water temperature sensor may not be sufficiently high. It was found that when the structure, position and attaching posture of the thermostat device are determined merely in consideration of size reduction, an accurate temperature of the cooling water cannot be detected.

[0009] When the detection value of the water temperature sensor is erroneous, the control of the engine may be unstable. Especially, the fuel injection amount of an injector is easily influenced by change of the temperature detected by the water temperature sensor. In a saddle type vehicle for controlling the injector based on the detection value of the water temperature sensor, when the detection value is erroneous, the fuel injection amount may not be controlled appropriately.

[0010] The present invention made in light of such circumstances has an object of, in a saddle type vehicle including a thermostat device having a thermostat and a water temperature sensor integrated with each other, locating the engine and the thermostat device in a small space while suppressing decline of the detection precision of the water temperature sensor.

[0011] A saddle type vehicle according to the present invention includes a body frame; an engine supported by the body frame, and having therein a flow inlet through which cooling water flows in and a flow outlet through which the cooling water flows out; an injector for supplying fuel to the engine; a radiator having therein a flow inlet through which the cooling water flows in and a flow outlet through which the cooling water flows out; a first cooling water path for connecting the flow outlet of the engine and the flow inlet of the radiator to each other; a second cooling water path for connecting the flow inlet of the engine and the flow outlet of the radiator to each other; a thermostat device including a housing having therein a flow path through which the cooling water flows, a thermostat located in the housing, and a water temperature sensor located in the housing above the thermostat, the thermostat device being located in the first cooling water path; and a control device for controlling the injector based on a temperature detected by the water temperature sensor. The housing of the thermostat device has therein an air discharge hole for communicating inside

and outside of the flowpath to each other. The thermostat device is located such that the air discharge hole and at least a portion of the water temperature sensor are located above the flow outlet of the engine, and such that at least a portion of the thermostat is located below the flow outlet of the engine.

[0012] The saddle type vehicle includes a thermostat device having a thermostat and a water temperature sensor integrated with each other. In the housing, the water temperature sensor is located above the thermostat, and thus is prevented from protruding laterally to the thermostat. Therefore, the thermostat device is easily located in a small space. However, since the water temperature sensor is located in an upper area in the housing, if air is stagnant in the housing, the air may cause the detection precision of the water temperature sensor to be declined if no measure is taken. In the saddle type vehicle, the air discharge hole is formed in the housing of the thermostat device. Therefore, air is not likely to be stagnant in the housing. In addition, the air discharge hole and at least a portion of the water temperature sensor are located above the flow outlet of the engine, and at least a portion of the thermostat is located below the flow outlet of the engine. Therefore, even in the case where the attaching position, the attaching posture or the like of the thermostat is set to be suitable to size reduction of the engine and the thermostat device, decline of the detection precision of the water temperature sensor can be suppressed. Accordingly, the entirety of the engine and the thermostat device can be located in a small space while decline of the detection precision of the water temperature sensor is suppressed.

[0013] In a preferable embodiment of the saddle type vehicle according to the present invention, the housing of the thermostat device has therein an inlet opening through which the cooling water flows in and an outlet opening through which the cooling water flows out. The thermostat device is attached to the engine such that the inlet opening of the housing and the flow outlet of the engine are connected to each other.

[0014] Owing to this, a temperature very close to the actual temperature of the cooling water in the engine can be detected by the water temperature sensor. Therefore, the detection precision of the water temperature sensor can be improved.

[0015] In another preferable embodiment of the saddle type vehicle according to the present invention, the housing includes a cylindrical section having the water temperature sensor located in an upper area thereof and having the thermostat located in a lower area thereof. The air discharge hole is formed outer to the water temperature sensor in a radial direction of the cylindrical section. The thermostat device is located such that the cylindrical section is inclined with respect to the vertical line and thus an area in which the air discharge hole is formed is located at a high position.

[0016] Owing to this, the thermostat device is located to be inclined with respect to the vertical line. Therefore,

the height of the thermostat device can be smaller as compared with the case where the thermostat device is located along the vertical line. In addition, since the area in which the air discharge hole is formed located at a high position, the air is smoothly discharged through the air discharge hole. Therefore, the detection precision of the water temperature sensor can be improved.

[0017] In still another preferable embodiment of the saddle type vehicle according to the present invention, the engine includes a cylinder having a cylinder axis line extending forward as seen in a plan view. The cylindrical section is located parallel to the cylinder axis line as seen in the plan view.

[0018] Owing to this, the thermostat device is prevented from protruding leftward or rightward. Although the thermostat device is located laterally to the cylinder head, the engine and the thermostat device can have a small total length in a left-right direction.

[0019] In still another preferable embodiment of the saddle type vehicle according to the present invention, the radiator includes a radiator main body having therein the flow inlet and the flow outlet, and a water injection section formed to have a cylinder shape protruding upward from the radiator main body, the water injection section receiving the cooling water injected thereinto. The water injection section is located above the air discharge hole of the thermostat device. The saddle type vehicle further includes an air discharge path for connecting the air discharge hole of the thermostat device and the water injection section of the radiator to each other.

[0020] Owing to this, the air in the thermostat device is naturally discharged to the water injection section of the radiator through the air discharge path. No special work for discharging the air in the thermostat device is needed, and the air in the thermostat device can be easily discharged. Even if a portion of the cooling water is discharged through the air discharge hole together with the air, such a portion of the cooling water is supplied to the radiator. Thus, the amount of the cooling water circulating in the engine and the radiator is not decreased.

[0021] In still another preferable embodiment of the saddle type vehicle according to the present invention, the engine includes a crankcase for accommodating a crankshaft; a cylinder body connected to the crankcase, having a cylinder therein, and extending forward as seen in a plan view; and a cylinder head connected to a tip portion of the cylinder body and having therein the flow outlet. The housing of the thermostat device has therein an inlet opening through which the cooling water flows in and an outlet opening through which the cooling water flows out. The thermostat device is attached to a lateral surface of the cylinder head such that the inlet opening of the housing and the flow outlet of the engine are connected to each other. The radiator is located laterally to the crankcase so as to be located on a line extended from the crankshaft. Both of the thermostat device and the radiator are located to the left of, or to the right of, a cylinder axis line as seen in the plan view.

[0022] Owing to this, the first cooling water path can be short. The entirety of the engine and the thermostat device can be located in a small space.

[0023] In still another preferable embodiment of the saddle type vehicle according to the present invention, the saddle type vehicle further includes a water pump attached to the cylinder head. The second cooling water path has a path for connecting the radiator and the water pump to each other. As seen in the plan view, the thermostat device is located in an area enclosed by the cylinder head, the cylinder body, the crankcase, and the path of the second cooling water path.

[0024] Owing to this, the thermostat device can be located in a small space.

[0025] In still another preferable embodiment of the saddle type vehicle according to the present invention, as seen in the plan view, among a position to the left of the cylinder head and a position to the right of the cylinder head, the thermostat device is located at one of the positions and the water pump is located at the other position. At least a portion of the path of the second cooling water path is located below the cylinder head.

[0026] Owing to this, the engine can be reduced in size.

[0027] In still another preferable embodiment of the saddle type vehicle according to the present invention, the saddle type vehicle further includes an air discharge path for connecting the air discharge hole of the thermostat device and the radiator to each other; and a water pump attached to the cylinder head. The second cooling water path has a path for connecting the radiator and the water pump to each other. As seen in the plan view, the air discharge path is located in an area enclosed by the cylinder head, the cylinder body, the crankcase and the path of the second cooling water path and also in an area above the crankcase, which is continued from the enclosed area.

[0028] Owing to this, the air discharge path can be located in a small space.

[0029] In still another preferable embodiment of the saddle type vehicle according to the present invention, as seen in the plan view, among a position to the left of the cylinder head and a position to the right of the cylinder head, the thermostat device is located at one of the positions and the water pump is located at the other position. At least a portion of the path of the second cooling water path is located below the cylinder head.

[0030] Owing to this, the engine can be located in a small space.

[0031] In still another preferable embodiment of the saddle type vehicle according to the present invention, the saddle type vehicle further includes an air discharge path for connecting the air discharge hole of the thermostat device and the radiator to each other. A portion of the air discharge path and a portion of the first cooling water path overlap each other in an up-down direction.

[0032] Owing to this, the air discharge path and the first cooling water path can have a small total width in the left-right direction. The air discharge path and the first

cooling water path can be located in a small space.

[0033] In still another preferable embodiment of the saddle type vehicle according to the present invention, the engine includes a crankcase for accommodating a crankshaft; a cylinder body connected to the crankcase, having a cylinder therein, and extending forward as seen in a plan view; and a cylinder head connected to a tip portion of the cylinder body and having therein the flow outlet. The housing of the thermostat device has therein an inlet opening through which the cooling water flows in and an outlet opening through which the cooling water flows out. The thermostat device is attached to a lateral surface of the cylinder head such that the inlet opening of the housing and the flow outlet of the engine are connected to each other. An ignition device is inserted into a lateral surface of the cylinder head. The thermostat device is located at such a position that does not overlap the ignition device as seen in a side view.

[0034] Owing to this, for removing the ignition plug from the cylinder head for maintenance, the thermostat device is not likely to be an obstacle. The provision of the thermostat device is prevented from making difficult a maintenance work on the ignition plug.

[0035] In still another preferable embodiment of the saddle type vehicle according to the present invention, the engine is swingably supported by the body frame via a pivot shaft.

[0036] Along with the swing of the engine, the first cooling water path, the thermostat device and the like also swing. Therefore, for a saddle type vehicle including an engine swingably supported by the body frame, especially the engine and the thermostat device are strongly required to be reduced in size. This is why the above-described effect that the engine and the thermostat device are reduced in size is conspicuous.

[0037] In still another preferable embodiment of the saddle type vehicle according to the present invention, the engine includes a cylinder having a cylinder axis line extending obliquely upward and forward as seen in a side view. The pivot shaft is located below the cylinder axis line as seen in the side view. The thermostat device is located above the cylinder axis line as seen in the side view.

[0038] Owing to this, an upper portion of the engine swings by a larger amount than a lower portion thereof. In the case where the thermostat device is located above the cylinder axis line like this, the above-described effect that the engine and the thermostat device are reduced in size is conspicuous.

[0039] According to the present invention, in a saddle type vehicle including a thermostat device having a thermostat and a water temperature sensor integrated with each other, the engine and the thermostat device can be located in a small space while decline of the detection precision of the water temperature sensor is suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040]

FIG. 1 is a side view of a motorcycle.
 FIG. 2 is a partial side view of an engine.
 FIG. 3 is a cross-sectional view taken along line III-III in FIG. 2.
 FIG. 4 is a partial perspective view of the engine.
 FIG. 5 is a cross-sectional view of a thermostat device in a state where a thermostat is closed as seen from the right.
 FIG. 6 is a cross-sectional view of the thermostat device in a state where the thermostat is closed as seen from the front.
 FIG. 7 is a cross-sectional view of the thermostat device in a state where the thermostat is opened as seen from the right.
 FIG. 8 is a structural view of a circulation path of cooling water.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0041] Hereinafter, an embodiment of the present invention will be described. As shown in FIG. 1, a saddle type vehicle in this embodiment is a scooter type motorcycle 1. The saddle type vehicle according to the present invention is not limited to a scooter type motorcycle and may be a different type of motorcycle, for example, of a moped type, on-road type, off-road type or the like. A saddle type vehicle according to the present invention refers to a vehicle which a rider rides astride, but is not limited to an automatic two-wheel vehicle and may be a three-wheel vehicle. A saddle type vehicle according to the present invention is not limited to a type of vehicle, a vehicle body of which is inclined when turning right or left, and may be an ATV (All Terrain Vehicle) or the like.
[0042] In the following description, the terms "front", "rear", "left" and "right" respectively refer to front, rear, left and right as seen from a rider of the motorcycle 1 unless otherwise specified.

[0043] The motorcycle 1 includes a body frame 2, a power unit 10 supported by the body frame 2, a seat 6 on which the rider sits, and a low footrest 7 located forward to the seat 6. Below the seat 6, an accommodation box 18 is located. At a position which is below the seat 6 and is rearward to the accommodation box 18, a fuel tank 19 is located. The seat 6 is a so-called flip-up type seat, and is rotatable around one end thereof acting as a fulcrum. By flipping up the seat, things can be put into, or taken out from the accommodation box 18, and also oil can be supplied to the fuel tank 19.

[0044] At a front end of the body frame 2, a head pipe 3 is provided. To the head pipe 3, a front fork 4 is attached. By a lower end portion of the front fork 4, a front wheel 5 is supported. As seen in a side view, the body frame 2 includes a first frame section 2a extending from the head pipe 3 obliquely downward and rearward, a second frame

section 2b extending rearward from a rear end of the first frame section 2a, a third frame section 2c extending from a rear end of the second frame section 2b obliquely upward and rearward, and a fourth frame section 2d extending from a rear end of the third frame section 2c obliquely upward and rearward. The fourth frame section 2d has a smaller inclination angle than that of the third frame section 2c. A set of the first frame section 2a, the second frame section 2b, the third frame section 2c and the fourth frame section 2d is provided in a pair, i.e., one set on the left side and the other set on the right side. Between the pair of third frame sections 2c, cross members 2e and 2f are extended (see FIG. 4). The cross member 2e couples middle portions of the left and right frame sections 2c to each other. The cross member 2f is located above the cross member 2e. The cross member 2f couples upper end portions of the left and right third frame sections 2c to each other. Although not shown, between the left and right frame sections 2a, between the left and right frame sections 2b, and between the left and right frame sections 2d, cross members are extended.

[0045] The power unit 10 is a so-called swing type power unit, and is supported by the body frame 2 via a pivot shaft 13 so as to be swingable upward and downward. The pivot shaft 13 is located below the power unit 10. This structure can provide a space above the power unit 10 unlike a structure in which the pivot shaft 13 is located above the power unit 10. In this embodiment, a portion of the accommodation box 18 is located in the space. In this manner, the accommodation box 18 of a larger volume can be located by use of the space. When the power unit 10 is swung about the pivot shaft 13, an upper portion of the power unit 10 is swung by a larger amount than a lower portion thereof.

[0046] The power unit 10 includes a water-cooled engine 11 (see FIG. 3) described later and a V belt type continuously variable transmission (not shown). A rear end portion of the power unit 10 is attached to a driving shaft 8a of a rear wheel 8 on the left side of the motorcycle 1. A driving power of the engine 11 is transmitted to the rear wheel 8 via the V belt type continuously variable transmission.

[0047] As shown in FIG. 1, on the right side of the motorcycle 1, a rear end portion of a rear arm 9 is supported by the driving shaft 8a of the rear wheel 8. A front end portion of the rear arm 9 is attached to the power unit 10. Between the rear arm 9 and the third frame section 2c of the body frame 2, a cushion unit 20 is extended. A front end portion of the cushion unit 20 is rotatably coupled to the upper end portion of the third frame section 2c. However, there is no specific limitation on the position of the body frame 2 to which the cushion unit 20 is coupled.

[0048] FIG. 2 is a right side view of a front portion of the power unit 10. FIG. 3 is a cross-sectional view taken along line III-III in FIG. 2. The engine 11 forms the front portion of the power unit 10. As shown in FIG. 3, the

engine 11 includes a crankcase 22 for accommodating a crankshaft 21, a cylinder body 23 connected to the crankcase 22, and a cylinder head 24 connected to the cylinder body 23. As seen in a plan view, the cylinder body 23 extends forward from the crankcase 22. As shown in FIG. 2, as seen in the side view, the cylinder body 23 is slightly inclined obliquely upward and forward. The cylinder head 24 is connected to a front end portion of the cylinder body 23.

[0049] As shown in FIG. 3, the cylinder body 23 has a cylinder 23a formed therein. The cylinder 23a may be integrated with, or separated from, the cylinder body 23. In the cylinder 23a, a piston 25 is slidably accommodated. The piston 25 is coupled to the crankshaft 21 via a connecting rod 26.

[0050] The cylinder head 24 has a concaved portion 24a in a lower surface thereof. By the concaved portion 24a, the cylinder 23a and the piston 25, a combustion chamber 27 is partitioned. Into the cylinder head 24, an ignition plug 28 is inserted so as to be exposed to the combustion chamber 27.

[0051] In the cylinder head 24, a water jacket 31 is formed. In the cylinder body 23, a water jacket 32 is formed. Although not shown, a gasket having a hole is provided between the cylinder body 23 and the cylinder head 24. The water jacket 31 and the water jacket 32 are connected to each other via the hole of the gasket. The water jacket 31 is formed around the concaved portion 24a, and the water jacket 32 is formed around the cylinder 23a. Namely, the water jackets 31 and 32 are formed around the combustion chamber 27. Owing to the water jackets 31 and 32, a cooling water path 40 (see FIG. 8) of the engine 11 is formed.

[0052] In the cylinder head 24, a camshaft 29 is located. The camshaft 29 is located parallel to the crankshaft 21. The camshaft 29 is coupled to the crankshaft 21 via a chain 30. The camshaft 29 is driven by the crankshaft 21 and is rotated together with the crankshaft 21.

[0053] Although not shown, the cylinder head 24 has an intake port and an exhaust port which are exposed to the combustion chamber 27, an intake valve for opening or closing the intake port, and an exhaust valve for opening or closing the exhaust port. The intake valve and the exhaust valve are driven by the camshaft 29.

[0054] On a left side surface of the cylinder head 24, a water pump 35 is attached. The water pump 35 includes a rotation shaft 35a and an impeller 35b secured to the rotation shaft 35a. The rotation shaft 35a is secured to the camshaft 29. When the camshaft 29 is rotated, the rotation shaft 35a is rotated, and the impeller 35b is also rotated. The water pump 35 is driven by the camshaft 29. Since the camshaft 29 is driven by the crankshaft 21, the water pump 35 is driven by the crankshaft 21.

[0055] In the left side surface of the cylinder head 24, a flow inlet 41 through which the cooling water flows into the cylinder head 24 is formed. The water pump 35 is structured to eject the cooling water toward the flow opening 41. In this embodiment, the water pump 35 is located

outer to the cylinder head 24. However, the water pump 35 merely needs to be located in the circulation path of the water, and there is no specific limitation on the position thereof.

[0056] In a right side surface of the cylinder head 24, a flow outlet 42 through which the cooling water flows out of the cylinder head 24 is formed. The flow outlet 42 is opened rightward. To the flow outlet 42, a thermostat device 80 having a thermostat 83 (see FIG. 5) and a water temperature sensor 84 integrated with each other is connected. The thermostat device 80 includes an inlet opening 85 through which the cooling water flows into the thermostat device 80 and an outlet opening 86 through which the cooling water flows out of the thermostat device 80. The thermostat device 80 is located such that the inlet opening 85 faces the flow outlet 42 of the cylinder head 24. The structure of the thermostat device 80 will be described later in detail.

[0057] As shown in FIG. 2, as seen in the side view, the thermostat device 80 is located so as to partially overlap the third frame section 2c. The thermostat device 80 is located between the left and right third frame section 2c. More specifically, the thermostat device 80 is located between the right third frame section 2c and the cylinder body 23/cylinder head 24.

[0058] As shown in FIG. 3, as seen in the plan view, the thermostat device 80 is located so as to partially overlap the cross member 2f. As seen in the plan view, the thermostat device 80 is located so as to be partially present between the cross member 2e and the cross member 2f.

[0059] As shown in FIG. 2, an intake pipe 14 is connected to an upper portion of the cylinder head 24. An exhaust pipe 15 is coupled to a lower portion of the cylinder head 24. On the upper portion of the cylinder head 24, an injector 16 for injecting fuel is provided. The injector 16 is structured to inject the fuel into the intake port (not shown). There is no specific limitation on the position of the injector 16. The injector 16 may be connected to the intake pipe 14. The injector 16 may be structured to inject the fuel into the combustion chamber 27.

[0060] As shown in FIG. 1, above the engine 11, the accommodation box 18 and the cushion unit 20 are provided. As shown in FIG. 4, the cylinder body 23 and the cylinder head 24 of the engine 11 are located between the left and right third frame section 2c. Therefore, the space above the engine 11 is not very large. In other words, there is not much room above the engine 11.

[0061] The motorcycle 1 includes an ECU (Electric Control Unit) 17 (see FIG. 1) as a control device for controlling the engine 11. There is no specific limitation on the position of the ECU 17. The ECU 17 is connected to the water temperature sensor 84 of the thermostat device 80 via a signal line (not shown). The ECU 17 is structured to receive a detection signal from the water temperature sensor 84. Based on the temperature of the cooling water detected by the water temperature sensor 84, the ECU 17 performs various types of control. Based on the tem-

perature of the cooling water detected by the water temperature sensor 84, the ECU 17 controls the injector 16. For example, the ECU 17 controls the injector 16 such that as the temperature detected by the water temperature sensor 84 is lower, the injector 16 injects a larger amount of fuel, whereas as the temperature detected by the water temperature sensor 84 is higher, the injector 16 injects a smaller amount of fuel.

[0062] As shown in FIG. 3, to the right of the crankcase 22, a radiator 50 is located. The radiator 50 is formed to have a generally rectangular parallelepiped shape in which a width in a left-right direction is shorter than a width in a front-rear direction and also than a width in an up-down direction. As shown in FIG. 2, the radiator 50 includes a core 51 for radiating heat from the cooling water, an upper tank 52 located above, and connected to, the core 51, and a lower tank 53 located below, and connected to, the core 51. The radiator 50 is a so-called down flow type radiator, and the cooling water flows into the core 51 from top to bottom. The upper tank 52 has a flow inlet 54 (see FIG. 3) through which the cooling water flows into the radiator 50. The lower tank 53 has a flow outlet 55 through which the cooling water flows out of the radiator 50. As shown in FIG. 3, in this embodiment, the flow inlet 54 is opened generally leftward, and the flow outlet 55 is opened generally forward. There is no specific limitation on the opening direction of the flow inlet 54 or the flow outlet 55.

[0063] As shown in FIG. 2, the upper tank 52 is provided with a cylindrical water injection section 56 extending upward. To an upper end of the water injection section 56, a radiator cap 57 is fit. To the radiator cap 57, one end of a hose 58 is connected. Although not shown, the other end of the hose 58 is connected to a reservoir tank.

[0064] As shown in FIG. 3, to a right end portion of the crankshaft 21, a fan 60 is attached. The fan 60 is driven by the crankshaft 21 and is rotated together with the crankshaft 21. The fan 60 is located to the left of the radiator 50. When the fan 60 is rotated, air flows from right to left toward the fan 60. This air flows outside the core 51 of the radiator 50 leftward. The cooling water flowing inside the core 51 is cooled by this air.

[0065] The outlet opening 86 of the thermostat device 80 and the flow inlet 54 of the radiator 50 are connected to each other via a hose 71. In other words, the one end of the hose 71 is connected to the outlet opening 86 of the thermostat device 80, and the other end of the hose 71 is connected to the flow inlet 54 of the radiator 50. As shown in FIG. 3, as seen in the plan view, the hose 71 generally extends obliquely rightward and rearward. As shown in FIG. 2, as seen in the side view, the hose 71 extends from the thermostat device 80 obliquely upward and rearward, then extends upward, and then extends rearward. The hose 71 forms a path for transporting the cooling water from the thermostat device 80 to the radiator 50. In this embodiment, the thermostat device 80 and the hose 71 form a first cooling water path for connecting the flow outlet 42 of the engine 11 and the flow

inlet 54 of the radiator 50 to each other.

[0066] As shown in FIG. 3, the flow outlet 55 of the radiator 50 and an intake opening 36 of the water pump 35 are connected to each other via a hose 72. In other words, one end of the hose 72 is connected to the flow outlet 55 of the radiator 50, and the other end of the hose 72 is connected to the intake opening 36 of the water pump 35. As shown in FIG. 3, as seen in the plan view, the hose 72 extends from the radiator 50 obliquely leftward and forward, passes below the cylinder head 24, and is curved rearward. As shown in FIG. 2, as seen in the side view, the hose 72 extends forward from the radiator 50, extends obliquely upward and forward, and then extends obliquely upward and rearward. The hose 72 forms a path for transporting the cooling water from the radiator 50 to the water pump 35. In this embodiment, the hose 72 and the water pump 35 form a second cooling water path for connecting the flow outlet 55 of the radiator 50 and the flow inlet 41 of the engine 11 to each other.

[0067] As shown in FIG. 1, a front surface and a lateral surface of the engine 11 are covered with a body cover 48. A lateral surface of the accommodation box 18 and a lateral surface of the fuel tank 19 are also covered with a body cover 48.

[0068] Now, a structure of the thermostat device 80 will be described. FIG. 5 is a cross-sectional view of the thermostat device 80 as seen from the right. FIG. 6 is a cross-sectional view of the thermostat device 80 as seen from the front. As shown in FIG. 5, the thermostat device 80 includes a housing 82 having therein a flow path 81 through which the cooling water flows, the thermostat 83 located in the housing 82, and the water temperature sensor 84 located in the housing 82 above the thermostat 83.

[0069] The housing 82 includes a vertically lengthy cylindrical section 82a, an inlet section 82b (see FIG. 6) extending laterally from a middle portion of the cylindrical section 82a, and an outlet section 82c (see FIG. 5) extending laterally from a lower portion of the cylindrical section 82a. The inlet section 82b extends leftward, and the outlet section 82c extends rearward (see FIG. 3). The inlet opening 85 is formed at a tip of the inlet section 82b, and the outlet opening 86 is formed at a tip of the outlet section 82c. In an upper area in the cylindrical section 82a, a hole 82d concentric with the cylindrical section 82a is formed. An upper portion of the cylindrical section 82a has an air discharge section 82e protruding laterally. On a lateral surface of the cylindrical section 82a, an attaching section 89 having a hole 88 is formed integrally with the cylindrical section 82a. As shown in FIG. 2, a bolt 90 is tightened to the hole 88. The bolt 90 secures the thermostat device 80 to the cylinder head 24.

[0070] The thermostat 83 includes a thermo-element 91 having a built-in element expanded or contracted by a temperature change, for example, wax or the like. At a lower end of the thermo-element 91, a cylindrical guide 92 is provided, and a cylindrical piston 93 is inserted into the guide 92. In accompaniment with the expansion or

contraction of the element in the thermo-element 91, the piston 93 is extended or retracted. A lower end portion of the piston 93 is supported by a bottom surface of the cylindrical section 82a of the housing 82. To an upper end portion of the thermo-element 91, a lower end portion of a spring 94 is attached. An upper end portion of the spring 94 is attached to the upper portion of the cylindrical section 82a of the housing 82. In this embodiment, the spring 94 is a coil spring, but there is no specific limitation on the type of the spring 94. The thermo-element 91 is urged downward by the spring 94.

[0071] The cylindrical section 82a of the housing 82 has a ring section 95 protruding inward in a radial direction. A hole 96 is formed at a center of the ring section 95. An outer peripheral portion of a bottom surface of the thermo-element 91 is put on the ring section 95.

[0072] When the temperature of the cooling water in the flow path 81 is low, the extending force of the piston 93 is smaller than the urging force of the spring 94. As a result, the thermo-element 91 is pressed to the ring section 95. In this case, the hole 96 is closed by the thermo-element 91, and the flow of the cooling water in the flow path 81 is stopped. By contrast, when the temperature of the cooling water in the flow path 81 is high, along with the expansion of the element in the thermo-element 91, the piston 93 extends against the urging force of the spring 94. As a result, as shown in FIG. 7, the thermo-element 91 is distanced in an upward direction from the ring section 95, which opens the hole 96. Thus, the cooling water flows in the flow path 81. In the following, a state where the hole 96 is opened and a state where the hole 96 is closed will be respectively referred to as the "state where the thermostat 83 is opened" and the "state where the thermostat 83 is closed". In the above-described manner, the thermostat 83 automatically adjusts the flow of the cooling water in accordance with the change of the temperature of the cooling water.

[0073] As shown in FIG. 5, a bypass hole 97, which is always open, is formed laterally to the hole 96. The bypass hole 97 has an inner diameter significantly smaller than the inner diameter of the hole 96. Therefore, when the thermostat 83 is opened, the cooling water flows toward the outlet opening 86 substantially solely through the hole 96. The bypass hole 97 is not absolutely necessary, and maybe omitted when not required.

[0074] The water temperature sensor 84 is inserted from above into the circular hole 82d of the cylindrical section 82a of the housing 82. The water temperature sensor 84 merely needs to be inserted into the circular hole 82d, and there is no specific limitation on how the water temperature sensor 84 is assembled to the housing 82. For example, the water temperature sensor 84 may be inserted into the circular hole 82d which is already made in the cylindrical section 82a. Alternatively, the water temperature sensor 84 may be put in a mold and a resin may be flown into the resin, so that the cylindrical section 82a having the water temperature sensor 84 integrally attached thereto is formed. In this case, the cir-

cular hole 82d is not formed in the cylindrical section 82a in advance, but the portion in which the water temperature sensor 84 is provided becomes the circular hole 82d.

[0075] The water temperature sensor 84 extends in an axial direction (downward in FIG. 5) of the cylindrical section 82a. A tip portion 84a of the water temperature sensor 84 is located laterally to the inlet opening 85. In this embodiment, the water temperature sensor 84 is located coaxially with the thermo-element 91. The water temperature sensor 84 is located above the thermo-element 91. The water temperature sensor 84 is located inside the spring 94. Owing to this structure, a portion of the cylindrical section 82a is located above the inlet opening 85. Since the cooling water flows from the inlet opening 85 via the hole 96 toward the outlet opening 86, the cooling water may be stagnant in an area above the inlet opening 85 in the cylindrical section 82a. However, the tip portion 84a of the water temperature sensor 84 is located laterally to the inlet opening 85, namely, in the main stream of the cooling water. Therefore, the detection precision of the water temperature sensor 84 is improved.

[0076] At the time of injecting the cooling water to the circulation path of the cooling water, the circulation path may be contaminated with air. In the upper area in the cylindrical section 82a, the air contaminating the cooling water may be undesirably stagnant. In order to discharge the air in the cooling water, an air discharge hole 87 is formed in the air discharge section 82e of the housing 82. At one end of the air discharge hole 87, an entrance 87a exposed to the flow path 81 and opened downward is formed. The entrance 87a is located at the highest possible position in the flow path 81. Nonetheless, the position of the entrance 87a may be appropriately changed as long as the air can be discharged. At the other end of the air discharge hole 87, an exit 82b which is open laterally is formed. The air discharge hole 87 has an inner diameter smaller than the inner diameter of the cylindrical section 82a. The entrance 87a and the exit 87b each have an inner diameter smaller than the inner diameter of the inlet opening 85, smaller than the inner diameter of the hole 96, and smaller than the inner diameter of the outlet opening 86.

[0077] As shown in FIG. 2, in this embodiment, the thermostat device 80 is located to have a posture of inclining forward with respect to the vertical direction. Therefore, the entrance 87a is located at a higher position than in the case where the thermostat device 80 is located in the vertical direction. The air discharge hole 87 extends obliquely upward and rearward from the entrance 87a toward the exit 87b. This structure is provided so that air, which has a small specific gravity, is discharged smoothly through the air discharge hole 87.

[0078] As shown in FIG. 2, as seen in the side view, a portion of the thermostat device 80, more specifically, a portion of the water temperature sensor 84, is located above the cylinder head 24. As seen in the side view, such a portion of the thermostat device 80 is located above the highest portion of the cylinder head 24. A por-

tion of the thermostat device 80 is located to the right of the cylinder head 24. In other words, as seen in the side view, such a portion of the thermostat device 80 overlaps the cylinder head 24.

[0079] As shown in FIG. 3, the air discharge hole 87 and the water injection section 56 of the radiator 50 are connected to each other via a hose 73. In other words, one end of the hose 73 is connected to the air discharge hole 87 of the thermostat device 80, and the other end of the hose 73 is connected to the water injection section 56 of the radiator 50. As seen in the plan view, the hose 73 generally extends obliquely rightward and rearward. More specifically, as seen in the plan view, the hose 73 extends rearward from the air discharge hole 87 of the thermostat device 80, then extends obliquely rightward and rearward, is curved rightward, and is connected to the water injection section 56 of the radiator 50. As shown in FIG. 2, as seen in the side view, the hose 73 extends generally rearward. More specifically, as seen in the side view, the hose 73 extends from the air discharge hole 87 of the thermostat device 80 obliquely upward and rearward, and then extends rearward. The hose 73 is located above the hose 71. A portion of the hose 73 is located above a portion of the hose 71. Such a portion of the hose 73 and such a portion of the hose 71 overlap each other in the up-down direction. A middle portion of the hose 73 and a middle portion of the hose 71 are secured together by a band 74 (see FIG. 3).

[0080] FIG. 8 is a structural view of the circulation path of the cooling water. As shown in FIG. 8, the cooling water ejected from the water pump 35 is introduced to the cooling water path 40 in the engine 11. More specifically, the cooling water ejected from the water pump 35 flows from the flow inlet 41 into the water jacket 31 in the cylinder head 24, and then flows into the water jacket 32 in the cylinder body 23. The cooling water which has flown in the water jacket 32 again flows into the water jacket 31 of the cylinder head 24. The cooling water flows in the water jackets 31 and 32 to cool the engine 11. The cooling water, after cooling the engine 11, flows out of the cooling water path 40 through the flow outlet 42, and flows into the thermostat device 80 through the inlet opening 85.

[0081] In the case where the thermostat 83 is opened, the cooling water in the thermostat device 80 is introduced out of the thermostat device 80 through the outlet opening 86 and flows into the upper tank 52 of the radiator 50 via the hose 71. The thermostat device 80 and the upper tank 52 of the radiator 50 are communicated to each other via the hose 71, and are also communicated to each other via the hose 73 and the water injection section 56. However, the inner diameter of the air discharge hole 87 is smaller than the inner diameter of the outlet opening 86, and the inner diameter of the hose 73 is smaller than the inner diameter of the hose 71. Therefore, the flow path resistance of the air discharge hole 87 and the hose 73 is larger than the flow path resistance of the outlet opening 86 and the hose 71. Accordingly, in the case where the thermostat 83 is opened, the supply

of the cooling water from the thermostat device 80 to the radiator 50 is performed substantially solely via the hose 71.

[0082] The cooling water supplied to the upper tank 52 flows from the upper tank 52 into the core 51, and flows downward in the core 51. At this point, the cooling water in the core 51 performs heat exchange with the air flowing outside the core 51 and thus is cooled. Namely, the cooling water radiates heat. The cooling water which has flown in the core 51 flows into the lower tank 53. The cooling water is sucked from the lower tank 53 via the hose 72 to the water pump 35. The sucked cooling water is again ejected from the water pump 35. Then, the above-described operation is repeated.

[0083] When the thermostat device 80 is contaminated with air, the air is discharged to the water injection section 56 of the radiator 50 via the air discharge hole 87 and the hose 73. Therefore, the air is prevented from being stagnant in the thermostat device 80, and thus no adverse influence is exerted on the detection performed by the water temperature sensor 84.

[0084] As described above, the motorcycle 1 in this embodiment includes the thermostat device 80 having the thermostat 83 and the water temperature sensor 84 integrated with each other. Since the thermostat 83 and the water temperature sensor 84 are integrated with each other, the number of components of the motorcycle 1 can be decreased, and the attaching work can be simplified. Thus, the cost can be reduced.

[0085] As shown in FIG. 3, the thermostat device 80 is located near the cylinder head 24 of the engine 11. The water temperature sensor 84 can detect a temperature close to the actual temperature of the cooling water in the engine 11. Therefore, based on such an accurate water temperature, the engine control can be done more appropriately.

[0086] Since the thermostat 83 and the water temperature sensor 84 are integrated with each other, the thermostat 83 is located near the cylinder head 24 as well as the water temperature sensor 84. However, as shown in FIG. 5, the water temperature sensor 84 and the thermostat 83 are located coaxially, and thus the thermostat device 80 has a vertically lengthy shape. As shown in FIG. 3, the thermostat device 80 does not protrude much forward or rightward. Therefore, the thermostat 80 can be located in a small space near the cylinder head 24.

[0087] Especially in this embodiment, the cylinder body 23 and cylinder head 24 are located between the left and right third frame sections 2c, and the accommodation box 18 and the cushion unit 20 are located above the cylinder body 23 and the cylinder head 24. There is no large space around the cylinder body 23 and the cylinder head 24. This is why the effect that the thermostat device 80 can be located in a small space is conspicuous.

[0088] As described above, in the housing 82 of the thermostat device 80, the water temperature sensor 84 is located above the thermostat 83. Owing to this, the thermostat device 80 is located in a small space. How-

ever, in the case where the circulation path of the cooling water is contaminated with air, the air may be undesirably stagnant in the upper area in the housing 82. Since the water temperature sensor 84 is located in the upper area in the housing 82, if the air is stagnant there, the water temperature sensor 84 is adversely influenced by the air and may not accurately detect the temperature of the cooling water.

[0089] In the motorcycle 1 in which the amount of the fuel to be injected by the injector 16 is controlled based on the detection value of the water temperature sensor 84 as in this embodiment, a slight detection error of the water temperature sensor 84 causes a large error of the fuel injection amount. The amount of fuel injected by the injector 16 is significantly influenced by the detection value of the water temperature sensor 84. In order to inject an appropriate amount of fuel from the injector 16, it is important that the detection precision of the water temperature sensor 84 should be improved.

[0090] In the thermostat device 80 in this embodiment, the air discharge hole 87 is formed in the upper area in the housing 82. The air discharge hole 87 and at least a portion of the water temperature sensor 84 are located above the flow outlet 42 of the engine 11, and at least a portion of the thermostat 83 is located below the flow outlet 42 of the engine 11. Even if the inside of the housing 82 is contaminated with air, the air is discharged outside the housing 82 via the air discharge hole 87. Therefore, decline of the detection precision of the water temperature sensor 84 due to the contaminating air can be suppressed. Thus, the injector 16 can be controlled properly so that an appropriate amount of fuel can be supplied to the engine 11.

[0091] As described above, according to this embodiment, the entirety of the thermostat 83 and the water temperature sensor 84 which are integrated with each other can be located in a small space while decline of the detection precision of the water temperature sensor 84 is suppressed.

[0092] In this embodiment, the thermostat device 80 is directly attached to the cylinder head 24. More specifically, the thermostat device 80 is attached to the cylinder head 24 such that the inlet opening 85 of the housing 82 and the flow outlet 42 of the engine 11 are connected to each other. Therefore, a temperature very close to the actual temperature of the cooling water in the engine 11 can be detected by the water temperature sensor 84. Thus, the detection precision of the water temperature sensor 84 can be further improved.

[0093] In this embodiment, the inlet opening 85 of the housing 82 and the flow outlet 42 of the engine 11 are located to face each other. As shown in FIG. 2, as seen in the side view, the inlet opening 85 of the housing 82 and the flow outlet 42 of the engine 11 are located to overlap each other. Therefore, the cooling water flows quickly from the flow outlet 42 of the engine 11 to the inlet opening 85 of the housing 82. Thus, the detection precision of the water temperature sensor 84 can be fur-

ther improved.

[0094] The housing 82 includes a cylindrical section 82a having the water temperature sensor 84 located in the upper area thereof and the thermostat 83 located in a lower area thereof. The air discharge hole 87 is formed outer to the cylindrical section 82a in the radial direction of the cylindrical area 82a. The thermostat device 80 is located such that the cylindrical section 82a is inclined with respect to the vertical line and thus the area in which the air discharge hole 87 is formed is located at a high position. Since the thermostat device 80 is located to be inclined with respect to the vertical line, the height of the thermostat device 80 can be smaller as compared with the case where the thermostat device 80 is located in the vertical line. The thermostat device 80 can be easily located in a space having a limited height. Since the thermostat device 80 is thus inclined, air can be smoothly discharged through the air discharge hole 87. Thus, the detection precision of the water temperature sensor 83 can be improved.

[0095] As shown in FIG. 3, the engine 11 includes the cylinder 23a having a cylinder axial line CL extending forward as seen in the plan view. The cylindrical section 82a of the housing 82 in the thermostat device 80 is located parallel to the cylinder axis line CL as seen in the plan view. The thermostat device 80 does not protrude leftward or rightward. Therefore, although the thermostat device 80 is located laterally to the cylinder head 24, the engine 11 and the thermostat device 80 have a small total length in the left-right direction.

[0096] As shown in FIG. 2, the water injection section 56 of the radiator 50 is located above the air discharge hole 87 of the thermostat device 80, and the air discharge hole 87 and the water injection section 56 are connected to each other via the hose 73. Since the air contaminating the cooling water moves to a high position because of buoyancy, the air in the thermostat device 80 is naturally discharged to the water injection section 56 via the hose 73. Thus, the air in the thermostat device 80 can be easily discharged. No special work is needed for air discharge.

[0097] Occasionally, a portion of the cooling water may be discharged from the air discharge hole 87 together with the air. However, such a portion of the cooling water is sent to the radiator 50 via the hose 73 and the water injection section 56. Therefore, even if a portion of the cooling water is discharged from the air discharge hole 87, such a portion of the cooling water stays in the circulation path. Even if a portion of the cooling water is discharged from the air discharge hole 87, this does not decrease the amount of the cooling water in the circulation path.

[0098] As shown in FIG. 3, the thermostat device 80 is located to the right of the cylinder head 24. The radiator 50 is located to the right of the crankcase 22 so as to be located on a line extended from the crankshaft 21. As seen in the plan view, both of the thermostat device 80 and the radiator 50 are located to the right of the cylinder axis line CL. Therefore, the hose 71 for connecting the

outlet opening 86 of the thermostat device 80 and the flow inlet 54 of the radiator 50 to each other can be short. Thus, the thermostat device 80 can be located in a small space. In addition, the hose 73 for connecting the air discharge hole 87 of the thermostat device 80 and the water injection section 56 of the radiator 50 to each other can be short. In this embodiment, both of the thermostat device 80 and the radiator 50 are located to the right of the cylinder axis line CL. Alternatively, the thermostat device 80 and the radiator 50 may be located to the left of the cylinder axis line CL as seen in the plan view.

[0099] As shown in FIG. 3, as seen in the plan view, the thermostat device 80 is located in an area enclosed by the cylinder head 24, the cylinder body 23, the crankcase 22 and the hose 72. Thus, the thermostat device 80 is located in a small space.

[0100] As shown in FIG. 3, the thermostat device 80 and the water pump 35 are respectively located to the right of, and to the left of, the cylinder head 24. The hose 72, which is connected to the radiator 50, passes below the cylinder head 24 and is connected to the water pump 35. Owing to such an arrangement, the engine 11 can be located in a small space.

[0101] In this embodiment, the thermostat device 80 is located to the right of the cylinder head 24, and the water pump 35 is located to the left of the cylinder head 24. The positions of the thermostat device 80 and the water pump 35 may be opposite to the above. Namely, the thermostat device 80 may be located to the left of the cylinder head 24, and the water pump 35 may be located to the right of the cylinder head 24. Alternatively, both of the thermostat device 80 and the water pump 35 may be located to the left of, or to the right of, the cylinder head 24.

[0102] As seen in the plan view, the hose 73 is located in an area enclosed by the cylinder head 24, the cylinder body 23, the crankcase 22 and the hose 72 and also in an area above the crankcase 22, which is continued from the above-mentioned enclosed area. Thus, the hose 73 for discharging air from the thermostat device 80 can be located in a small space.

[0103] A portion of the hose 73 and a portion of the hose 71 overlap each other in the up-down direction. The hose 73 and the hose 71 can have a small total width in the left-right direction, and can be located in a small space.

[0104] As shown in FIG. 2, the ignition plug 28 is inserted into a lateral surface of the cylinder head 24. As seen in the side view, the thermostat device 80 is located rearward to the ignition plug 28. The thermostat device 80 is located so as not to overlap the ignition plug 28 as seen in the side view. Therefore, for removing the ignition plug 28 from the cylinder head 24 for maintenance, the thermostat device 80 is not likely to be an obstacle. The provision of the thermostat device 80 is prevented from making difficult a maintenance work on the ignition plug 28.

[0105] The engine 11 is swingable with respect to the body frame 2 about the pivot shaft 13. In the case of the

engine 11 swinging with respect to the body frame 2, the cylinder body 23 and the cylinder head 24 swing especially significantly along with the swing of the engine 11. Therefore, the cylinder body 23, the cylinder head 24 and the components in the vicinity thereof need to be reduced in size. This is why the above-described effect of size reduction is conspicuous for the motorcycle 1 including the swingable engine 11 as in this embodiment.

[0106] Especially in this embodiment, a lower portion of the engine 11 is swingably supported by the pivot shaft 13. As shown in FIG. 2, as seen in the side view, the pivot shaft 13 is located below the cylinder axis line CL, and the thermostat device 80 is located above the cylinder axis line CL. With such a structure, an upper portion of the engine 11 swings by a larger amount than the lower portion thereof. The thermostat device 80 attached to the upper portion of the cylinder head 24 swings larger. This is why in this embodiment, the above-described effect of size reduction is conspicuous.

[0107] An embodiment of the present invention has been described. The present invention may be carried out in various other forms.

[0108] The hose 71 and the hose 72 may each any path which can transport the cooling water, and there is no specific limitation on the material thereof. Instead of flexible hoses 71 and 72, non-flexible pipes or the like may be used. This is also applicable to the hose 73.

[0109] In the above embodiment, the engine 11 is a single-cylinder engine. Alternatively, the engine according to the present invention may be a multi-cylinder engine.

[0110] In the above embodiment, the radiator 50 is located laterally to the crankcase 22, but the radiator 50 may be located at a different position.

[0111] In this specification, the term "cooling water" is a generic term of a liquid which can cool the engine 11. The "cooling water" does not need to be water, and may be an aqueous solution, or any other coolant.

Claims

1. A saddle type vehicle, comprising:

- a body frame;
- an engine supported by the body frame, and having therein a flow inlet through which cooling water flows in and a flow outlet through which the cooling water flows out;
- an injector for supplying fuel to the engine;
- a radiator having therein a flow inlet through which the cooling water flows in and a flow outlet through which the cooling water flows out;
- a first cooling water path for connecting the flow outlet of the engine and the flow inlet of the radiator to each other;
- a second cooling water path for connecting the flow inlet of the engine and the flow outlet of the

radiator to each other;

a thermostat device including a housing having therein a flow path through which the cooling water flows, a thermostat located in the housing, and a water temperature sensor located in the housing above the thermostat, the thermostat device being located in the first cooling water path; and

a control device for controlling the injector based on a temperature detected by the water temperature sensor;

wherein:

the housing of the thermostat device has therein an air discharge hole for communicating inside and outside of the flow path to each other; and the thermostat device is located such that the air discharge hole and at least a portion of the water temperature sensor are located above the flow outlet of the engine, and such that at least a portion of the thermostat is located below the flow outlet of the engine.

2. A saddle type vehicle according to claim 1, wherein:

the housing of the thermostat device has therein an inlet opening through which the cooling water flows in and an outlet opening through which the cooling water flows out; and the thermostat device is attached to the engine such that the inlet opening of the housing and the flow outlet of the engine are connected to each other.

3. A saddle type vehicle according to claim 1, wherein:

the housing includes a cylindrical section having the water temperature sensor located in an upper area thereof and having the thermostat located in a lower area thereof; the air discharge hole is formed outer to the water temperature sensor in a radial direction of the cylindrical section; and the thermostat device is located such that the cylindrical section is inclined with respect to the vertical line and thus an area in which the air discharge hole is formed is located at a high position.

4. A saddle type vehicle according to claim 3, wherein:

the engine includes a cylinder having a cylinder axis line extending forward as seen in a plan view; and the cylindrical section is located parallel to the cylinder axis line as seen in the plan view.

5. A saddle type vehicle according to claim 1, wherein:

the radiator includes a radiator main body having therein the flow inlet and the flow outlet, and a water injection section formed to have a cylinder shape protruding upward from the radiator main body, the water injection section receiving the cooling water injected thereinto;

the water injection section is located above the air discharge hole of the thermostat device; and the saddle type vehicle further includes an air discharge path for connecting the air discharge hole of the thermostat device and the water injection section of the radiator to each other.

6. A saddle type vehicle according to claim 1, wherein:

the engine includes a crankcase for accommodating a crankshaft; a cylinder body connected to the crankcase, having a cylinder therein, and extending forward as seen in a plan view; and a cylinder head connected to a tip portion of the cylinder body and having therein the flow outlet; the housing of the thermostat device has therein an inlet opening through which the cooling water flows in and an outlet opening through which the cooling water flows out;

the thermostat device is attached to a lateral surface of the cylinder head such that the inlet opening of the housing and the flow outlet of the engine are connected to each other;

the radiator is located laterally to the crankcase so as to be located on a line extended from the crankshaft; and

both of the thermostat device and the radiator are located to the left of, or to the right of, a cylinder axis line as seen in the plan view.

7. A saddle type vehicle according to claim 6, further comprising a water pump attached to the cylinder head; wherein :

the second cooling water path has a path for connecting the radiator and the water pump to each other; and

as seen in the plan view, the thermostat device is located in an area enclosed by the cylinder head, the cylinder body, the crankcase, and the path of the second cooling water path.

8. A saddle type vehicle according to claim 7, wherein:

as seen in the plan view, among a position to the left of the cylinder head and a position to the right of the cylinder head, the thermostat device is located at one of the positions and the water pump is located at the other position; and at least a portion of the path of the second cool-

ing water path is located below the cylinder head.

9. A saddle type vehicle according to claim 6, further comprising:

an air discharge path for connecting the air discharge hole of the thermostat device and the radiator to each other; and
a water pump attached to the cylinder head;

wherein:

the second cooling water path has a path for connecting the radiator and the water pump to each other; and
as seen in the plan view, the air discharge path is located in an area enclosed by the cylinder head, the cylinder body, the crankcase and the path of the second cooling water path and also in an area above the crankcase, which is continued from the enclosed area.

10. A saddle type vehicle according to claim 9, wherein:

as seen in the plan view, among a position to the left of the cylinder head and a position to the right of the cylinder head, the thermostat device is located at one of the positions and the water pump is located at the other position; and
at least a portion of the path of the second cooling water path is located below the cylinder head.

11. A saddle type vehicle according to claim 6, further comprising an air discharge path for connecting the air discharge hole of the thermostat device and the radiator to each other;
wherein a portion of the air discharge path and a portion of the first cooling water path overlap each other in an up-down direction.

12. A saddle type vehicle according to claim 1, wherein:

the engine includes a crankcase for accommodating a crankshaft; a cylinder body connected to the crankcase, having a cylinder therein, and extending forward as seen in a plan view; and a cylinder head connected to a tip portion of the cylinder body and having therein the flow outlet;
the housing of the thermostat device has therein an inlet opening through which the cooling water flows in and an outlet opening through which the cooling water flows out;
the thermostat device is attached to a lateral surface of the cylinder head such that the inlet opening of the housing and the flow outlet of the engine are connected to each other;

an ignition device is inserted into a lateral surface of the cylinder head; and
the thermostat device is located at such a position that does not overlap the ignition device as seen in a side view.

13. A saddle type vehicle according to claim 1, wherein the engine is swingably supported by the body frame via a pivot shaft.

14. A saddle type vehicle according to claim 13, wherein:

the engine includes a cylinder having a cylinder axis line extending obliquely upward and forward as seen in a side view;
the pivot shaft is located below the cylinder axis line as seen in the side view; and
the thermostat device is located above the cylinder axis line as seen in the side view.

FIG.1

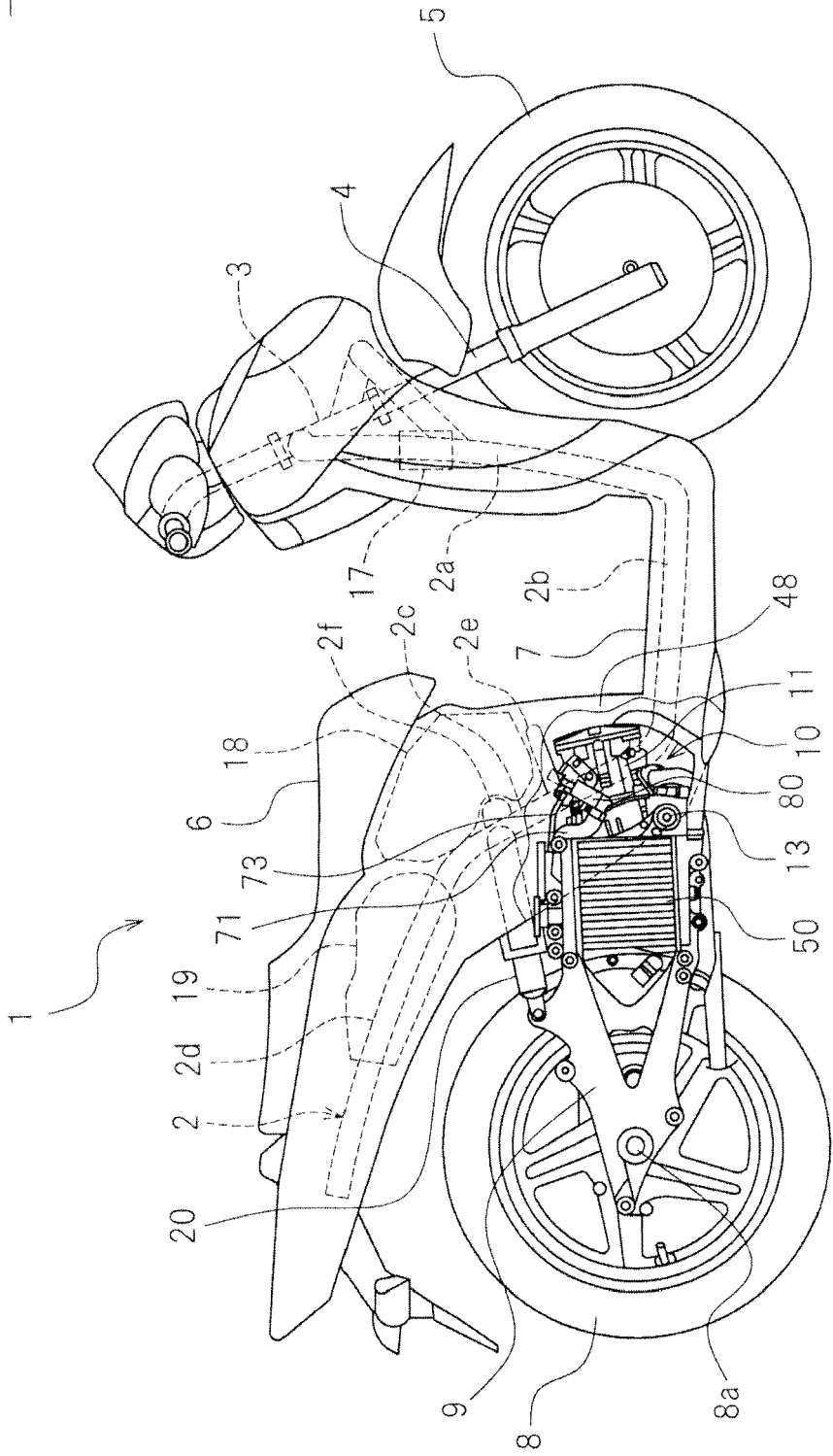


FIG. 2

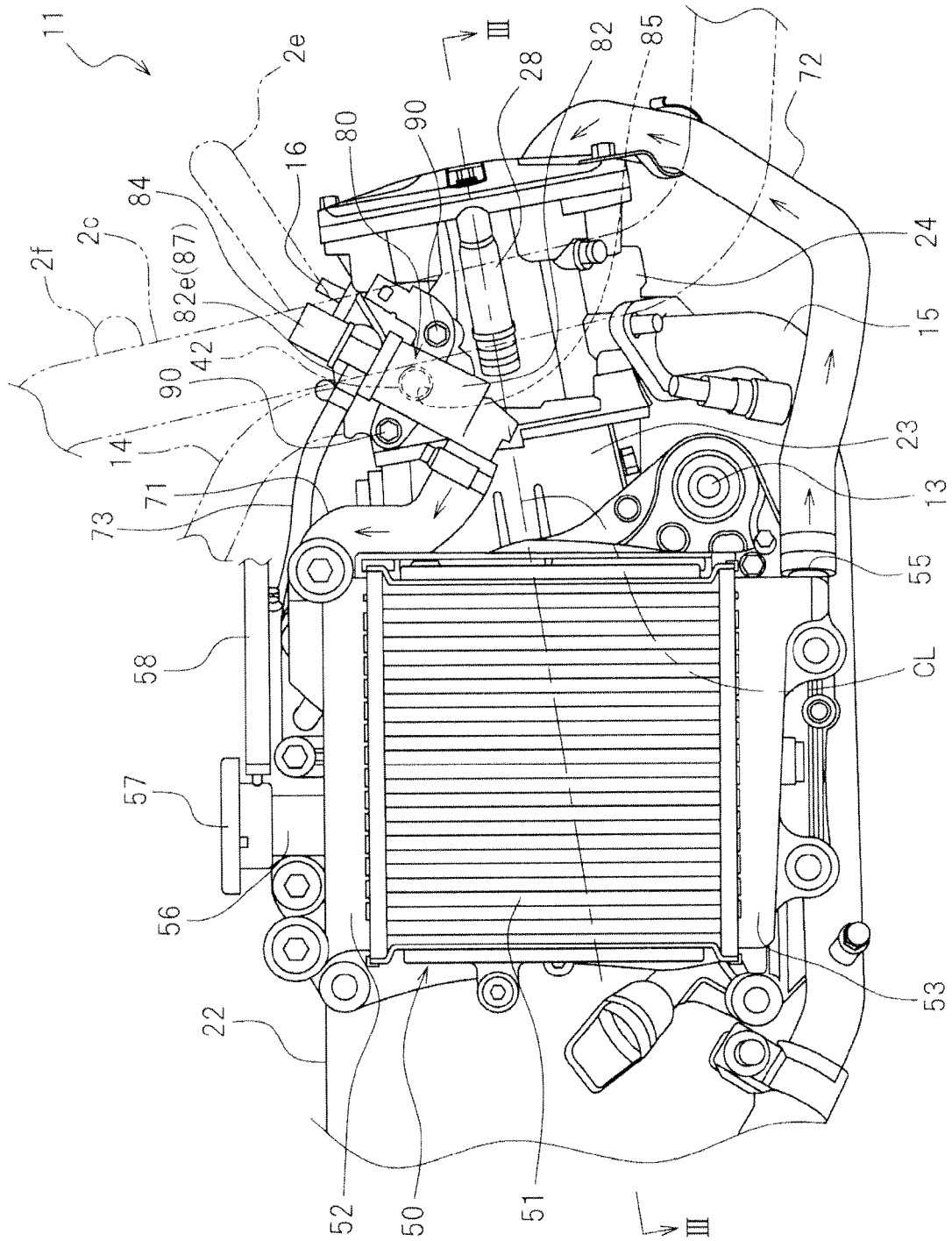


FIG.3

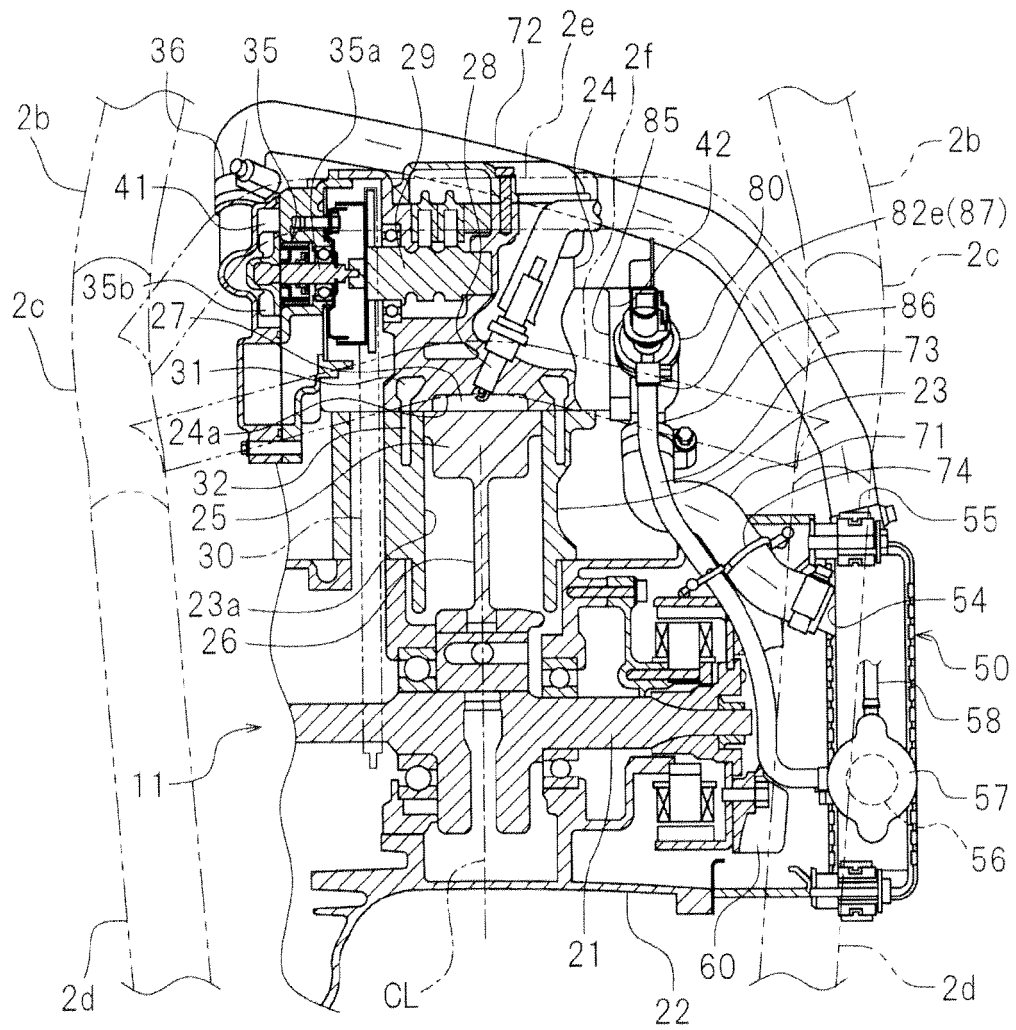


FIG.4

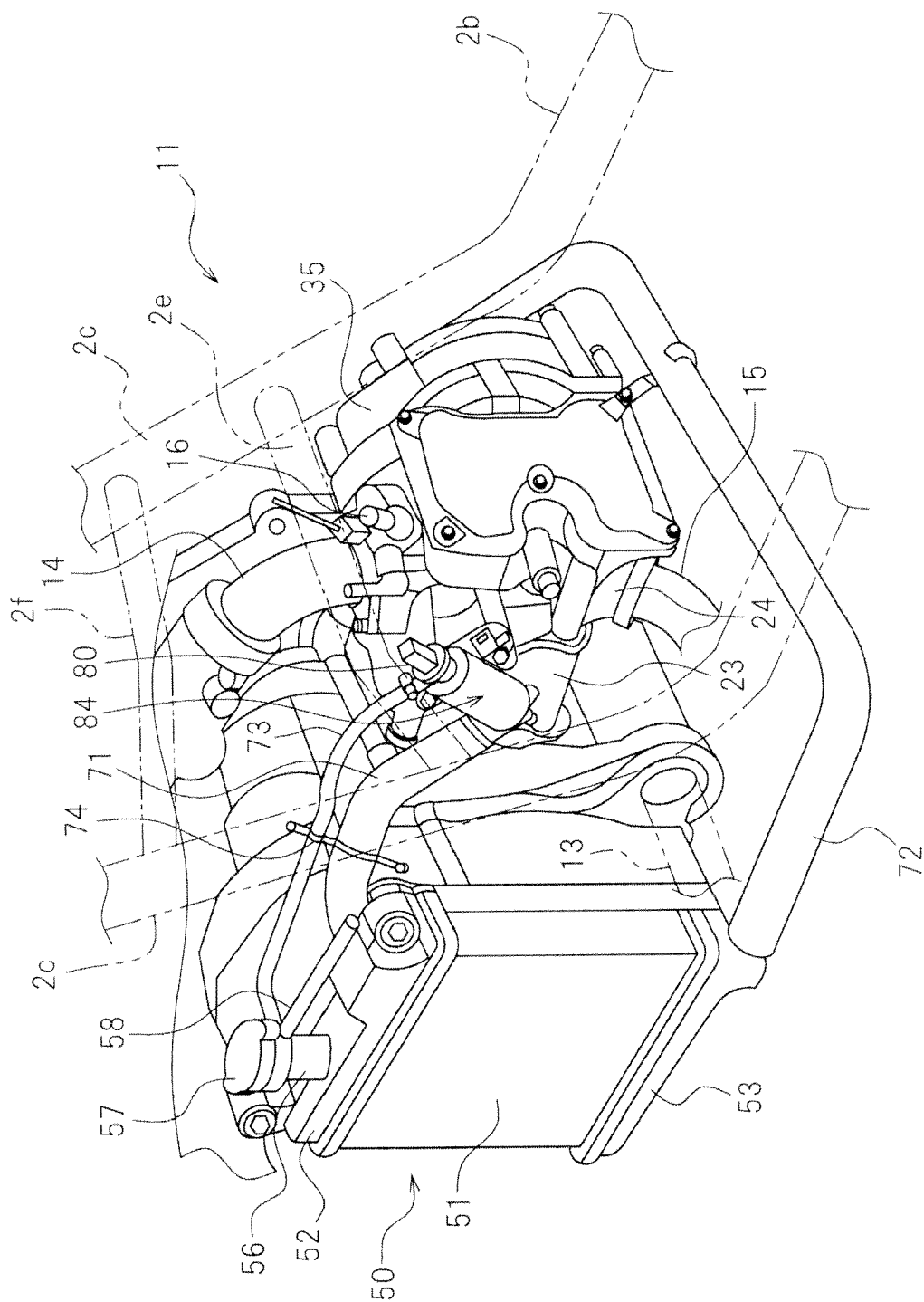


FIG.5

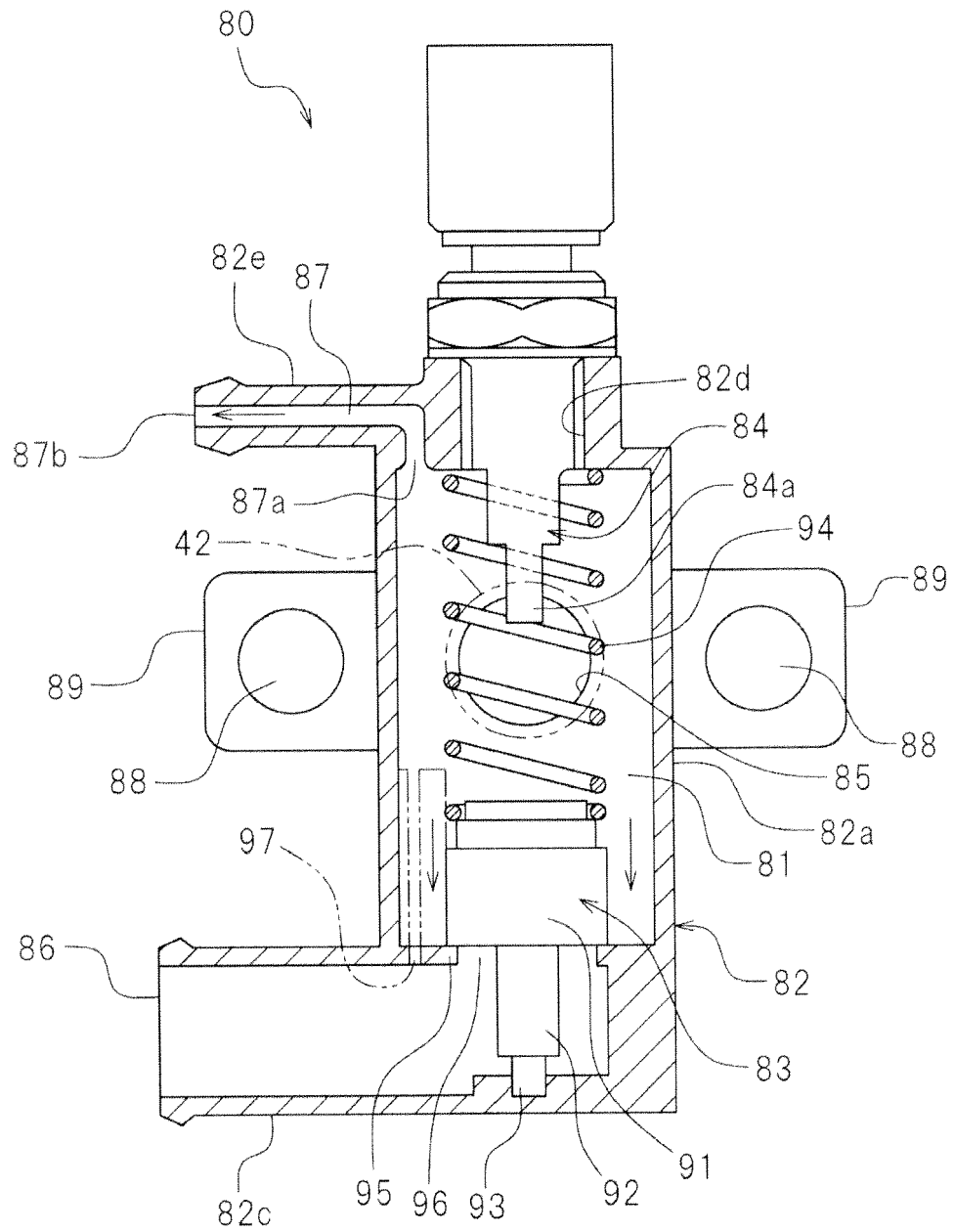


FIG.6

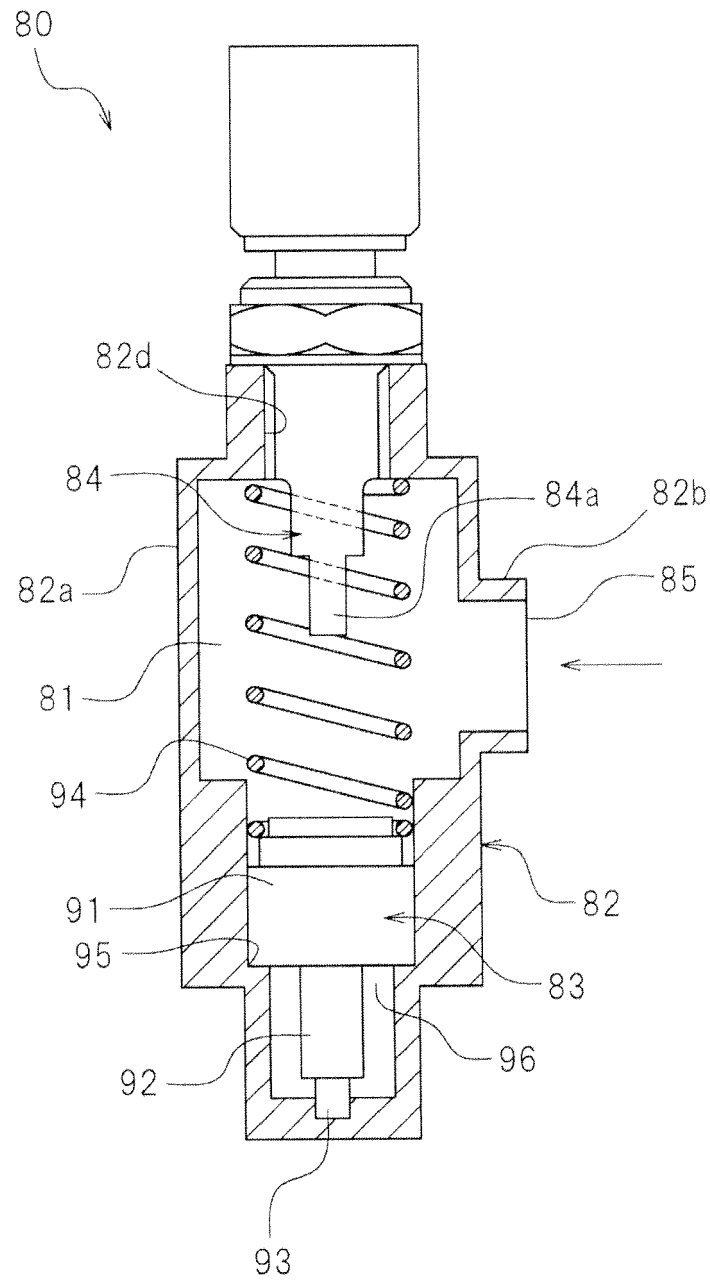


FIG. 7

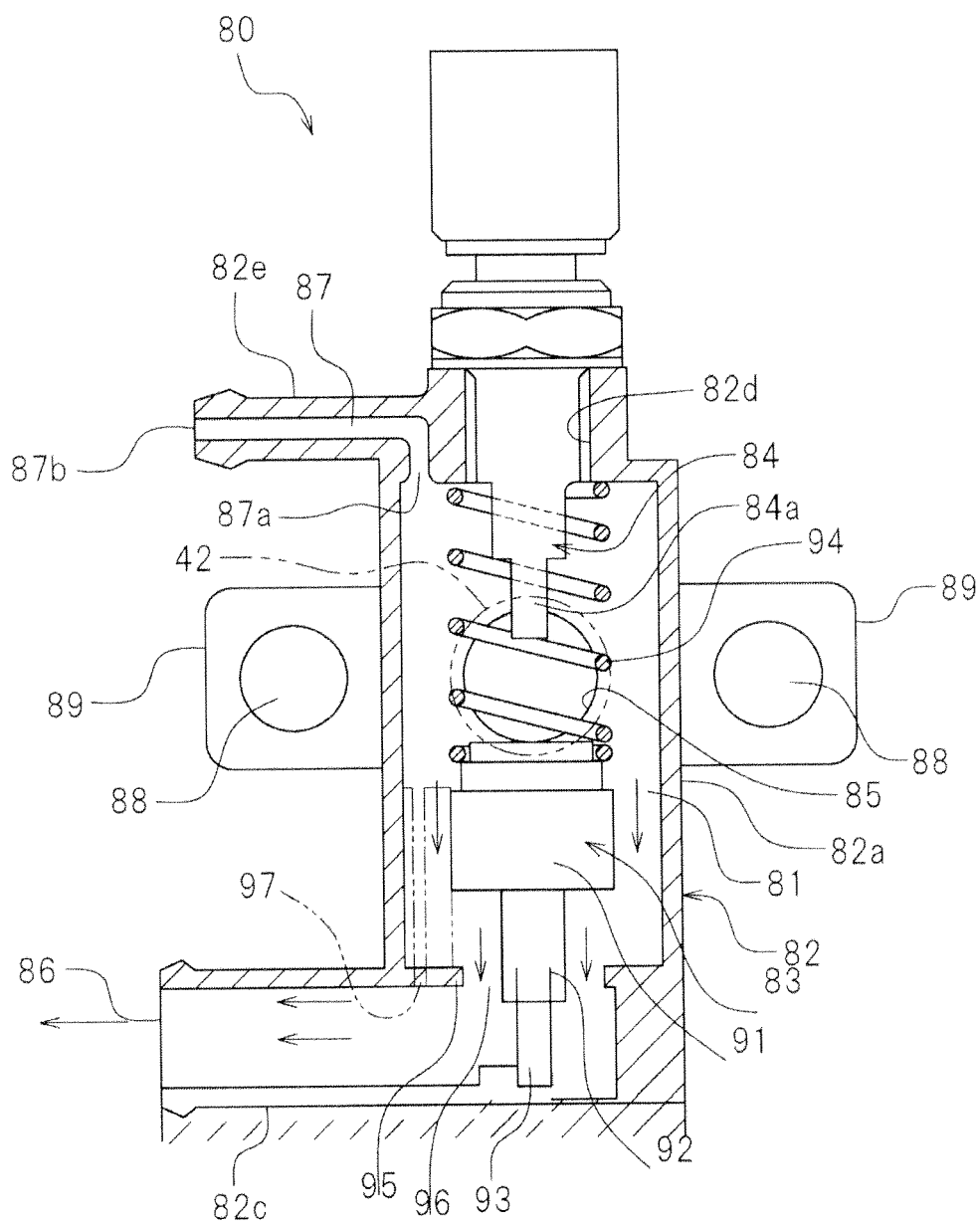
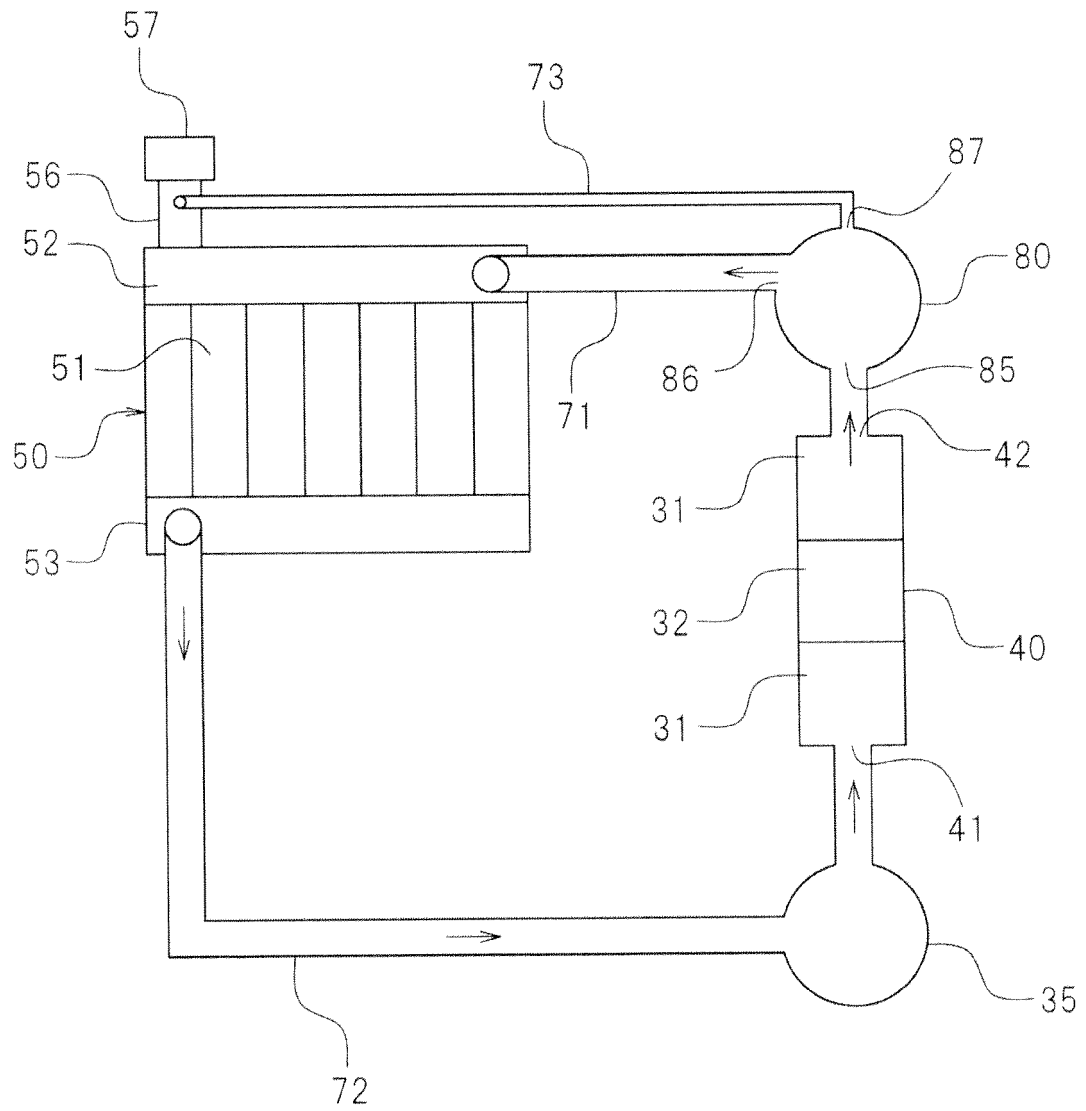


FIG.8





EUROPEAN SEARCH REPORT

Application Number
EP 12 18 5122

DOCUMENTS CONSIDERED TO BE RELEVANT			
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