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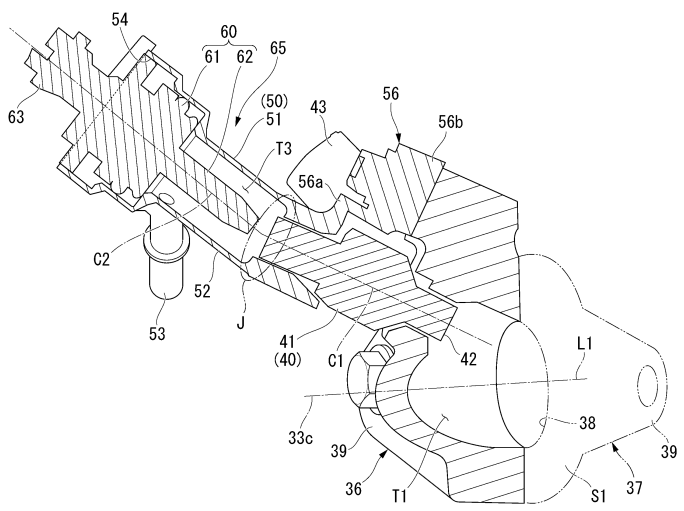
(54) FUEL SUPPLY DEVICE

(57) A fuel supply device includes: a main frame 22 disposed above an engine 10 in a vehicle vertical direction and extending in a first direction (front-rear direction of the vehicle) as viewed from the vehicle vertical direction; an injector injecting fuel to be supplied to the engine 10, a fuel chamber portion 50 connected to the injector and accumulating fuel to be supplied to the injector, and a heater device 60 connected to the fuel chamber portion 50 and heating the fuel accumulated in the fuel chamber portion 50. The heater device 60 is disposed to be offset with respect to the main frame 22 in a second direction (vehicle left-right direction) that is orthogonal to the first direction as viewed from the vehicle vertical direction.

FIG. 6



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a fuel supply device.

Description of Related Art

[0002] In the past, efforts to mitigate or reduce the effects of climate change have continued, and research and development on reducing carbon dioxide emissions has been conducted to achieve this goal.

[0003] For example, Patent Document 1 below discloses an injector, a fuel joint (fuel chamber portion) that supplies fuel to a fuel supply port of the injector and holds the injector, and a heater device that is attached to the fuel joint and has a rod-shaped heater portion for heating the fuel in the fuel joint. The injector and the heater portion are disposed with their axis lines parallel and coaxial to each other.

[0004] [Patent document 1] Japanese Patent No. 4834728

SUMMARY OF THE INVENTION

[0005] In order to reduce the amount of carbon dioxide emissions, when the above conventional technology is applied as is to compact equipment such as motorcycles, it is necessary to compactly accommodate a raising temperature portion including a heater device while securing clearances with peripheral parts, and ingenuity is desired.

[0006] Aspects according to the present invention have been made in view of the above-described problems, and an objective thereof is, in a fuel supply device in which a raising temperature portion that heats fuel is connected to an injector, to make an equipment itself compact by disposing an internal combustion engine and a frame member close to each other while securing a clearance between the raising temperature portion and the frame member. And, by extension, it contributes to the mitigation or impact reduction of climate change.

[0007] In order to solve the above-described problem and achieve the objective, the present invention employs the following aspects.

<1> A fuel supply device according to one aspect of the present invention includes: an internal combustion engine (10) mounted in an equipment (1); a frame member (22) of the equipment (1) disposed above the internal combustion engine (10) in a vertical direction of the equipment (1) and extending in a first direction as viewed from the vertical direction; an injector (40) that injects fuel to be supplied to the internal combustion engine (10); a fuel chamber portion (50) that is connected to the injector (40) and accumulates fuel to be supplied to the injector (40); a heater device (60) that is connected to the fuel chamber portion (50) and heats the fuel accumulated in the fuel chamber portion (50), wherein the heater device (60) is disposed to be offset with respect to the frame member (22) in a second direction orthogonal to the first direction as viewed from the vertical direction.

According to this configuration, since the frame member of the equipment is disposed above the internal combustion engine and the heater device connected to the injector is disposed to be offset in the width direction (the second direction) that is orthogonal to the longitudinal direction (the first direction) of the frame member as viewed from the vertical direction, the clearance between the heater device and the frame member can be easily secured. This improves the degree of freedom of disposition of the heater device relative to the frame member in the vertical direction and ensures maintainability of the heater device from above. While securing the clearance between the heater device and the frame member, the internal combustion engine and the frame member can be disposed close to each other, and the equipment itself can be made compact.

<2> In the above aspect <1>, the heater device (60) and the frame member (22) may be disposed to overlap each other as viewed from the second direction.

According to this configuration, the heater device and the frame member are disposed to overlap each other in the vertical direction, thereby efficiently disposing the configuration in which the fuel chamber portion and the heater device are connected to the injector.

<3> In the above aspect <1> or <2>, wherein the first direction may be a front-rear direction of the device (1) and the second direction may be a left-right direction of the device (1), the frame member (22) may extend in the front-rear direction along a left-right center (CL) of the equipment (1), an intake passage (TA) of the internal combustion engine (10) may be disposed to be offset to one side in the left-right direction relative to the left-right center (CL).

According to this configuration, the intake passage of the internal combustion engine is disposed to be offset to one side in the left-right direction, which facilitates the disposition of the injector and the heater device provided in the intake passage to one side in the left-right direction and facilitates the disposition of the heater device offset to the frame member.

[0008] According to the present invention, in the fuel supply device in which the raising temperature portion that heats the fuel is connected to the injector, the equipment itself can be made compact by disposing the internal combustion engine and the frame member close to each other while securing the clearance between the

raising temperature portion and the frame member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a right side view of a motorcycle in an embodiment of the present invention.
FIG. 2 is an enlarged view of a main part of FIG. 1.
FIG. 3 is a top view of an area around an intake passage part of the above motorcycle.
FIG. 4 is a top view removing some parts from FIG. 3.
FIG. 5 is a perspective view of an injector, a fuel chamber portion, and a heater device attached to the intake passage part.
FIG. 6 is a cross-sectional view of the injector and the fuel chamber portion along their respective center axis lines.

DETAILED DESCRIPTION OF THE INVENTION

[0010] Hereinafter, embodiments of the present invention will be described with reference to the drawings. In the following description, directions such as forward, rearward, left, and right are the same as directions in a vehicle to be described below unless otherwise specified. In the drawings used in the following explanations, an arrow FR indicating a front of a vehicle, an arrow LH indicating a left side of the vehicle, an arrow UP indicating an upper side of the vehicle, and a line CL indicating a left-right center of a vehicle body are indicated at appropriate places in the drawings.

<Entire Vehicle>

[0011] As shown in FIG. 1, this embodiment is applied to a motorcycle 1, which is a saddle-riding vehicle. A front wheel 2 of the motorcycle 1 is supported by lower ends of a pair of left and right front forks 3. The upper portions of the left and right front forks 3 are supported by a head pipe 21 at a front end of a vehicle body frame 20 via a steering stem 4. A bar handle 6 for steering is attached to an upper portion of the steering stem 4.

[0012] A rear wheel 7 of the motorcycle 1 is supported by a rear end of a swing arm 8. A front end of the swing arm 8 is supported by a pivot frame 23 at a front-rear middle section of the vehicle body frame 20. The term "middle" as used in this embodiment means not only a center between two ends of subjects, but also an inner range between the two ends of the subjects. The rear wheel 7 is connected to a power unit PU of the motorcycle 1 via a chain-type transmission mechanism disposed, for example, on the left side of the rear of the vehicle body.

[0013] The power unit PU is an integrated unit that includes an engine (internal combustion engine) 10 which is the prime mover of the motorcycle 1, and a clutch and a transmission (both not shown) that disconnect and shift an output of the engine 10, and is fixedly supported on the vehicle body frame 20.

[0014] The engine 10 has a cylinder 12 standing above a front of a crankcase 11. An intake passage part 32 is connected to a rear of the cylinder 12. An exhaust pipe 14 is connected to a front of the cylinder 12. The exhaust pipe 14 is routed from the front of the engine 10 downwardly, e.g., to the right rear, and is connected to an exhaust muffler 14a disposed at the rear right side of the vehicle body.

[0015] A fuel tank 15 that stores fuel to be supplied to the engine 10 is disposed above the engine 10. A seat 16 on which a driver and a rear passenger sit is disposed behind the fuel tank 15. A pair of main steps 17 on each side on which legs of the driver are placed, and a pair of pillion steps 18 on each side on which legs of the rear passenger are placed, are disposed on both sides of a lower part of the vehicle body.

<Vehicle Body frame>

[0016] Referring to FIG. 1, the vehicle body frame 20 is configured by integrally connecting multiple types of steel materials by welding or the like.

[0017] The vehicle body frame 20 includes: a single head pipe 21 of which an axis is disposed in the center of the left and right sides of the vehicle body; a single main frame 22 which extends from the top of the head pipe 21 rearwardly and downwardly along the center of the left and right sides of the vehicle body; a single pivot frame 23 which extends from the rear lower end of the main frame 22 rearwardly and downwardly along the center of the left and right sides of the vehicle body at a relatively steep inclination; and a single down frame 27 which extends from the lower part of the head pipe 21 rearwardly and downwardly along the center of the left and right sides of the vehicle body at a steeper angle than the main frame 22.

[0018] The vehicle body frame 20 has a pair of left and right seat rails 25 joined at the front end thereof to the rear of the main frame 22 and extending rearwardly and substantially horizontally from the front end, and a pair of left and right support frames 26 joined at the front end thereof to the upper and lower middle section of the pivot frame 23 and extending upwardly and rearwardly and rising rearwardly from the front end. The rear ends of the left and right support frames 26 are joined from below to the front and rear middle sections of the left and right seat rails 25, respectively.

[0019] The main frame 22, the pivot frame 23, the down frame 27, and the left and right seat rails 25 are each constructed by combining pressed frame bodies formed by pressing steel plates.

[0020] Referring to FIG. 3, the main frame 22 is constructed by a pair of left and right main pressed frame bodies 22L, 22R joined together. The left and right main pressed frame bodies 22L, 22R are each one-piece steel sheet press-formed parts, and each has a bulging shape that expands outwardly in the vehicle width direction (out-

wardly in the left-right direction). Joint flanges 22b are bent and extended from both ends of the bulging shape, respectively. These joint flanges 22b are abutted to each other in the vehicle width direction and are joined together by spot welding or other means to form the integrated main frame 22 having a closed cross-sectional structure with the left and right bulging shapes facing each other.

[0021] The pivot frame 23, the down frame 27, and the left and right seat rails 25 also have generally the same closed cross-portion structure, and detailed descriptions are omitted. The support frame 26 is made of square steel tubes, for example.

[0022] The vehicle body frame 20 is not limited to a combination of pressed frame bodies, but may be made of steel tubes. The down frame 27 is not limited to a single frame, but may be a pair of left and right frames.

<Engine>

[0023] Referring to FIGS. 1 and 2, the engine 10 is an air-cooled single-cylinder engine with a center axis line of rotation (crankshaft axis line) of a crankshaft (not shown) along the left-right direction (vehicle width direction). The engine 10 has the cylinder 12 standing at the front upper end of the crankcase 11 in a forward inclined posture. In addition to gasoline, the engine 10 can be operated using ethanol or a fuel mixture of gasoline and ethanol (hereinafter collectively referred to as ethanol fuel). In other words, the motorcycle 1 is a flexible fuel motorcycle (FFM) that can run on multiple types of fuel.

[0024] The cylinder 12 has, in order from the crankcase 11 side, a cylinder main body 12a, a cylinder head 12b, and a head cover 12c. A piston (not shown) is fitted inside the cylinder main body 12a, and the reciprocating motion of the piston is converted into the rotational motion of the crankshaft in the crankcase 11. The rotational power of the crankshaft is output to the left side of the rear of the crankcase 11 via a clutch and a transmission (both not shown) in the rear of the crankcase 11. The output rotational power is transmitted to the rear wheels 7 via a chain-type transmission mechanism.

[0025] At a rear (intake side) of the cylinder head 12b, a downstream end of the intake passage part 32 including the throttle body 33 is connected. A reference sign 34 in the drawings indicates an air cleaner box to which an upstream end of the intake passage part 32 is connected, a reference sign 35 indicates a connecting tube connecting the throttle body 33 to the air cleaner box 34, and a reference sign 36 indicates an intake pipe member connecting the throttle body 33 to the cylinder head 12b. The connecting tube 35 and the intake pipe member 36 are included in the intake passage part 32.

[0026] The air cleaner box 34 is disposed within a triangular-shaped region R1 (see FIG. 1) in a side view surrounded by the pivot frame 23, the seat rail 25 and the support frame 26. An outer side of the region R1 in the vehicle width direction is covered by a side cover 19 as a vehicle body cover.

<Fuel Supply Device>

[0027] Here, the motorcycle 1 configures a fuel supply device including a fuel tank 15, a fuel pump (not shown), a fuel hose (not shown), an injector (fuel injection valve) 40, and the like.

[0028] Referring to FIGS. 1, 2, and 6, fuel from the fuel tank 15, for example, is sucked into the fuel pump disposed in the fuel tank 15 and discharged downstream. The fuel discharged from the fuel pump is supplied to the chamber room T3 of the fuel chamber portion 50 connected to the injector 40. A heater portion 62 faces the chamber room T3 and can heat the fuel accumulated in the chamber room T3.

[0029] The injector 40 is operated and controlled by an ECU (Electric Control Unit) and injects fuel into the intake passage part 32 in response to an output of a throttle sensor and other sensors.

[0030] Referring to FIGS. 3 and 4 together, the intake passage part 32 including the throttle body 33 is generally disposed to be biased on one side (right side in the embodiment) in the left-right direction in relation to the left-right center CL of the vehicle body.

[0031] Referring to FIGS. 4 to 6, a port opening portion 37 forming an opening of an intake port to the outside of the cylinder (external opening 38) is provided at the rear of the cylinder head 12b. The port opening portion 37 forms a plane S1 with a normal direction L1 (along the normal direction L1) sloping backward and outward in the vehicle width direction, and the external opening 38 along the plane S1. The external opening 38 of the intake port has an oblique opening toward the normal direction L1 (backward and toward the outside of the vehicle width direction).

[0032] The front end (downstream end) of the intake pipe member 36 is fixed to the port opening portion 37. The intake pipe member 36 forms a first intake passage T1 extending rearwardly generally along the normal direction L1 of the plane S1 of the port opening portion 37. In detail, the first intake passage T1 extends in a straight line inclined with respect to the front-rear direction of the vehicle toward the normal direction L1 of the aforementioned plane S1 of the intake port in the top view of the vehicle (hereinafter simply referred to as the top view). The first intake passage T1 extends generally in a straight line (in detail, in a slightly upward convex curve) inclined rising backward and upward with respect to the front-rear direction of the vehicle in the side view. The intake pipe member 36 is secured to the port opening portion 37 by a pair of fasteners 39 positioned across the external opening 38.

[0033] Referring to FIGS. 2 to 4, the front end (downstream end) of the throttle body 33 is connected to the rear end (upstream end) of the intake pipe member 36. A cylindrical main body 33a of the throttle body 33 forms a second intake passage T2 that is linearly connected upstream of the first intake passage T1 in the intake pipe member 36. A center axis line (bore center axis line 33c)

of the second intake passage T2 in the throttle body 33 extends backward in the side view in a straight line with a slight rear rising, and extends backward in the top view with a slope backward and outward in the vehicle width direction as in the normal direction L1 of the above plane S1 of the intake port.

[0034] A butterfly valve 33d as a throttle valve is rotatably supported in the main body 33a of the throttle body 33. A rotation center axis line of the butterfly valve 33d, 33d1 is disposed horizontally and orthogonal to the bore center axis line 33c. One end (right end) of a valve rotation axis protrudes outside the main body 33a, a pulley 33e is integrally rotatable attached to this protrusion, and this pulley 33e is driven by an operation cable 33f. The intake passage (including the first intake passage T1 and the second intake passage T2) formed by the intake passage part 32 as a whole is hereinafter referred to as the intake passage TA (see FIG. 1). A line 33v in FIG. 2 is a straight line orthogonal to the rotation center axis line 33d1 and the bore center axis line 33c, and a direction along this line 33v is referred to as an orthogonal direction 33v.

<Injector>

[0035] Referring to FIGS. 5 and 6, the injector 40 is mounted on an upper front side of the intake pipe member 36.

[0036] The injector 40 has a cylindrical injector body 41, a valve portion (not shown) housed in the injector body 41, and an electromagnetic drive unit (not shown) that drives the valve portion. The injector body 41 forms a fuel flow path for circulating fuel inside. The fuel flow path is provided with the valve portion and a return spring (not shown). The valve portion closes the fuel flow path by a biasing force exerted by the return spring. As a result, the injector 40 is closed.

[0037] The electromagnetic drive unit is provided in the injector body 41 and forms a magnetic circuit. The electromagnetic drive unit causes the valve portion to be driven in an axial direction of the injector body 41 against the biasing force of the return spring to open the fuel flow path. As a result, the injector 40 is opened and fuel is injected into the first intake passage T1 from an injection port 42 at a tip of the injector body 41. A coupler 43 is provided to protrude from an outer circumference of the injector body 41 for connecting a power supply harness for driving the valve. The coupler 43 protrudes on one side (right side, in the offset direction of the intake passage component 32) in the left-right direction.

[0038] The injector 40 is disposed to be inclined so that a center axis line C1 along a longitudinal direction (longitudinal direction of the injector body 41) is positioned upper as it goes to the rear side (upstream side) (is away from the intake pipe member 36 and the throttle body 33). Hereafter, the longitudinal direction of the injector 40 is referred to as a first longitudinal direction and the center axis line C1 of the injector 40 is referred to as a first center axis line C1. The upper rear side of the injector 40 (opposite the injection port 42) corresponds to the upstream side of the injector 40.

[0039] A rearwardly extended portion of the injector 40 in the first longitudinal direction is provided with a fuel chamber portion 50 that accumulates fuel supplied to the injector 40 and a heater device 60 that heats (raises the temperature of) the fuel in the fuel chamber portion 50. The fuel chamber portion 50 and the heater device 60 configures a raising temperature portion 65 that raises the temperature of the fuel supplied to the injector 40.

[0040] The fuel chamber portion 50 has a chamber case 51. The chamber case 51 has a cylindrical shape open to the upper rearward and forms a chamber room T3 as an internal space. A nozzle 53 for connecting the fuel hose is provided to be protruded on an outer circumference of an axial midsection (not necessarily in the center) of an outer peripheral wall 52 of the chamber case 51. The nozzle 53 protrudes from the fuel chamber portion 50 to the other side (left side, opposite the offset direction of the intake passage part 32) in the left-right direction, and the fuel hose (not shown) is connected to the fuel pump while extending to the other side in the left-right direction.

[0041] An upper rear portion of the injector body 41 is fitted and connected to a lower front portion of chamber case 51. An opening portion 54 at an upper rear end of the chamber case 51 is closed by fitting a main body portion 61 of the heater device 60.

[0042] The heater device 60 has a rod-shaped heater portion 62 protruding from the main body portion 61 into the chamber room T3. The heater portion 62 is coaxially disposed with the chamber case 51. A coupler 63 is provided to be protruded at an upper rear end of the main body portion 61 for connecting a power feed harness for operating a heater.

[0043] Fuel supplied from the fuel hose is supplied and accumulated in the chamber room T3 and heated by the heat generated by the heater portion 62. The heated fuel reaches the injector body 41 of the injector 40 and is injected into the intake passage TA from the injection port 42 by driving the valve portion. In the ethanol-fueled engine 10, it is effective to inject heated fuel into the intake passage TA to promote vaporization of the injected fuel in order to improve a cold starting performance and to reduce harmful components in the exhaust gas.

[0044] Hereinafter, a longitudinal direction of the fuel chamber portion 50 (the longitudinal (axial) direction of the chamber case 51 and the heater portion 62) is referred to as a second longitudinal direction, and a center axis line of the fuel chamber portion 50 (a center axis line common to the chamber case 51 and the heater portion 62) is referred to as a second center axis line C2. The respective longitudinal directions of the chamber case 51 and the heater portion 62 are parallel to each other, and the respective center axis lines of the chamber case 51 and the heater portion 62 coincide with each other. The respective longitudinal directions of the chamber case 51 and the heater portion 62 may be non-parallel

to each other, or the respective center axis lines of the chamber case 51 and the heater portion 62 may be disposed out of alignment with each other.

[0045] The fuel chamber portion 50 is disposed to be inclined in an axial direction with respect to the injector 40. The second center axis line C2 of the fuel chamber portion 50 and the first center axis line C1 of the injector 40 intersect each other at a connection portion J between the fuel chamber portion 50 and the injector 40, but they need not necessarily intersect.

[0046] The first center axis line C1 of the injector 40 is inclined to rise backward and inclined backwardly to approach the center axis line of the intake passage TA (in this case the bore center axis line 33c).

[0047] The second center axis line C2 of the fuel chamber portion 50, similar to the first center axis line C1, is inclined to rise backward and inclined backwardly to approach the center axis line of the intake passage TA (in this case, the bore center axis line 33c).

[0048] The second center axis line C2 slopes relative to the first center axis line C1 further away from the throttle body 33 as it goes to the rear side (so that the fuel chamber portion 50 is rearwardly higher than the injector 40). The relative angle between the first center axis line C1 and the second center axis line C2 is, for example, less than 20 degrees to minimize the effect of too much standing up on the arrangement space of peripheral parts.

[0049] Referring to FIG. 4, the fuel chamber portion 50 is inclined further backward and upward with respect to the injector 40 to facilitate securing the clearance between it and the throttle body 33. An intake system component 33g, such as an idle air control valve (IACV), for example, is disposed on an upper surface of the throttle body 33, and the fuel chamber portion 50 is made to facilitate securing the clearance with respect to this intake system component 33g.

[0050] The main body portion 61 of the heater device 60 is disposed so that at least a part of it overlaps with the throttle body 33 in the top view.

If the entire main body portion 61 of the heater device 60 is disposed so that it overlaps the throttle body 33 in the top view, a disposition space of the heater device 60 does not expand in the horizontal direction, but a vertical clearance between the heater device 60 and the throttle body 33 becomes difficult to be secured.

[0051] On the other hand, when a part of the heater device 60 is disposed so that it overlaps with the throttle body 33 in the top view, while suppressing the expansion of the disposition space of the heater device 60 in the horizontal direction, the vertical clearance between the heater device 60 and the throttle body 33 is easily secured.

[0052] Referring to FIG. 2, the heater device 60 and the fuel chamber portion 50 are in a standing disposition closer to a vertical direction to the injector 40. This causes the travelling wind which passes around the cylinder 12 and of which the temperature is raised to easily hit the fuel chamber portion 50, and as a result, the fuel stored in the fuel chamber portion 50 can be easily warmed, and the fuel can be warmed with reduced heater power while the vehicle is travelling.

[0053] Here, an operation of the heater device 60 will be described. When the vehicle is parked and the engine 10 is stopped, the engine 10 is cold and the fuel in the fuel supply device is also cold. In order to accelerate the vaporization of the fuel to be injected into the intake passage TA, it is necessary to raise the temperature of the fuel by the heater device 60 before starting the engine 10. A suitable timing for the start of fuel heating by the heater device 60 is, for example, when a main switch of the vehicle is turned on while the engine 10 is stopped and the vehicle is parked.

[0054] The raising the temperature of the fuel by the heater device 60 starts, for example, at a timing when the heater device 60 is turned on. A control unit of the heater device 60 activates a timer with the heater device 60 turned on, and turns off the heater device 60 after a specified time has elapsed. The engine 10 can then be started (starter drive). At this time, the user may be notified that the engine can be started by lighting an indicator lamp, etc.

[0055] The duration of heater-on may be varied according to, for example, the outside temperature or the machine temperature. The temperature detection at this time may use, for example, detection information from existing intake air temperature sensors, oil temperature sensors, or the like. A temperature sensor can also be installed in the fuel chamber portion 50 to directly detect the temperature of the fuel in the chamber room T3. In addition to (or instead of) the duration of heater-on, the output of the heater device 60 may be varied.

[0056] In this embodiment, the heater is turned off when predetermined conditions are met (e.g., a predetermined amount of time has elapsed) after the fuel has begun to heat, but the heating by the heater-on may be continued in order to promote the vaporization of the fuel while the vehicle is travelling. In this embodiment, the fuel chamber portion 50 is easily exposed to the running air that flows around the engine 10 and is heated by the engine 10, which contributes to reducing the amount of power required to continue the heater-on.

[0057] The heater device 60 is disposed to overlap with any of the engine 10, particularly the cylinder main body 12a, the cylinder head 12b and the head cover 12c, in the front-rear view of the vehicle.

[0058] As described above with reference to FIGS. 3 and 4, the intake passage part 32 are disposed to be biased to one side (right side) in the left-right direction relative to the left-right center CL of the vehicle body.

[0059] The intake passage part 32 (especially the injector 40, the fuel chamber portion 50, and the heater portion 62) is disposed to be offset to one side (right side) in the left-right direction relative to the main frame 22 disposed at the left-right center CL of the vehicle body. The intake passage part 32 is disposed to avoid the main frame 22 to one side (right side) in the left-right direction

in the top view.

[0060] As a result, an area around the upper end of the rearwardly inclined fuel chamber portion 50 (including the heater device 60) can be disposed to overlap with the main frame 22 in the side view (see FIG. 2). Therefore, a large rearward upward inclination angle of the fuel chamber portion 50 can be secured, and the fuel chamber portion 50 and the heater device 60 can be made to stand closer to the vertical direction to receive the engine heat more easily.

[0061] In the embodiment, the main frame 22 is provided singly at the left-right center CL of the vehicle body and overlaps the left-right center CL of the vehicle body in the top view for the entire length of the front-rear direction. The intake passage part 32 is disposed to be offset to one side in the left-right direction with respect to this main frame 22. As a variation of this configuration, the main frame 22 can be provided in a pair of the left and right sides.

[0062] That is, the main frame 22 may be provided to be offset to the left-right center CL of the vehicle body (i.e., avoiding the left-right center CL of the vehicle body), and the intake passage part 32 may be disposed at the left-right center CL of the vehicle body (so that they overlap the left-right center CL of the vehicle body from the top view). In this case, the intake passage part 32 is disposed to be offset in the left-right direction relative to the left- and right main frames 22 and is disposed between the left and right main frames 22. This makes it difficult for the intake passage part 32 to be subjected to disturbances from outside the vehicle width direction.

[0063] Referring to FIG. 5, plate-shaped ribs 55 extending outwardly in the left-right direction are integrally formed on an outer circumference of a front end side of the outer peripheral wall 52 of the chamber case 51. Each of the rib 55 is provided in a range extending from a front end of the chamber case 51 to a rear end of the injector body 41 of the injector 40 to reinforce the connection portion J of the fuel chamber portion 50 and the injector 40, and to substantially increase the outer surface area of the chamber case 51 to facilitate receiving the engine heat.

[0064] The chamber case 51 has an integrally formed fixing portion 56 for fixing the fuel chamber portion 50 to a passage member. The fixing portion 56 has an arm portion 56a (see FIG. 6) extending forward from a tip of the rib 55 on one side (right side) in the left-right direction as the rib 55 extends, and a fastening boss 56b formed at a tip of the arm portion 56a. By providing the fixing portion 56 where the rib 55 extends, the outer surface area of the chamber case 51 is further increased to facilitate heat reception of the engine heat.

[0065] By fastening the fixing portion 56 to the intake pipe member 36, the fuel chamber portion 50 is fixed to the intake pipe member 36 and the injector 40 is fixed to the intake pipe member 36 in the form of being held by the fuel chamber portion 50 from the upstream side. The fuel chamber portion 50 with such the fixing portion 56 also serves as a fixing member for the injector 40.

[0066] As described above, the fuel supply device in the above embodiment includes: the engine 10 mounted on the motorcycle 1; the intake pipe member 36 connected to the engine 10 and forming the intake passage TA (first intake passage T1) therein; the throttle body 33 connected upstream of the intake pipe member 36 and adjusting the amount of intake air to the engine 10; the injector 40 connected to the intake pipe member 36, having the first longitudinal direction, and injecting fuel into the intake passage TA; and the fuel chamber portion 50 connected to the opposite side of the intake pipe member 36 in the first longitudinal direction in the injector 40, having the second longitudinal direction, and accumulating the fuel to be supplied to the injector 40 and facing the heater portion 62.

[0067] The injector 40 is disposed so that the first center axis line C1 along the first longitudinal direction is inclined to be away from the throttle body 33 as it goes upstream of the intake passage TA with respect to the bore center axis line 33c along the bore center in the throttle body 33. The fuel chamber portion 50 is disposed so that the second center axis line C2 along the second longitudinal direction is inclined to be further away from the throttle body 33 as it goes upstream of the intake passage TA with respect to the first center axis line C1 of the injector 40.

[0068] According to this configuration, since the first center axis line C1 along the first longitudinal direction in the injector 40 is disposed inclined to be further away from the throttle body 33 as it goes upstream of the intake passage TA with respect to the bore center axis line 33c along the bore center in the throttle body 33, and the second center axis line C2 along the second longitudinal direction in the fuel chamber portion 50 is disposed inclined to be more further away from the throttle body 33 as it goes upstream of the intake passage TA with respect to the first center axis line C1 of the injector 40, the fuel chamber portion 50 connected upstream of the injector 40 can be disposed as far as possible from the throttle body 33 in the radial direction thereof. Therefore, even in a configuration in which the fuel chamber portion 50 is disposed in the longitudinal direction of the injector 40, it is easier to secure a clearance between the fuel chamber portion 50 and the throttle body 33, and the degree of freedom in the arrangement of parts attached around the throttle body 33 can be increased.

[0069] In the above fuel supply device, the heater device 60 is provided to heat fuel accumulated in the fuel chamber portion 50, the heater device 60 comprising: the main body portion 61 connected to the opposite side of the injector 40 in the second longitudinal direction in the fuel chamber portion 50; and the heater portion 62 extending from the main body portion 61 into the fuel chamber portion 50 and disposed coaxially with the fuel chamber portion 50.

[0070] According to this configuration, since the heater portion 62 extends along the longitudinal direction of the

fuel chamber portion 50, the fuel in the fuel chamber portion 50 can be efficiently heated. The fuel chamber portion 50 and the heater portion 60, which are connected upstream of the injector 40, can be disposed as far as possible from the throttle body 33 in the radial direction thereof. Therefore, even in a configuration in which the fuel chamber portion 50 and the heater device 60 are disposed in the longitudinal direction of the injector 40, it is easier to secure a clearance between the fuel chamber portion 50 and heater device 60 and the throttle body 33, and the degree of freedom in the arrangement of parts attached around the throttle body 33 can be increased.

[0071] In the above fuel supply device, the throttle body 33 is provided with the butterfly valve 33d that opens and closes the intake passage TA, and the heater device 60 is disposed to overlap the throttle body 33 when viewed from the orthogonal direction 33v, which is perpendicular to both the rotation center axis line 33d1 of the butterfly valve 33d and the bore center axis line 33c.

[0072] According to this configuration, dead space tends to occur around the butterfly valve 33d, and by disposing the heater device 60 and the throttle body 33 to overlap when viewed from the orthogonal direction 33v perpendicular to both the rotation center axis line 33d1 of the butterfly valve 33d and the bore center axis line 33c, the fuel chamber portion 50 and the heater device 60 can be disposed by making effective use of the dead space.

[0073] In the above fuel supply device, the heater device 60 is disposed to overlap with the throttle body 33 in the upper view of the throttle body 33.

[0074] According to this configuration, by disposing the heater device 60 and the throttle body 33 to overlap each other in the upper view of the throttle body 33, the fuel chamber portion 50 and the heater device 60 can be disposed by effectively utilizing the dead space around the butterfly valve 33d as described above.

[0075] In the above fuel supply device, the fuel chamber portion 50 is disposed behind the engine 10 and is disposed to overlap the engine 10 in the front-rear direction view, and the fuel chamber portion 50 is disposed so that the angle of the second center axis line C2 to the front-rear direction of the vehicle is closer to the right angle (closer to the vertical direction) than the first center axis line C1 of the injector 40.

[0076] According to this configuration, since the second center axis line C2 of the fuel chamber portion 50 is positioned at the angle closer to the right angle to the front-rear direction of the vehicle (the direction of vehicle travel) than the first center axis line C1 of the injector 40, the front projection area of the fuel chamber portion 50 can be easily secured. Therefore, it is easier for the running wind that flows around the engine 10 and is heated to hit the fuel chamber portion 50, and it is easier to heat the fuel in the fuel chamber portion 50 using the heat of the engine 10.

[0077] In the above fuel supply device, the fuel chamber portion 50 is provided with the ribs 55 protruding outwardly from the outer wall (outer peripheral wall 52) surrounding the internal space (chamber room T3).

[0078] According to this configuration, by integrally forming the ribs 55 on the outer wall of the fuel chamber portion 50, the outer surface area (heat-receiving area) of the fuel chamber portion 50 is increased to make it easier to receive heat from the engine 10 and to further heat the fuel in the fuel chamber portion 50. This can promote vaporization of the fuel while the vehicle is traveling.

[0079] The above fuel supply device includes: the engine 10 mounted on the motorcycle 1; the frame member (main frame 22) of the motorcycle 1 disposed above the engine 10 in the vertical direction (vehicle vertical direction) and extending in the first direction (vehicle front-rear direction) as viewed from the vertical direction; the injector 40 that injects fuel to be supplied to the engine 10; the fuel chamber portion 50 connected to the injector 40 to accumulate the fuel to be supplied to the injector 40; and the heater device 60 connected to the fuel chamber portion 50 to heat the fuel accumulated in the fuel chamber portion 50. The heater device 60 is disposed to be offset with respect to the main frame 22 in the second direction (vehicle left-right direction) which is orthogonal to the first direction as viewed from the vertical direction.

[0080] According to this configuration, since the main frame 22 of the motorcycle 1 is disposed above the engine 10 and the heater device 60 which is connected to the injector 40 is disposed to be offset in the vehicle width direction (vehicle left-right direction) which is orthogonal to the longitudinal direction (vehicle front-rear direction) of the main frame 22 as viewed from the vertical direction, the clearance between the heater device 60 and the main frame 22 can be easily secured. This improves the degree of freedom of disposition of the heater device 60 relative to the main frame 22 in the vertical direction and ensures maintainability of the heater device 60 from above.

[0081] In the above fuel supply device, the heater device 60 and the main frame 22 are disposed to overlap each other as viewed from the second direction (vehicle left-right direction).

[0082] According to this configuration, the heater device 60 and the main frame 22 are disposed to overlap each other in the vertical direction, thereby efficiently disposing the configuration in which the fuel chamber portion 50 and the heater device 60 are connected to the injector 40.

[0083] In the above fuel supply device, the first direction is the front-rear direction of the motorcycle 1, the second direction is the left-right direction of the motorcycle 1, the main frame 22 extends in the front-rear direction along the left-right center CL of the vehicle body of the motorcycle 1, and the intake passage TA of the engine 10 is disposed to be offset to one side (right side) in the left-right direction relative to the left-right center CL of the vehicle body.

[0084] According to this configuration, the intake passage TA of the engine 10 is disposed to be offset to one side in the left-right direction, which facilitates the disposition of the injector 40 and heater device 60 provided in the intake passage TA to one side in the left-right direction and facilitates the disposition of the heater device 60 offset to the main frame 22.

[0085] The present invention is not limited to the above embodiment. For example, the fuel supply device of the present embodiment may be applied to a saddle-riding vehicle other than a motorcycle.

[0086] The above-mentioned saddle-riding vehicle includes all vehicles in which the driver straddles the vehicle body, and includes not only motorcycles (including motorized bicycles and scooter-type vehicles) but also three-wheeled (including vehicles with two front wheels and one rear wheel in addition to one front wheel and two rear wheels) or four-wheeled (such as all-terrain vehicles) vehicles. The system may be applied to a HEV (Hybrid Electric Vehicle) and the like that include an electric motor as a prime mover. The system may be applied to vehicles other than saddle-riding vehicles (e.g., passenger cars, buses, trucks, etc.). That is, the vehicle of the embodiment is a flexible fuel motorcycle (FFM), but it may also be a four-wheeled vehicle (flexible fuel vehicle (FFV)).

Although the fuel supply device of the embodiment is applied to a vehicle, the invention is not limited to application to vehicles, but may also be applied to various types of transportation equipment such as aircraft and ships, as well as various vehicles and moving vehicles such as construction machinery and industrial machinery. Furthermore, the invention can be widely applied to equipment other than vehicles, such as hand-pushed lawn mowers and sweepers, as long as they are equipped with a fuel supply device.

[0087] The configuration in the above embodiment is an example of the invention, and various changes are possible without departing from the gist of the invention, such as replacing the component elements of the embodiment with well-known components.

EXPLANATION OF REFERENCES

[0088]

1 Motorcycle (Equipment, Movable body, Saddle-riding vehicle)
10 Engine (Internal combustion engine)
22 Main frame (Frame member)
32 Intake passage part
33 Throttle body
33c Bore center axis line
33d Butterfly valve
33d1 Rotation center axis line
33v Orthogonal direction
36 Intake pipe member (Intake passage forming portion)
40 Injector (Fuel injection valve)
50 Fuel chamber portion
52 Outer peripheral wall (Outer wall)
55 Rib
60 Heater device
61 Main body portion
62 Heater portion
C1 First center axis line
C2 Second center axis line
CL Left-right center of vehicle body
T3 Chamber room (Internal space)
TA Intake passage

Claims

1. A fuel supply device comprising:

an internal combustion engine (10) mounted in an equipment (1);
a frame member (22) of the equipment (1) disposed above the internal combustion engine (10) in a vertical direction of the equipment (1) and extending in a first direction as viewed from the vertical direction;
an injector (40) that injects fuel to be supplied to the internal combustion engine (10);
a fuel chamber portion (50) that is connected to the injector (40) and accumulates fuel to be supplied to the injector (40);
a heater device (60) that is connected to the fuel chamber portion (50) and heats the fuel accumulated in the fuel chamber portion (50),
wherein the heater device (60) is disposed to be offset with respect to the frame member (22) in a second direction orthogonal to the first direction as viewed from the vertical direction.

2. The fuel supply device according to claim 1,
wherein the heater device (60) and the frame member (22) are disposed to overlap each other as viewed from the second direction.

3. The fuel supply device according to claim 1 or 2,

wherein the first direction is a front-rear direction of the device (1) and the second direction is a left-right direction of the device (1),
the frame member (22) extends in the front-rear direction along a left-right center (CL) of the equipment (1),
an intake passage (TA) of the internal combustion engine (10) is disposed to be offset to one side in the left-right direction relative to the left-right center (CL).

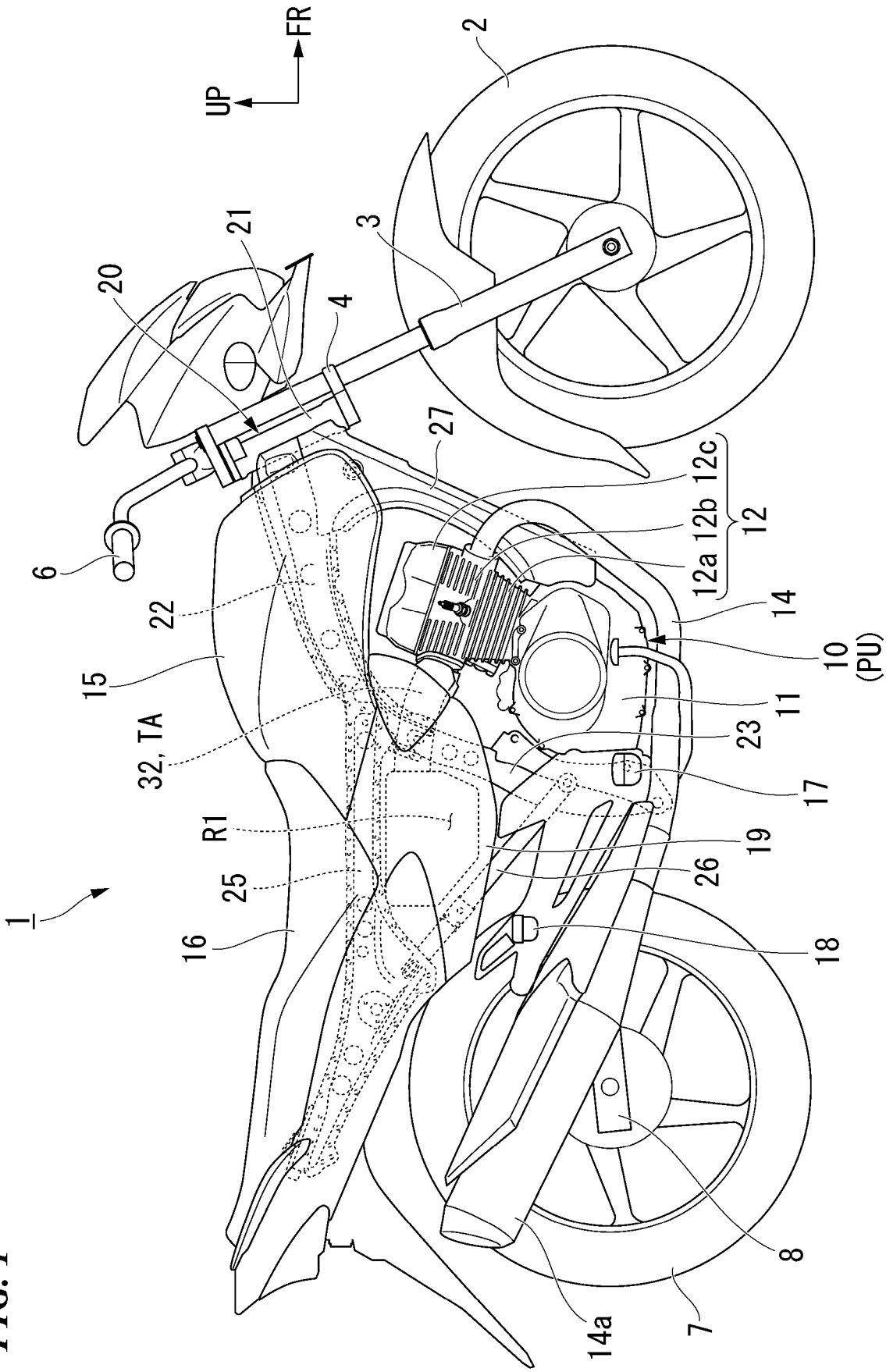
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FIG. 1

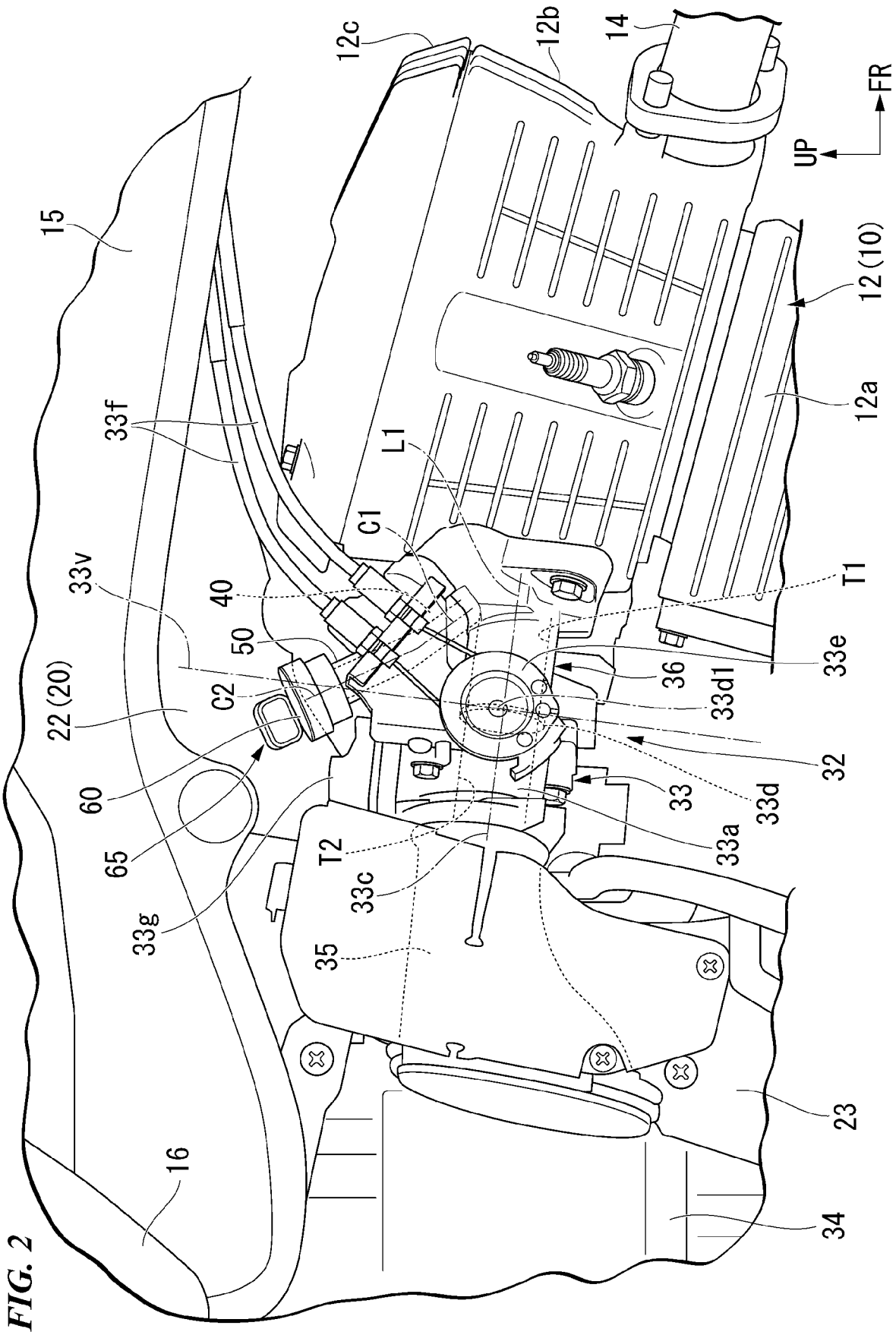
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FIG. 2

FIG. 3

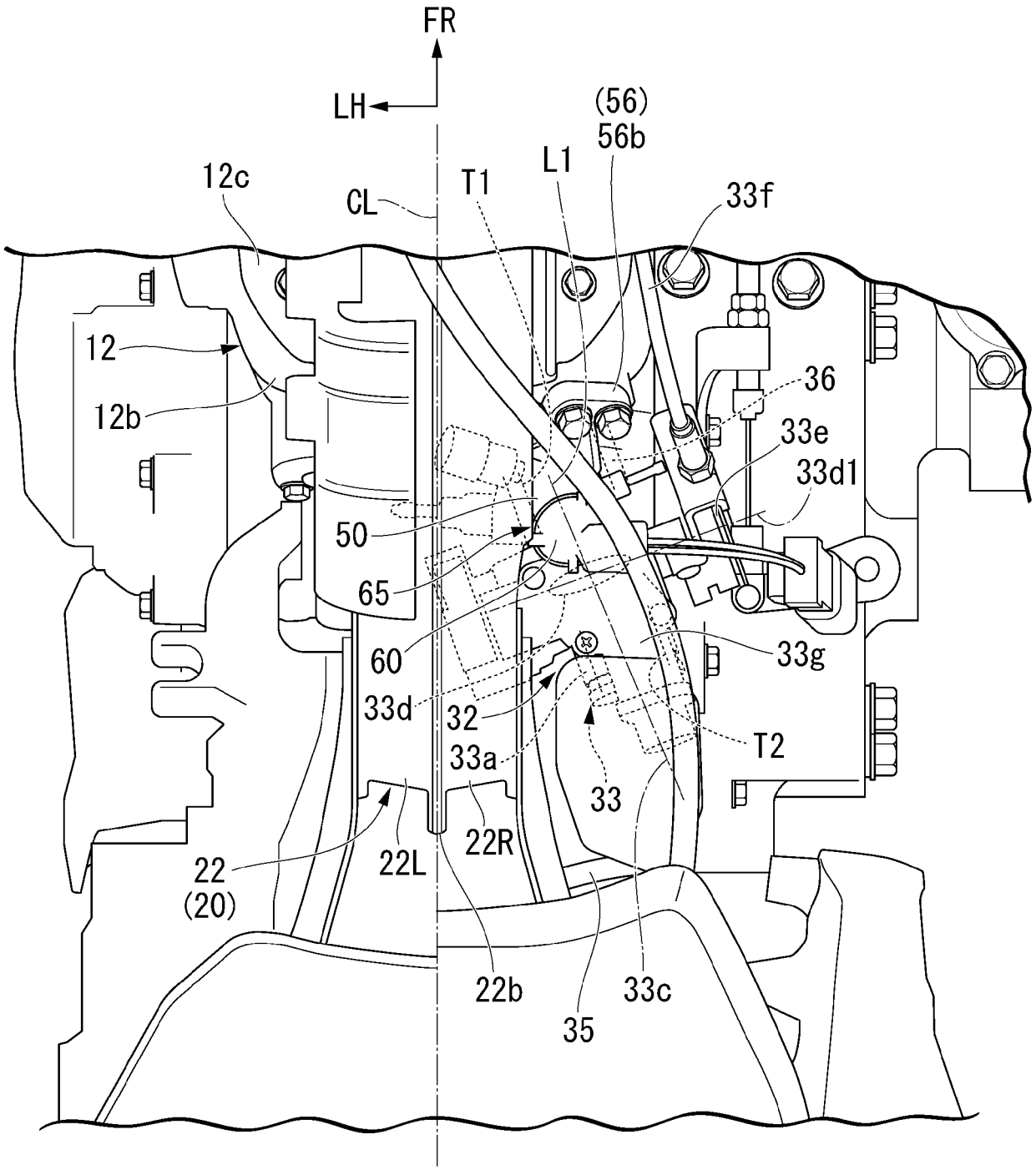
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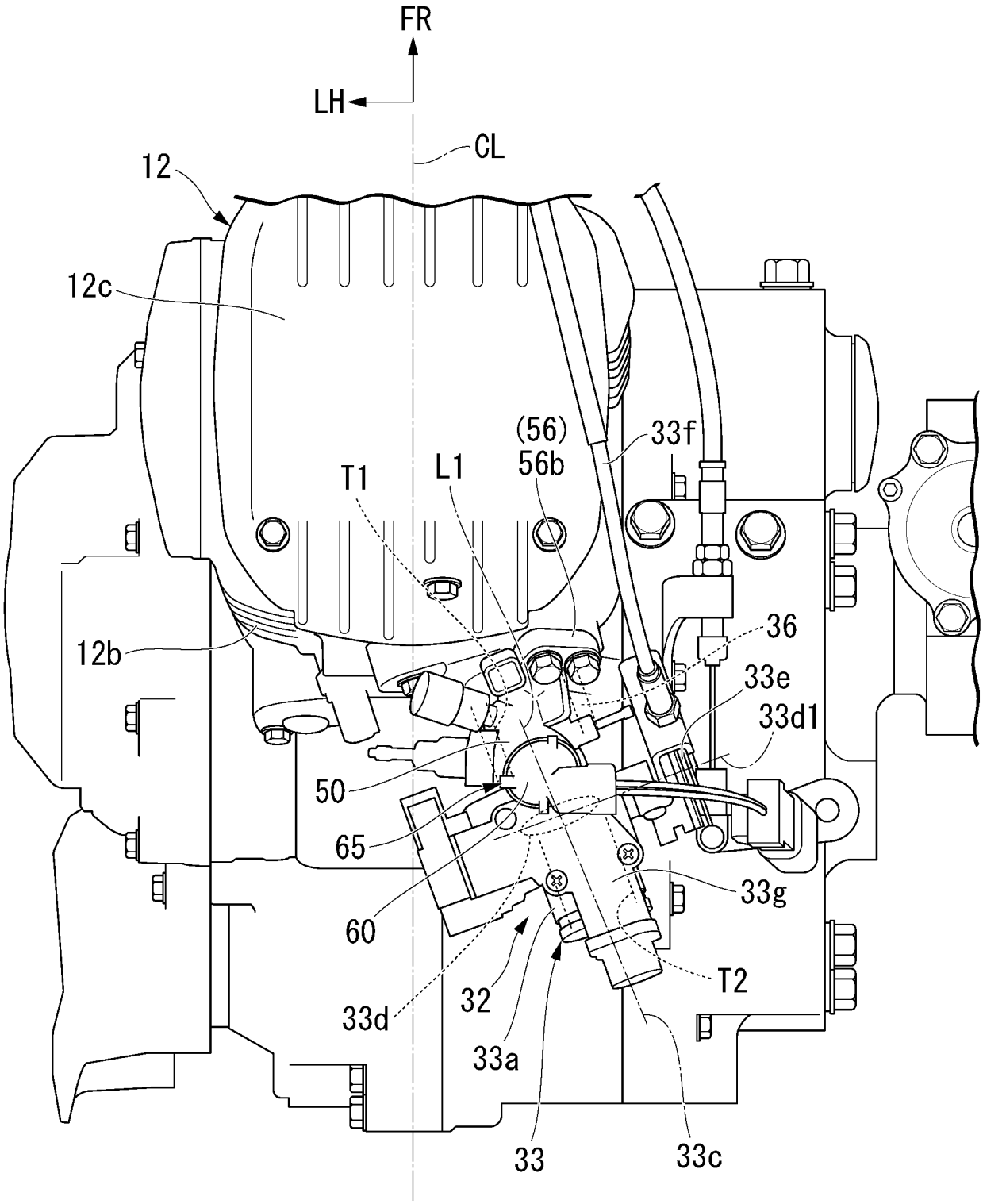
FIG. 4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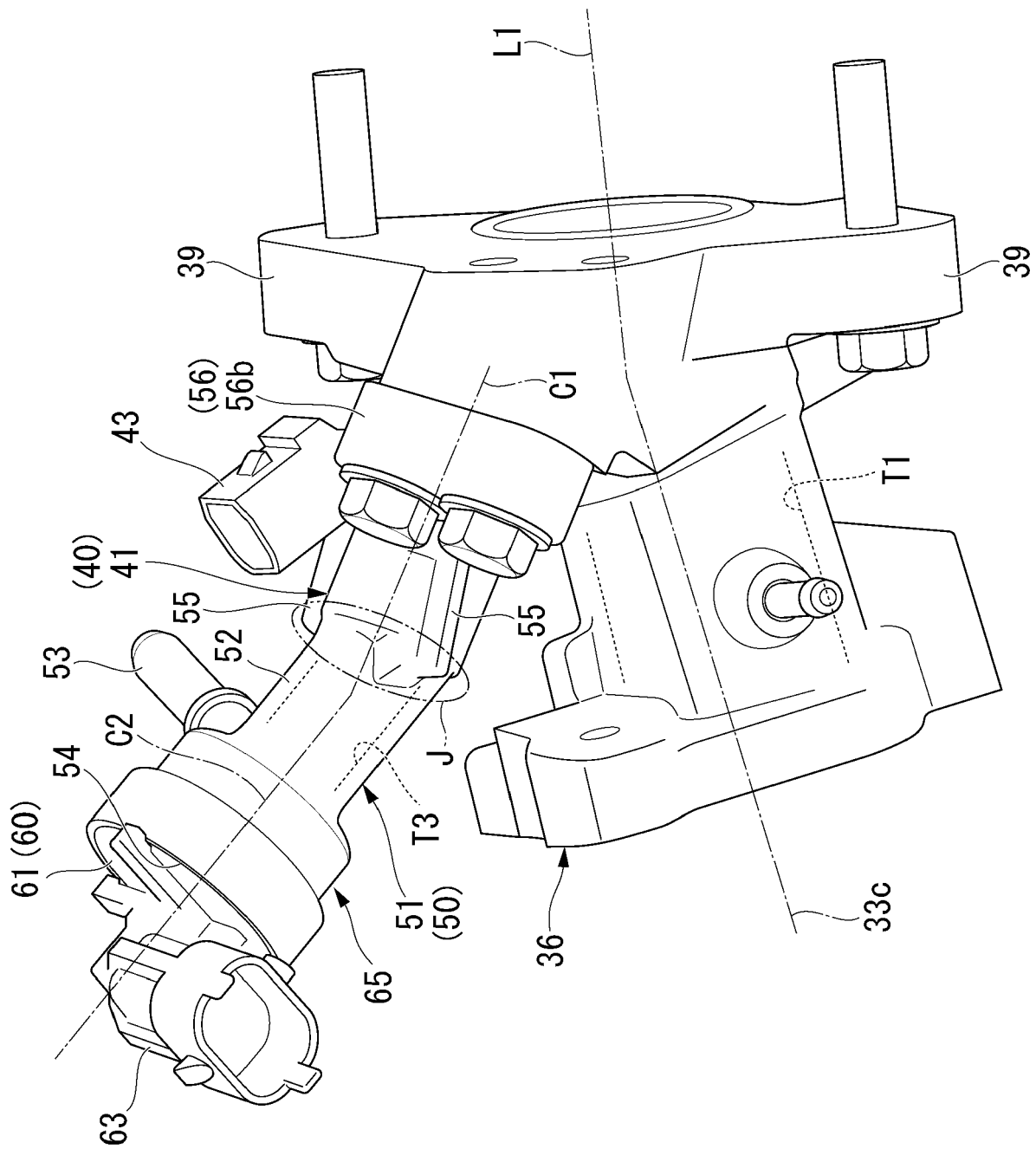
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FIG. 5

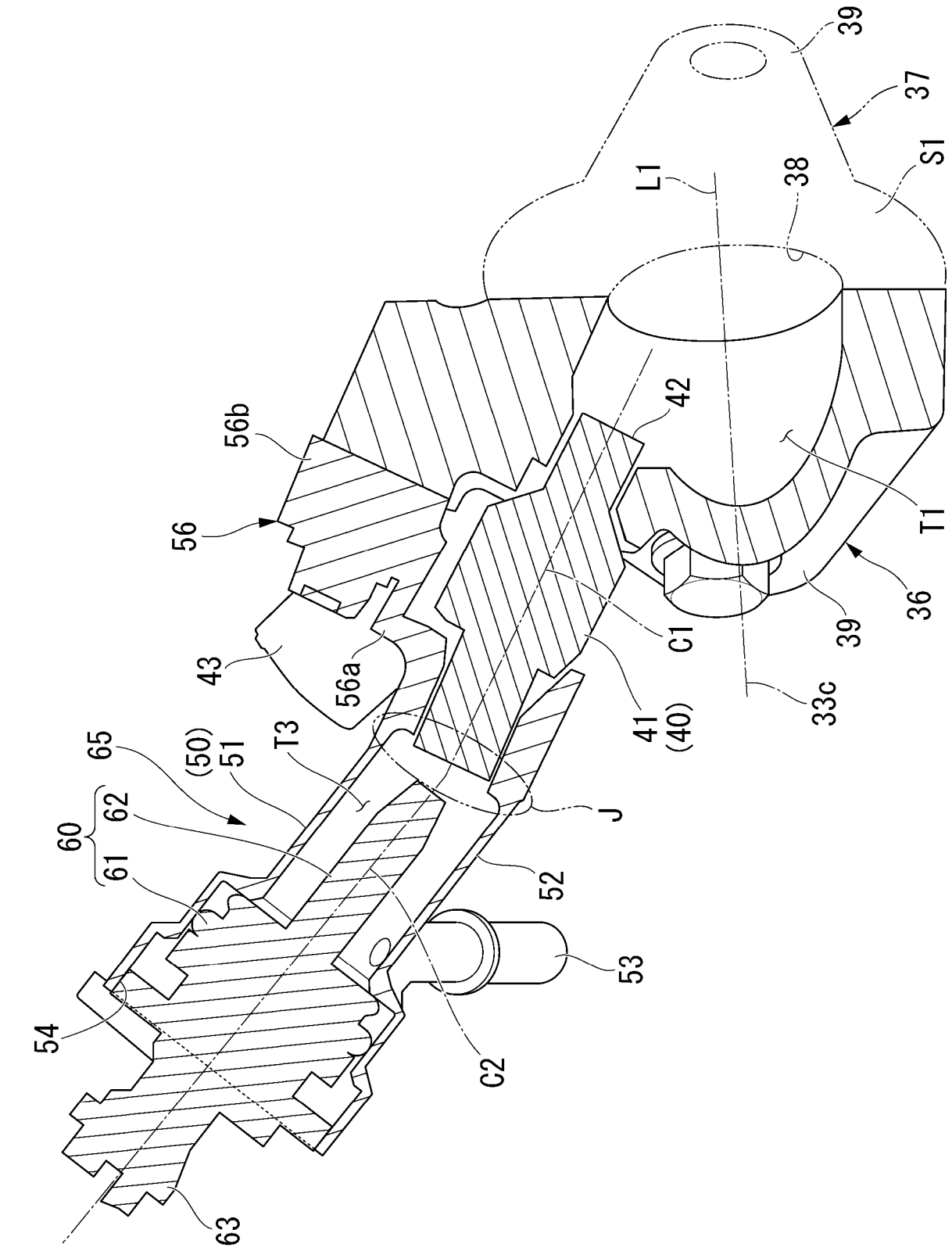
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FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 February 2024	Nobre Correia, S

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13-02-2024

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