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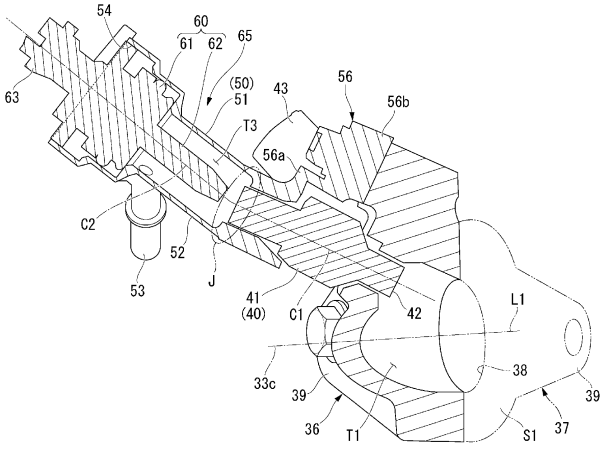
(54) FUEL SUPPLY APPARATUS

(57) A fuel supply apparatus includes: a temperature rise part (65) that is connected to an injector (40) at an opposite side of an intake pipe member (36) in a first longitudinal direction, has a second longitudinal direction, accumulates fuel supplied to the injector (40), and increases the temperature of the fuel, wherein the injector (40) is arranged such that a first center axis line (C1) along the first longitudinal direction is inclined relative to a bore center axis line (33c) along a bore center in a throttle body and is separated from the bore center axis line (33c) toward an upstream side of an intake passage, and the temperature rise part (65) is arranged such that a second center axis line (C2) along the second longitudinal direction is inclined relative to the first center axis line (C1) of the injector (40) and is further separated from the bore center axis line (33c) toward the upstream side of the intake passage.

FIG. 6



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Description

BACKGROUND

Field of the Invention

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

Background

[0002] In the related art, efforts aiming at reduction of impacts on or relaxation of climate change have been continuing, and toward the realization of this purpose, research and development regarding reduction of emission amount of carbon dioxide has been made.

[0003] For example, a configuration in Japanese Patent No. 4834728 includes: 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 includes a heater portion having a rod shape for heating the fuel in the fuel joint. The injector and the heater portion are arranged such that axis lines are parallel and coaxial to each other.

SUMMARY

[0004] In order to reduce the emission amount of carbon dioxide, when the related art described above is applied as is to a small apparatus such as a motorcycle, there is a problem that since a distance from a throttle body to an engine is short, it is difficult to ensure a clearance between the throttle body and a temperature rise part including the heater device or the like.

[0005] An aspect of the present invention aims at, in a fuel supply apparatus in which a temperature rise part that heats fuel continues to an injector, easily ensuring a clearance between the temperature rise part and a throttle body. The aspect of the present invention contributes to reduction of impacts on or relaxation of climate change.

[0006] A fuel supply apparatus according to a first aspect of the present invention includes: an internal combustion engine (10) that is provided on an apparatus (1); an intake passage formation portion (36) which is connected to the internal combustion engine (10) and in which an intake passage (TA) is formed; a throttle body (33) that is connected to an upstream side of the intake passage formation portion (36) and adjusts an intake amount to the internal combustion engine (10); an injector (40) that is connected to the intake passage formation portion (36), has a first longitudinal direction, and injects fuel into the intake passage (TA); and a temperature rise part (65) that is connected to the injector (40) at an opposite side of the intake passage formation portion (36) in the first longitudinal direction, has a second longitudinal direction, accumulates fuel supplied to the injector (40), and increases the temperature of the fuel, wherein the injector (40) is arranged such that a first center axis line (C1) along the first longitudinal direction is inclined relative to a bore center axis line (33c) along a bore center in the throttle body (33) and is separated from the bore center axis line (33c) toward an upstream side of the intake passage (TA), and the temperature rise part (65) is arranged such that a second center axis line (C2) along the second longitudinal direction is inclined relative to the first center axis line (C1) of the injector (40) and is further separated from the bore center axis line (33c) toward the upstream side of the intake passage (TA).

[0007] According to this configuration, by arranging the first center axis line along the first longitudinal direction in the injector to be inclined relative to the bore center axis line of the throttle body and be separated from the bore center axis line toward the upstream side of the intake passage and arranging the second center axis line along the second longitudinal direction in the temperature rise part to be inclined relative to the first center axis line of the injector and be further separated from the bore center axis line toward the upstream side of the intake passage, the temperature rise part that continues to the upstream side of the injector can be arranged to be separated as far as possible from the throttle body in a radial direction of the throttle body. Therefore, even in a configuration in which the temperature rise part is arranged in the longitudinal direction of the injector, it is possible to easily ensure a clearance between the temperature rise part and the throttle body and enhance the degree of freedom of arrangement of a component that is provided around the throttle body.

[0008] A second aspect of the present invention is the first aspect described above, wherein the temperature rise part (65) may include: a fuel chamber portion (50) that accumulates the fuel supplied to the injector (40); and a heater device (60) that heats the fuel accumulated in the fuel chamber portion (50), and the heater device (60) may include: a main body portion (61) that is connected to the fuel chamber portion (50) at an opposite side of the injector (40) in the second longitudinal direction; and a heater portion (62) that extends from the main body portion (61) into the fuel chamber portion (50) and is arranged along the second longitudinal direction.

[0009] According to this configuration, the heater portion extends along the longitudinal direction of the fuel chamber portion, and thereby, it is possible to efficiently heat the fuel in the fuel chamber portion. The fuel chamber portion and the heater device that continue to the upstream side of the injector can be arranged to be separated as far as possible from the throttle body in a radial direction of the throttle body. Therefore, even in a configuration in which the fuel chamber portion and the heater device are arranged to continue in the longitudinal direction of the injector, it is possible to easily ensure a clearance between the fuel chamber portion and the heater device, and the throttle body and enhance the degree of freedom of arrangement of a component that is provided around the throttle body.

[0010] A third aspect of the present invention is the second aspect described above, wherein the throttle body (33) may include: a butterfly valve (33d) that opens and closes the intake passage (TA), and the heater device (60) may be arranged so as to overlap the throttle body (33) when seen from an orthogonal direction (33v) that is orthogonal to both of a rotation center axis line (33d1) of the butterfly valve (33d) and the bore center axis line (33c).

[0011] According to this configuration, a dead space easily occurs around the butterfly valve, and by using an arrangement in which the heater device and the throttle body overlap each other when seen from the orthogonal direction that is orthogonal to the rotation center axis line of the butterfly valve and the bore center axis line, it is possible to effectively use the dead space and arrange the fuel chamber portion and the heater device.

[0012] A fourth aspect of the present invention is the second or third aspect described above, wherein the heater device (60) may be arranged so as to overlap the throttle body (33) in a top view of the apparatus (1).

[0013] According to this configuration, by using an arrangement in which the heater device and the throttle body overlap each other in the top view of the apparatus, similarly to the configuration described above, it is possible to effectively use the dead space around the butterfly valve and arrange the fuel chamber portion and the heater device.

[0014] A fifth aspect of the present invention is any one of the second to fourth aspects described above, wherein the apparatus (1) may be a movable body that travels in a forward direction, the fuel chamber portion (50) may be arranged at a rearward position of the internal combustion engine (10) and be arranged to overlap the internal combustion engine (10) in a forward-rearward direction view, and the fuel chamber portion (50) may be arranged such that the second center axis line (C2) is at an angle closer to a right angle with respect to a forward-rearward direction than the first center axis line (C 1) of the injector (40).

[0015] According to this configuration, by arranging the second center axis line of the fuel chamber portion at an angle closer to a right angle with respect to the forward-rearward direction (vehicle travel direction) than the first center axis line of the injector, it is possible to easily ensure a front projection area of the fuel chamber portion. Therefore, a travel wind that flows around the internal combustion engine and receives the heat easily hits the fuel chamber portion, and it is possible to use the heat of the internal combustion engine and easily heat the fuel in the fuel chamber portion.

[0016] A sixth aspect of the present invention is any one of the second to fifth aspects described above, wherein the fuel chamber portion (50) may include a rib (55) that protrudes outward from an outer wall (52) which surrounds an internal space (T3). According to this configuration, by integrally forming the rib on the outer wall of the fuel chamber portion, it is possible to increase an outer surface area (heat reception area) of the fuel chamber portion and easily receive the heat of the internal combustion engine, and it is possible to further easily heat the fuel in the fuel chamber portion.

[0017] According to the aspect of the present invention, in a fuel supply apparatus in which the temperature rise part that heats the fuel continues to the injector, it is possible to easily ensure the clearance between the temperature rise part and the throttle body.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

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 around an intake passage component of the motorcycle described above.

FIG. 4 is a top view in which part of components are eliminated from FIG. 3.

FIG. 5 is a perspective view of an injector, a fuel chamber portion, and a heater device that are attached to the intake passage component described above.

FIG. 6 is a cross-sectional view along center axis lines of the injector and the fuel chamber portion described above.

DESCRIPTION OF THE REFERENCE NUMERALS

[0019]

1	Motorcycle (apparatus, movable body, saddle riding vehicle)
10	Engine (internal combustion engine)
22	Main frame (frame member)
32	Intake passage component
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 formation portion)
40	Injector (fuel injection valve)
50	Fuel chamber portion
52	Outer circumference 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	Vehicle body leftward-rightward middle
T3	Chamber room (internal space)
TA	Intake passage

DESCRIPTION OF EMBODIMENTS

[0020] Hereinafter, embodiments of the present invention will be described with reference to the drawings. Directions such as forward, rearward, leftward, and rightward directions in the following description are the same as directions in a vehicle described below unless otherwise stated. In appropriate positions in the drawings used in the following description, an arrow FR that indicates a vehicle forward direction, an arrow LH that indicates a vehicle leftward direction, an arrow UP that indicates a vehicle upward direction, and a line CL that indicates a vehicle body leftward-rightward middle are shown.

<Entire vehicle>

[0021] As shown in FIG. 1, the present embodiment is applied to a motorcycle 1 which is a saddle riding vehicle (an apparatus, a movable body). A front wheel 2 of the motorcycle 1 is supported by lower end portions of a pair of left and right front forks 3. Upper portions of the left and right front forks 3 are supported by a head pipe 21 at a front end portion 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.

[0022] A rear wheel 7 of the motorcycle 1 is supported by a rear end portion of a swing arm 8. A front end portion of the swing arm 8 is supported by a pivot frame 23 at a forward-rearward middle portion of the vehicle body frame 20. A term "middle" used in the present embodiment includes not only a middle between both ends of a target but also an inner range between both ends of the target. The rear wheel 7 is connected to a power unit PU of the motorcycle 1, for example, via a chain-type transmission mechanism that is arranged on a left side of a vehicle body rear part.

[0023] The power unit PU is an integral unit including: an engine (internal combustion engine) 10 which is a motor of the motorcycle 1; and a clutch (not shown) and a transmission (not shown) that connects, disconnects, and changes the speed of an output of the engine 10. The power unit PU is fixedly supported by the vehicle body frame 20.

[0024] In the engine 10, a cylinder 12 stands at a front upper portion of a crankcase 11. An intake passage component 32 is connected to a rear portion of the cylinder 12. An exhaust pipe 14 is connected to a front portion of the cylinder 12. The exhaust pipe 14 passes through a lower portion of the engine 10 from a front portion of the engine 10, is arranged, for example, toward a right rear portion of the engine 10, and is connected to an exhaust muffler 14a that is arranged on the right side of a vehicle body rear part.

[0025] A fuel tank 15 that stores a fuel supplied to the engine 10 is arranged above the engine 10. A seat 16 on which a driver and a rear passenger are seated is arranged at a rearward position of the fuel tank 15. A pair of left and right main steps 17 on which feet of the driver are placed, and a pair of left and right pillion steps 18 on which feet of the rear passenger are placed are arranged on both sides of a vehicle body lower part.

<Vehicle body frame>

[0026] With reference to FIG. 1, the vehicle body frame 20 is constituted by integrally joining a plurality of steel materials by welding or the like.

[0027] The vehicle body frame 20 includes: a single head pipe 21 having an axis center arranged at a vehicle body leftward-rightward middle; a single main frame 22 that extends rearward and downward along the vehicle body leftward-rightward middle from an upper portion of the head pipe 21; a single pivot frame 23 that extends rearward and downward along the vehicle body leftward-rightward middle from a rear lower end portion of the main frame 22 at a relatively steep inclination; and a single down frame 27 that extends rearward and downward along the vehicle body leftward-rightward middle from a lower portion of the head pipe 21 at a steeper inclination than the main frame 22.

[0028] Further, the vehicle body frame 20 includes: a pair of left and right seat rails 25 having a front end portion joined to a rear portion of the main frame 22 and extending rearward substantially horizontally from the front end portion; and a pair of left and right support frames 26 having a front end portion joined to an upward-downward intermediate portion of the pivot frame 23 and extending rearward and upward from the front end portion. Rear end portions of the left and right support frames 26 are respectively joined to forward-rearward intermediate portions of the left and right seat rails 25 from below.

[0029] Each of the main frame 22, the pivot frame 23, the down frame 27, and the left and right seat rails 25 is constituted by combining press frame bodies formed by pressing steel plates.

[0030] With reference to FIG. 3, the main frame 22 is constituted by integrally joining a pair of left and right main press frame bodies 22L, 22R. Each of the left and right main press frame bodies 22L, 22R is an integral steel plate press mold component and has an expansion shape that expands outward (outward in a leftward-rightward direction) in a vehicle width direction. A joint flange 22b is bent and extends from each of both ends of the expansion shape. By allowing the joint flanges 22b to be in contact with each other in the vehicle width direction and to be integrally joined by spot welding or the like, an integral main frame 22 having a closed cross-sectional structure in which the left and right expansion shapes face each other is constituted.

[0031] The pivot frame 23, the down frame 27, and the left and right seat rails 25 also have a substantially similar closed cross-sectional structure, and a detailed description is omitted. The support frame 26 is constituted of, for example, a square steel pipe.

[0032] The vehicle body frame 20 is not limited to a combination of press frame bodies and may be a com-

bination of steel pipes. The down frame 27 is not limited to a single down frame and may be a pair of left and right down frames.

<Engine>

[0033] With reference to FIG. 1 and FIG. 2, the engine 10 is an air-cooled single cylinder engine having a rotation center axis line (crank axis line) of a crankshaft (not shown) that is along a leftward-rightward direction (vehicle width direction). In the engine 10, the cylinder 12 stands in a forward inclined attitude at a front upper end of the crankcase 11. The engine 10 can be operated using ethanol or a blend fuel (hereinafter, collectively referred to as an ethanol fuel) of gasoline and ethanol in addition to gasoline. That is, the motorcycle 1 is a flexible fuel motorcycle (FFM) that can travel using a plurality of types of fuel.

[0034] The cylinder 12 includes a cylinder main body 12a, a cylinder head 12b, and a head cover 12c in this order from the crankcase 11 side. A piston (not shown) is fitted into the cylinder main body 12a, and the reciprocation movement of the piston is converted into a rotation movement of the crankshaft in the crankcase 11. The rotation power of the crankshaft is output to a rear left side of the crankcase 11 via a transmission (not shown) and a clutch (not shown) in the rear portion of the crankcase 11. The output rotation power is transmitted to the rear wheel 7 via a chain-type transmission mechanism.

[0035] A downstream end of the intake passage component 32 including a throttle body 33 is connected to a rear portion (intake side) of the cylinder head 12b. Reference numeral 34 in the drawing represents an air cleaner box to which an upstream end of the intake passage component 32 is connected, reference numeral 35 represents a connecting tube that connects the throttle body 33 to the air cleaner box 34, and reference numeral 36 represents an intake tube member that connects the throttle body 33 to the cylinder head 12b. The connecting tube 35 and the intake pipe member 36 (intake passage formation portion) are included in the intake passage component 32.

[0036] The air cleaner box 34 is arranged in a region R1 (refer to FIG. 1) having a triangle shape in a side view surrounded by the pivot frame 23, a seat rail 25, and the support frame 26.

[0037] The outside in the vehicle width direction of the region R1 is covered by a side cover 19 as a vehicle body cover.

<Fuel supply apparatus>

[0038] Here, the motorcycle 1 includes a fuel supply apparatus including the fuel tank 15, a fuel pump (not shown), a fuel hose (not shown), an injector (fuel injection valve) 40, and the like.

[0039] With reference to FIG. 1, FIG. 2, and FIG. 6, the fuel of the fuel tank 15 is, for example, suctioned by the fuel pump arranged in the fuel tank 15 and is discharged to the downstream side. The fuel discharged from the fuel pump is supplied into a chamber room T3 of a fuel chamber portion 50 that continues to the injector 40. A heater portion 62 faces the chamber room T3 and is capable of heating the fuel accumulated in the chamber room T3.

[0040] The injector 40 is operated and controlled by an ECU (Electric Control Unit) and injects fuel into the intake passage component 32 in accordance with an output of a throttle sensor or the like.

[0041] With reference also to FIG. 3 and FIG. 4, the intake passage component 32 including the throttle body 33 is arranged to be displaced wholly to one side (right side in the embodiment) in the leftward-rightward direction with respect to a vehicle body leftward-rightward middle CL.

[0042] With reference to FIG. 4 to FIG. 6, a port opening portion 37 that forms an opening (an external opening 38) to the outside of the cylinder of the intake port is provided on a rear portion of the cylinder head 12b. The port opening portion 37 forms a plane S1 in which a normal direction L1 (direction along a normal line L1) is inclined rearward and outward in the vehicle width direction and the external opening 38 along the plane S1. The external opening 38 of the intake port opens obliquely toward the normal direction L1 (rearward and outward in the vehicle width direction).

[0043] A front end portion (a downstream end portion) 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 that extends rearward substantially along the normal direction L1 of the plane S1 of the port opening portion 37. In particular, the first intake passage T1 extends linearly to be inclined relative to a vehicle forward-rearward direction toward the normal direction L1 of the plane S1 of the intake port in a vehicle top view (hereinafter, simply referred to as a top view). The first intake passage T1 extends substantially linearly (in particular, in a curved form that protrudes slightly upward) to be inclined rearward and upward with respect to the vehicle forward-rearward direction in the side view. The intake pipe member 36 is fixed to the port opening portion 37 by a pair of fastening portions 39 arranged to sandwich the external opening 38.

[0044] With reference to FIG. 2 to FIG. 4, a front end portion (a downstream end portion) of the throttle body 33 is connected to a rear end portion (an upstream end portion) of the intake pipe member 36. A main body 33a having a cylindrical shape of the throttle body 33 forms a second intake passage T2 that linearly continues to the upstream side of the first intake passage T1 of the intake pipe member 36. A center axis line (a bore center axis line 33c) of the second intake passage T2 in the throttle body 33 extends rearward linearly to be inclined slightly upward and rearward in the side view, and extends rearward to be inclined rearward and outward in the vehicle width direction similarly to the normal direction L1 of the

plane S1 of the intake port in the top view.

[0045] 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 33d1 of the butterfly valve 33d is arranged substantially horizontally and is arranged to be orthogonal to the bore center axis line 33c. One end portion (right end portion) of a valve rotation shaft is a protrusion portion that protrudes to the outside of the main body 33a. A pulley 33e is attached integrally rotatably to the protrusion portion, and the pulley 33e is driven by an operation cable 33f.

[0046] Hereinafter, the intake passage (including the first intake passage T1 and the second intake passage T2) formed of the entire intake passage component 32 is referred to as an intake passage TA (refer to 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 the straight line 33v is referred to as an orthogonal direction 33v.

<Injector>

[0047] With reference to FIG. 5 and FIG. 6, the injector 40 is attached to a front upper portion of the intake pipe member 36.

[0048] The injector 40 includes an injector body 41 having a cylindrical shape, a valve portion (not shown) accommodated in the injector body 41, and an electromagnetic drive portion (not shown) that drives the valve portion.

[0049] A fuel flow path through which the fuel flows is formed within the injector body 41. The valve portion and a return spring (not shown) are provided on the fuel flow path. The valve portion closes the fuel flow path by a biasing force applied from the return spring. As a result, the valve of the injector 40 is closed.

[0050] The electromagnetic drive portion is provided on the injector body 41 and forms a magnetic circuit. The electromagnetic drive portion drives the valve portion in an axis direction of the injector body 41 against the biasing force of the return spring and opens the fuel flow path. As a result, the valve of the injector 40 is opened, and the fuel is injected into the first intake passage T1 from an injection port 42 at a front end of the injector body 41. A coupler 43 for connecting a power supply harness used for driving the valve is provided to protrude on an outer circumferential portion of the injector body 41. The coupler 43 protrudes to one side (a right side, an offset direction of the intake passage component 32) in the leftward-rightward direction.

[0051] A center axis line C1 along a longitudinal direction (longitudinal direction of the injector body 41) of the injector 40 is arranged to be inclined such that a further rearward side (upstream side) is located at an upper position (is away from the intake pipe member 36 and the throttle body 33). Hereinafter, 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. An upper rear side (opposite side of the injection port 42) of the injector 40 corresponds to the upstream side of the injector 40.

[0052] The fuel chamber portion 50 that accumulates the fuel supplied to the injector 40 and a heater device 60 that heats (increases the temperature of) the fuel in the fuel chamber portion 50 are provided on an extension portion that extends rearward in the first longitudinal direction of the injector 40. A temperature rise part 65 that increases the temperature of the fuel supplied to the injector 40 includes the fuel chamber portion 50 and the heater device 60.

[0053] The fuel chamber portion 50 includes a chamber case 51. The chamber case 51 has a cylindrical shape that opens upward and rearward and forms the chamber room T3 as an internal space. A nozzle 53 for connecting the fuel hose is provided to protrude on an outer circumference of an axis direction intermediate portion (not limited to the middle) of an outer circumference wall 52 of the chamber case 51. The nozzle 53 protrudes from the fuel chamber portion 50 to the other side (left side, an opposite side of an offset direction of the intake passage component 32) in the leftward-rightward direction, and the fuel hose (not shown) is connected to the fuel pump while extending to the other side in the leftward-rightward direction.

[0054] An upper rear portion of the injector body 41 is fitted into and connected to a lower front portion of the chamber case 51. A main body portion 61 of the heater device 60 is fitted into an opening portion 54 at an upper rear end of the chamber case 51, and the opening portion 54 is closed.

[0055] In the heater device 60, a heater portion 62 having a rod shape protrudes from the main body portion 61 into the chamber room T3. The heater portion 62 is arranged coaxially with the chamber case 51. A coupler 63 for connecting the power supply harness used for operating the heater is provided to protrude on an upper rear end of the main body portion 61.

[0056] The fuel supplied from the fuel hose is supplied into and accumulated in the chamber room T3, and the temperature of the fuel is increased by the heat generated by the heater portion 62. The fuel having an increased temperature arrives at the inside of the injector body 41 of the injector 40 and is injected into the intake passage TA from the injection port 42 by the drive of the valve portion.

[0057] In the ethanol fuel engine 10, in order to improve the start-up performance at a cold time, and in order to reduce hazardous components included in the exhaust gas, it is effective to inject the heated fuel into the intake passage TA and promote vaporization of the injection fuel.

[0058] Hereinafter, a longitudinal direction (longitudinal direction (axis direction) of the chamber case 51 and the heater portion 62) of the fuel chamber portion 50 is referred to as a second longitudinal direction, and the center axis line (center axis line common to the chamber

case 51 and the heater portion 62) of the fuel chamber portion 50 is referred to as a second center axis line C2. The longitudinal directions of the chamber case 51 and the heater portion 62 are parallel to each other, and the center axis lines of the chamber case 51 and the heater portion 62 are matched with each other. The longitudinal directions of the chamber case 51 and the heater portion 62 may be non-parallel to each other. The center axis lines of the chamber case 51 and the heater portion 62 may be arranged to be displaced from each other.

[0059] The fuel chamber portion 50 is arranged such that the axis direction is inclined relative 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 do not necessarily need to intersect each other.

[0060] The first center axis line C1 of the injector 40 is inclined rearward and upward and is inclined rearward so as to approach the center axis line (in this case, the bore center axis line 33c) of the intake passage TA.

[0061] Similarly to the first center axis line C1, the second center axis line C2 of the fuel chamber portion 50 is inclined rearward and upward and is inclined rearward so as to approach the center axis line (in this case, the bore center axis line 33c) of the intake passage TA.

[0062] The second center axis line C2 is inclined relative to the first center axis line C1 such that a further rearward side is away from the throttle body 33 (such that the fuel chamber portion 50 is inclined further rearward and upward than the injector 40). A relative angle between the first center axis line C1 and the second center axis line C2 is, for example, less than 20 degrees, and the impact of standing too vertically on the arrangement space of peripheral components is reduced.

[0063] With reference to FIG. 4, the fuel chamber portion 50 is inclined further rearward and upward relative to the injector 40, and thereby, it is possible to easily ensure the clearance between the fuel chamber portion 50 and the throttle body 33.

[0064] For example, an intake system component 33g such as an IACV (Idle Air Control Valve) is arranged on an upper surface portion of the throttle body 33, and the fuel chamber portion 50 can easily ensure the clearance with respect to the intake system component 33g.

[0065] The main body portion 61 of the heater device 60 is arranged so as to partially overlap the throttle body 33 in a top view.

[0066] When the entire main body portion 61 of the heater device 60 is arranged so as to overlap the throttle body 33 in the top view, the arrangement space of the heater device 60 does not extend in a horizontal direction, but it is difficult to ensure the clearance in an upward-downward direction between the heater device 60 and the throttle body 33.

[0067] On the other hand, by arranging part of the heater device 60 so as to overlap the throttle body 33 in the top view, the clearance in the upward-downward direction between the heater device 60 and the throttle body 33 can be easily ensured while preventing the arrangement space of the heater device 60 from extending in the horizontal direction.

[0068] With reference to FIG. 2, the heater device 60 and the fuel chamber portion 50 are arranged to stand close to the vertical direction relative to the injector 40. Therefore, the travel wind passing around the cylinder 12 and having an increased temperature easily hits the fuel chamber portion 50. As a result, it is possible to heat the fuel accumulated in the fuel chamber portion 50 and heat the fuel while reducing the heater electric power during traveling of the vehicle.

[0069] Here, an operation of the heater device 60 is described.

[0070] When the vehicle is stopped or parked, and the driving of the engine 10 is stopped, the engine 10 is cool, and the fuel in the fuel supply apparatus is also cool. In order to promote vaporization of the fuel injected to the intake passage TA, it is necessary to increase the temperature of the fuel by the heater device 60 before the start-up of the engine 10. As a timing of starting increasing the temperature of the fuel by the heater device 60, for example, a timing when a main switch of a vehicle in a stopping or parking state in which the engine 10 is stopped is turned on is preferable.

[0071] The increase of the temperature of the fuel by the heater device 60 is started, for example, from a timing when the operation of the heater device 60 is turned on. A control portion of the heater device 60 operates a timer when the heater device 60 is turned on, and turns off the heater device 60 after a specified period of time elapses. Then, the start-up (starter driving) of the engine 10 is enabled. At this time, a user may be notified that the engine start-up is enabled by lighting an indicator lamp or the like.

[0072] The duration of the heater-on may vary, for example, depending on the outside temperature or the engine temperature. The temperature detection at this time can utilize, for example, detection information of an existing intake temperature sensor, an oil temperature sensor, or the like. Further, the temperature sensor can be provided on the fuel chamber portion 50, and the temperature of the fuel in the chamber room T3 can be also directly detected. In addition to the duration (or instead of the duration) of the heater-on, the output of the heater device 60 may be varied.

[0073] In the present embodiment, when a predetermined condition is satisfied (for example, a predetermined period of time elapses, or the like) after heating of the fuel is started, the heater is turned off, but the heating by the heater-on may be continued in order to promote vaporization of the fuel during traveling of the vehicle. In the present embodiment, since a structure is employed in which the travel wind that flows around the engine 10 and receives heat easily hits the fuel chamber portion 50, the structure contributes to reduction of an electric power amount when the heater-on is continued.

[0074] The heater device 60 is arranged to overlap, in particular, any of the cylinder main body 12a, the cylinder head 12b, and the head cover 12c of the engine 10 in a vehicle forward-rearward direction view.

[0075] With reference to FIG. 3 and FIG. 4, as described above, the intake passage component 32 is arranged to be displaced to one side (right side) in the leftward-rightward direction with respect to the vehicle body leftward-rightward middle CL.

[0076] The intake passage component 32 (particularly, the injector 40, the fuel chamber portion 50, and the heater portion 62) is arranged to be offset to one side (right side) in the leftward-rightward direction with respect to the main frame 22 located at the vehicle body leftward-rightward middle CL. The intake passage component 32 is arranged so as to avoid the main frame 22 to one side (right side) in the leftward-rightward direction in the top view.

[0077] As a result, an upper end and the vicinity thereof (including the heater device 60) of the fuel chamber portion 50 that is inclined rearward and upward can be arranged so as to overlap the main frame 22 in a side view (refer to FIG. 2). Therefore, it is possible to ensure a large inclination angle toward a rearward upward direction of the fuel chamber portion 50, and it is possible to allow the fuel chamber portion 50 and the heater device 60 to stand closer to the vertical direction and easily receive the engine heat.

[0078] In the embodiment, a single main frame 22 is provided at the vehicle body leftward-rightward middle CL and is provided so as to overlap the vehicle body leftward-rightward middle CL in the top view throughout the entire length in the forward-rearward direction. The intake passage component 32 is arranged to be offset to one side in the leftward-rightward direction relative to the main frame 22.

[0079] As a modification example of this configuration, a configuration can also be used in which a pair of left and right main frames 22 are provided.

[0080] That is, the main frame 22 may be provided (provided to avoid the vehicle body leftward-rightward middle CL) to be offset relative to the vehicle body leftward-rightward middle CL, and the intake passage component 32 may be arranged (arranged so as to overlap the vehicle body leftward-rightward middle CL in the top view) on the vehicle body leftward-rightward middle CL. At this time, the intake passage component 32 is arranged to be offset in the leftward-rightward direction relative to the left and right main frames 22 and is arranged between the left and right main frames 22. Thereby, disturbance from the outside in the vehicle width direction does not easily act on the intake passage component 32.

[0081] With reference to FIG. 5, a rib 55 having a plate shape and extending outward in the leftward-rightward direction is integrally formed on an outer circumference on the front end side of the outer circumference wall 52 of the chamber case 51. Each rib 55 is provided in a range extending from a front end portion of the chamber case 51 to a rear end portion of the injector body 41 of the injector 40. Each rib 55 reinforces the connection portion J between the fuel chamber portion 50 and the injector 40, substantially increases an outer surface area of the chamber case 51, and facilitates reception of the engine heat.

[0082] A fixation portion 56 for fixing the fuel chamber portion 50 to a passage member is integrally formed on the chamber case 51. The fixation portion 56 includes: an arm section 56a (refer to FIG. 6) that extends forward so as to extend the rib 55 from a front end portion of the rib 55 on one side (right side) in the leftward-rightward direction; and a fastening boss 56b formed on a front end of the arm section 56a. By including the fixation portion 56 formed by extending the rib 55, the outer surface area of the chamber case 51 is further increased, and reception of the engine heat is facilitated.

[0083] By fastening the fixation 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 a state of being pressed to the fuel chamber portion 50 from the upstream side. The fuel chamber portion 50 that includes such a fixation portion 56 also serves as a fixation member of the injector 40.

[0084] As described above, the fuel supply apparatus in the embodiment described above includes: an engine 10 that is provided on a motorcycle 1; an intake pipe member 36 which is connected to the engine 10 and in which an intake passage TA (first intake passage T1) is formed; a throttle body 33 that is connected to an upstream side of the intake pipe member 36 and adjusts an intake amount to the engine 10; an injector 40 that is connected to the intake pipe member 36, has a first longitudinal direction, and injects fuel into the intake passage TA; and a fuel chamber portion 50 which is connected to the injector 40 at an opposite side of the intake pipe member 36 in the first longitudinal direction, has a second longitudinal direction, and accumulates fuel supplied to the injector 40 and which a heater portion 60 faces, wherein the injector 40 is arranged such that a first center axis line C1 along the first longitudinal direction is inclined relative to a bore center axis line 33c along a bore center in the throttle body 33 and is separated from the throttle body 33 toward an upstream side of the intake passage TA, and the fuel chamber portion 50 is arranged such that a second center axis line C2 along the second longitudinal direction is inclined relative to the first center axis line C1 of the injector 40 and is further separated from the throttle body 33 toward the upstream side of the intake passage TA.

[0085] According to this configuration, by arranging the first center axis line C1 along the first longitudinal direction in the injector 40 to be inclined relative to the bore center axis line 33c of the throttle body 33 and be separated from the throttle body 33 toward the upstream side of the intake passage TA and arranging the second center axis line C2 along the second longitudinal direction in

the fuel chamber portion 50 to be inclined relative to the first center axis line C1 of the injector 40 and be further separated from the throttle body 33 toward the upstream side of the intake passage TA, the fuel chamber portion 50 that continues to the upstream side of the injector 40 can be arranged to be separated as far as possible from the throttle body 33 in a radial direction of the throttle body 33. Therefore, even in a configuration in which the fuel chamber portion 50 is arranged in the longitudinal direction of the injector 40, it is possible to easily ensure a clearance between the fuel chamber portion 50 and the throttle body 33 and enhance the degree of freedom of arrangement of a component that is provided around the throttle body 33.

[0086] Further, the fuel supply apparatus described above includes a heater device 60 that heats the fuel accumulated in the fuel chamber portion 50, and the heater device 60 includes: a main body portion 61 that is connected to the fuel chamber portion 50 at an opposite side of the injector 40 in the second longitudinal direction; and the heater portion 62 that extends from the main body portion 61 into the fuel chamber portion 50 and is arranged coaxially with fuel chamber portion 50.

[0087] According to this configuration, the heater portion 62 extends along the longitudinal direction of the fuel chamber portion 50, and thereby, it is possible to efficiently heat the fuel in the fuel chamber portion 50. The fuel chamber portion 50 and the heater device 60 that continue to the upstream side of the injector 40 can be arranged to be separated as far as possible from the throttle body 33 in a radial direction of the throttle body 33. Therefore, even in a configuration in which the fuel chamber portion 50 and the heater device 60 are arranged to continue in the longitudinal direction of the injector 40, it is possible to easily ensure a clearance between the fuel chamber portion 50 and the heater device 60, and the throttle body 33 and enhance the degree of freedom of arrangement of a component that is provided around the throttle body 33.

[0088] Further, in the fuel supply apparatus described above, the throttle body 33 includes: a butterfly valve 33d that opens and closes the intake passage TA, and the heater device 60 is arranged so as to overlap the throttle body 33 when seen from an orthogonal direction 33v that is orthogonal to both of a rotation center axis line 33d1 of the butterfly valve 33d and the bore center axis line 33c.

[0089] According to this configuration, a dead space easily occurs around the butterfly valve 33d, and by using an arrangement in which the heater device 60 and the throttle body 33 overlap each other when seen from the orthogonal direction 33v that is orthogonal to the rotation center axis line 33d1 of the butterfly valve 33d and the bore center axis line 33c, it is possible to effectively use the dead space and arrange the fuel chamber portion 50 and the heater device 60.

[0090] Further, in the fuel supply apparatus described above, the heater device 60 is arranged so as to overlap the throttle body 33 in a top view of the throttle body 33.

[0091] According to this configuration, by using an arrangement in which the heater device 60 and the throttle body 33 overlap each other in the top view of the throttle body 33, similarly to the configuration described above, it is possible to effectively use the dead space around the butterfly valve 33d and arrange the fuel chamber portion 50 and the heater device 60.

[0092] Further, in the fuel supply apparatus described above, the fuel chamber portion 50 is arranged at a rearward position of the engine 10 and is arranged to overlap the engine 10 in a forward-rearward direction view, and the fuel chamber portion 50 is arranged such that the second center axis line C2 is at an angle (angle close to the vertical direction) closer to a right angle with respect to a vehicle forward-rearward direction than the first center axis line C1 of the injector 40.

[0093] According to this configuration, by arranging the second center axis line C2 of the fuel chamber portion 50 at an angle closer to a right angle with respect to the vehicle forward-rearward direction (vehicle travel direction) than the first center axis line C1 of the injector 40, it is possible to easily ensure a front projection area of the fuel chamber portion 50. Therefore, a travel wind that flows around the engine 10 and receives the heat easily hits the fuel chamber portion 50, and it is possible to use the heat of the engine 10 and easily heat the fuel in the fuel chamber portion 50.

[0094] Further, in the fuel supply apparatus described above, the fuel chamber portion 50 includes a rib 55 that protrudes outward from an outer wall (outer circumference wall 52) which surrounds an internal space (chamber room T3).

[0095] According to this configuration, by integrally forming the rib 55 on the outer wall of the fuel chamber portion 50, it is possible to increase an outer surface area (heat reception area) of the fuel chamber portion 50 and easily receive the heat of the engine 10, and it is possible to further easily heat the fuel in the fuel chamber portion 50. Thereby, it is possible to promote vaporization of the fuel during traveling of the vehicle.

[0096] Further, the fuel supply apparatus described above includes: an engine 10 that is provided on a motorcycle 1; a frame member (main frame 22) of the motorcycle 1 that is arranged above the engine in an upward-downward direction (vehicle upward-downward direction) of the motorcycle 1 and extends in a first direction (vehicle forward-rearward direction) when seen from the upward-downward direction; an injector 40 that injects fuel supplied to the engine 10; a fuel chamber portion 50 that is connected to the injector 40 and accumulates fuel supplied to the injector 40; and 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 arranged to be offset in a second direction (vehicle leftward-rightward direction) that is orthogonal to the first direction when seen from the upward-downward direction relative to the main frame 22.

[0097] According to this configuration, by arranging the main frame 22 of the motorcycle 1 above the engine 10 and arranging the heater device 60 connected to the injector 40 to be offset in the vehicle width direction (vehicle leftward-rightward direction) that is orthogonal to the longitudinal direction (vehicle forward-rearward direction) of the main frame 22 when seen from the upward-downward direction, it is possible to easily ensure a clearance between the heater device 60 and the main frame 22. Thereby, the degree of freedom of arrangement in the upward-downward direction of the heater device 60 with respect to the main frame 22 is improved, and it is possible to ensure maintenance properties from an upward direction of the heater device 60.

[0098] Further, in the fuel supply apparatus described above, the heater device 60 and the main frame 22 are arranged so as to overlap each other when seen from the second direction (vehicle leftward-rightward direction).

[0099] According to this configuration, by arranging the heater device 60 and the main frame 22 to overlap each other in the upward-downward direction, it is possible to efficiently arrange a configuration in which the fuel chamber portion 50 and the heater device 60 are connected to the injector 40.

[0100] Further, in the fuel supply apparatus described above, the first direction is a forward-rearward direction of the motorcycle 1, the second direction is a leftward-rightward direction of the motorcycle 1, the main frame 22 extends in the forward-rearward direction along a vehicle body leftward-rightward middle CL of the motorcycle 1, and an intake passage TA of the engine 10 is arranged to be offset to one side (right side) in the leftward-rightward direction relative to the vehicle body leftward-rightward middle CL.

[0101] According to this configuration, by arranging the intake passage TA of the engine 10 to be offset to one side in the leftward-rightward direction, it is possible to easily arrange the injector 40 and the heater device 60 that are provided on the intake passage TA on one side in the leftward-rightward direction, and it is possible to easily obtain an arrangement in which the heater device 60 is offset relative to the main frame 22.

[0102] The present invention is not limited to the embodiments described above. For example, the fuel supply apparatus of the present embodiment may be applied to saddle riding vehicles other than motorcycles.

[0103] The saddle riding vehicles include all vehicles on which a driver rides by straddling the vehicle body and include not only motorcycles (including motorized bicycles and scooter-type vehicles) but also three-wheeled vehicles (including vehicles having two front wheels and one rear wheel in addition to vehicles having one front wheel and two rear wheels) or four-wheeled vehicles (four-wheeled buggies or the like). The fuel supply apparatus of the present embodiment may be applied to vehicles including an electric motor in a prime mover such as HEVs (Hybrid Electric Vehicles).

[0104] The fuel supply apparatus of the present embodiment may be applied to vehicles (passenger vehicles, buses, trucks, or the like) other than saddle riding vehicles. That is, the vehicle of the embodiment is a flexible fuel motorcycle (FFM), but may be a four-wheeled vehicle (flexible fuel vehicle (FFV)).

[0105] Although the fuel supply apparatus of the present embodiment is applied to vehicles, the application of the present invention is not limited to vehicles, and the present invention may be applied to various vehicles and movable bodies such as various transport apparatuses such as aircraft or ships, construction machinery, and industrial machinery. Further, the present invention is broadly applicable to apparatuses other than vehicles if the apparatus includes a fuel supply apparatus such as, for example, push mowers or cleaning machines.

[0106] The configurations in the embodiments described above are merely examples of the present invention, and various changes can be made without departing from the scope of the present invention such as replacing the components of the embodiment with well-known components.

Claims

1. A fuel supply apparatus comprising:

an internal combustion engine (10) that is provided on an apparatus (1);
an intake passage formation portion (36) which is connected to the internal combustion engine (10) and in which an intake passage (TA) is formed;
a throttle body (33) that is connected to an upstream side of the intake passage formation portion (36) and adjusts an intake amount to the internal combustion engine (10);
an injector (40) that is connected to the intake passage formation portion (36), has a first longitudinal direction, and injects fuel into the intake passage (TA); and
a temperature rise part (65) that is connected to the injector (40) at an opposite side of the intake passage formation portion (36) in the first longitudinal direction, has a second longitudinal direction, accumulates fuel supplied to the injector (40), and increases a temperature of the fuel,
wherein the injector (40) is arranged such that a first center axis line (C1) along the first longitudinal direction is inclined relative to a bore center axis line (33c) along a bore center in the throttle body (33) and is separated from the bore center axis line (33c) toward an upstream side of the intake passage (TA), and
the temperature rise part (65) is arranged such that a second center axis line (C2) along the second longitudinal direction is inclined relative

to the first center axis line (C1) of the injector (40) and is further separated from the bore center axis line (33c) toward the upstream side of the intake passage (TA).

2. The fuel supply apparatus according to claim 1, wherein the temperature rise part (65) comprises: a fuel chamber portion (50) that accumulates the fuel supplied to the injector (40); and a heater device (60) that heats the fuel accumulated in the fuel chamber portion (50), and
the heater device (60) comprises:

a main body portion (61) that is connected to the fuel chamber portion (50) at an opposite side of the injector (40) in the second longitudinal direction; and
a heater portion (62) that extends from the main body portion (61) into the fuel chamber portion (50) and is arranged along the second longitudinal direction.

3. The fuel supply apparatus according to claim 2,

wherein the throttle body (33) comprises: a butterfly valve (33d) that opens and closes the intake passage (TA), and
the heater device (60) is arranged so as to overlap the throttle body (33) when seen from an orthogonal direction (33v) that is orthogonal to both of a rotation center axis line (33d1) of the butterfly valve (33d) and the bore center axis line (33c).

4. The fuel supply apparatus according to claim 2 or 3, wherein the heater device (60) is arranged so as to overlap the throttle body (33) in a top view of the apparatus (1).

5. The fuel supply apparatus according to any one of claims 2 to 4,

wherein the apparatus (1) is a movable body that travels in a forward direction,
the fuel chamber portion (50) is arranged at a rearward position of the internal combustion engine (10) and is arranged to overlap the internal combustion engine (10) in a forward-rearward direction view, and
the fuel chamber portion (50) is arranged such that the second center axis line (C2) is at an angle closer to a right angle with respect to a forward-rearward direction than the first center axis line (C1) of the injector (40).

6. The fuel supply apparatus according to any one of claims 2 to 5,
wherein the fuel chamber portion (50) comprises a rib (55) that protrudes outward from an outer wall (52) which surrounds an internal space (T3).

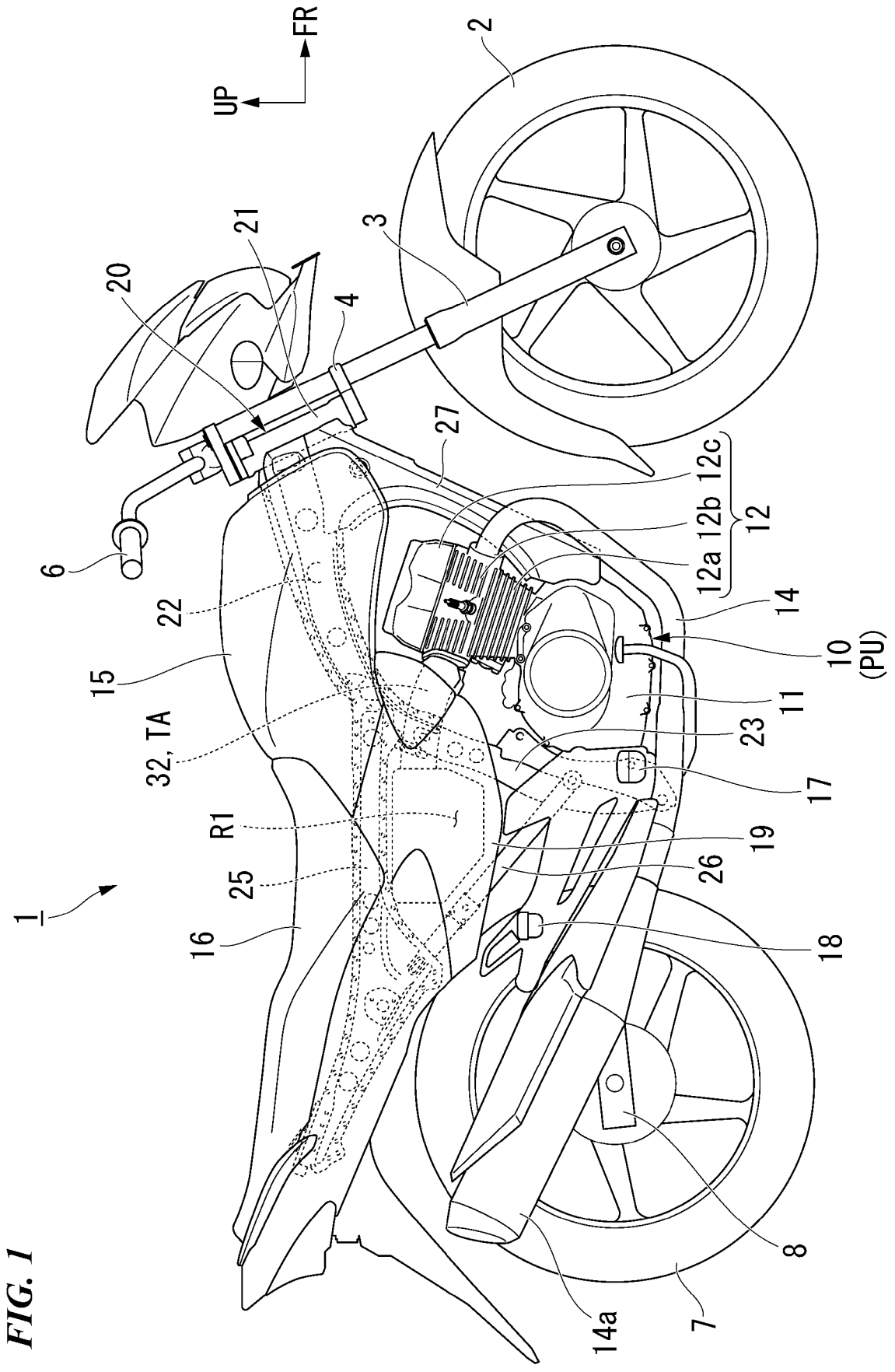
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FIG. 1

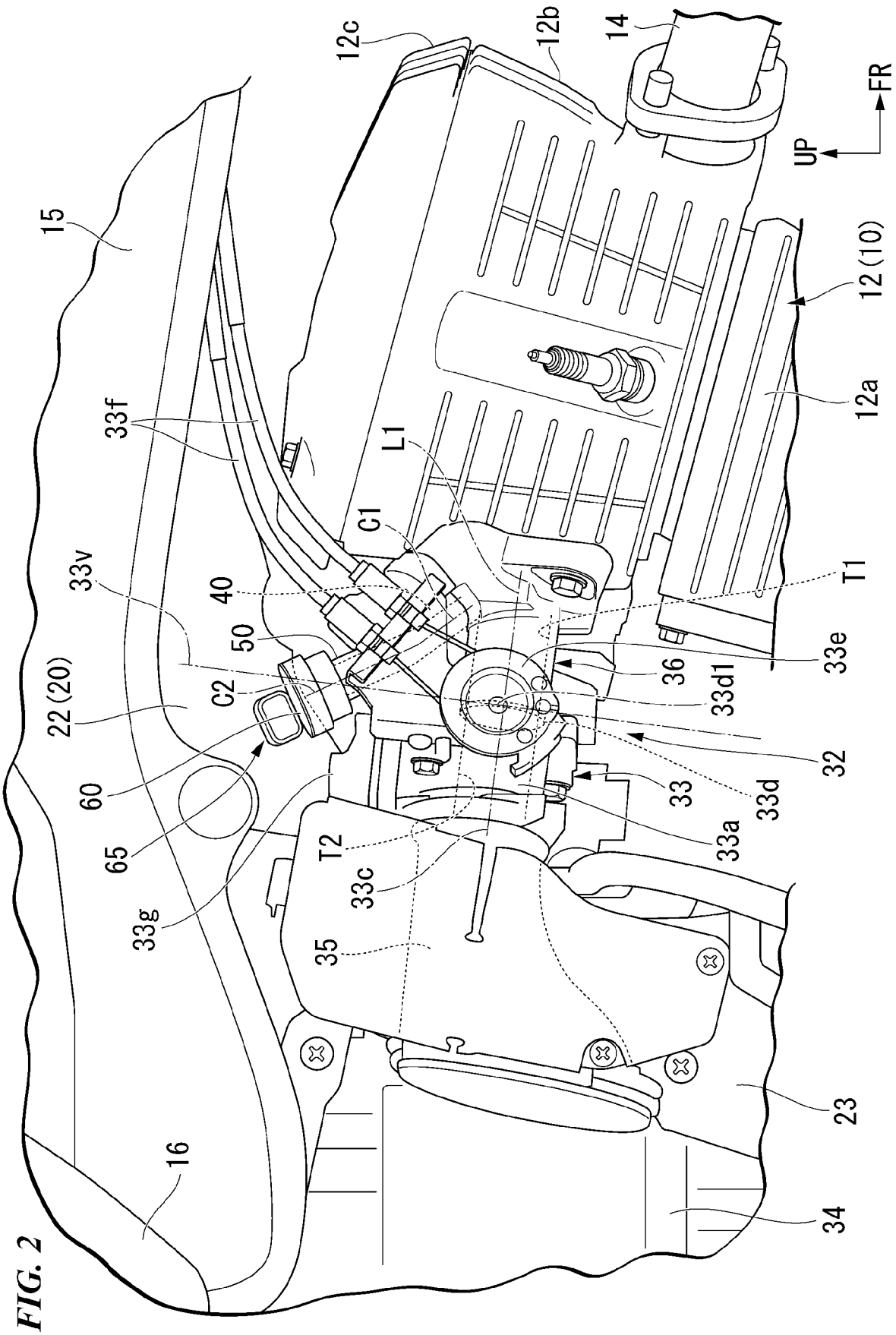
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FIG. 2

FIG. 3

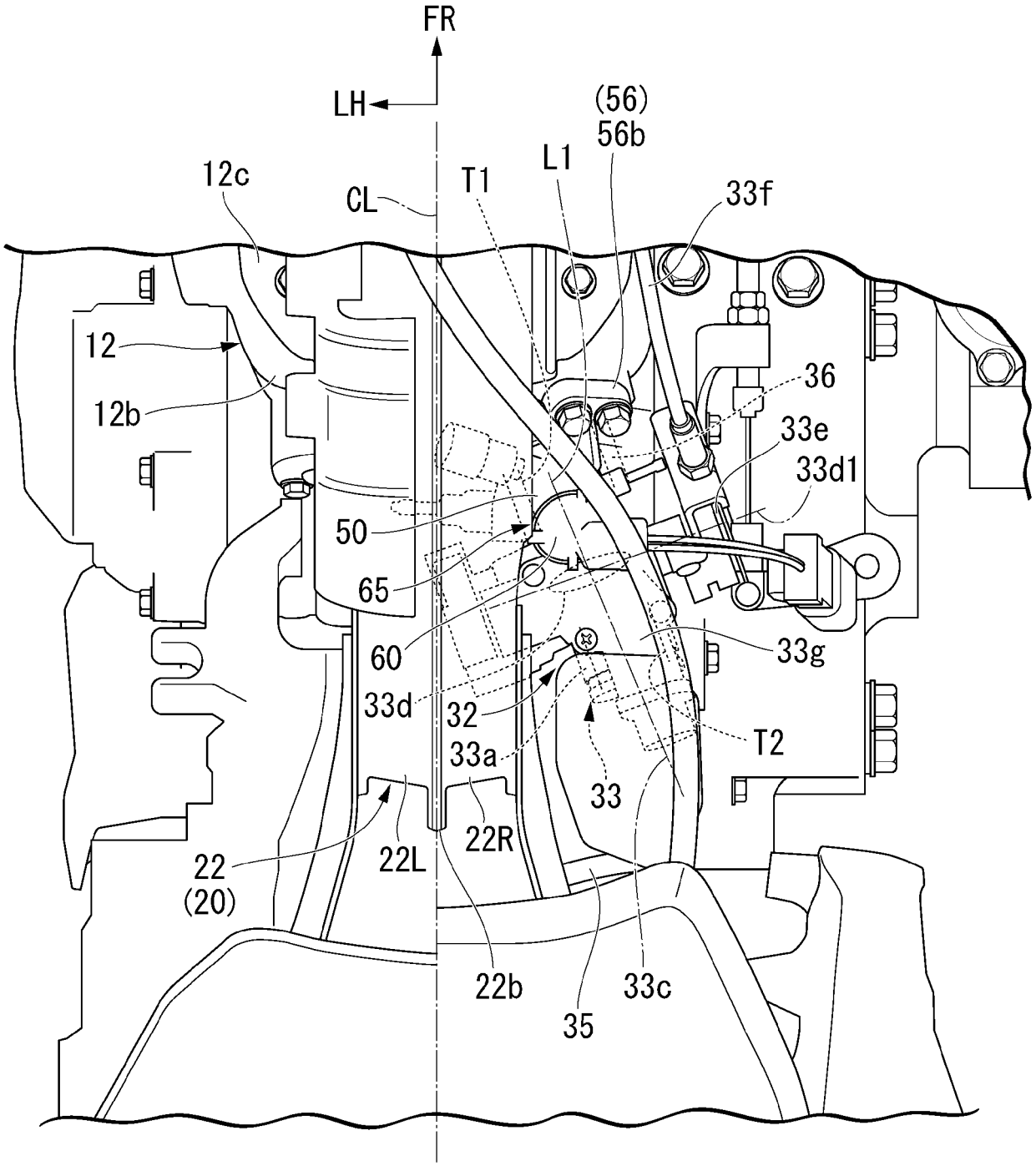
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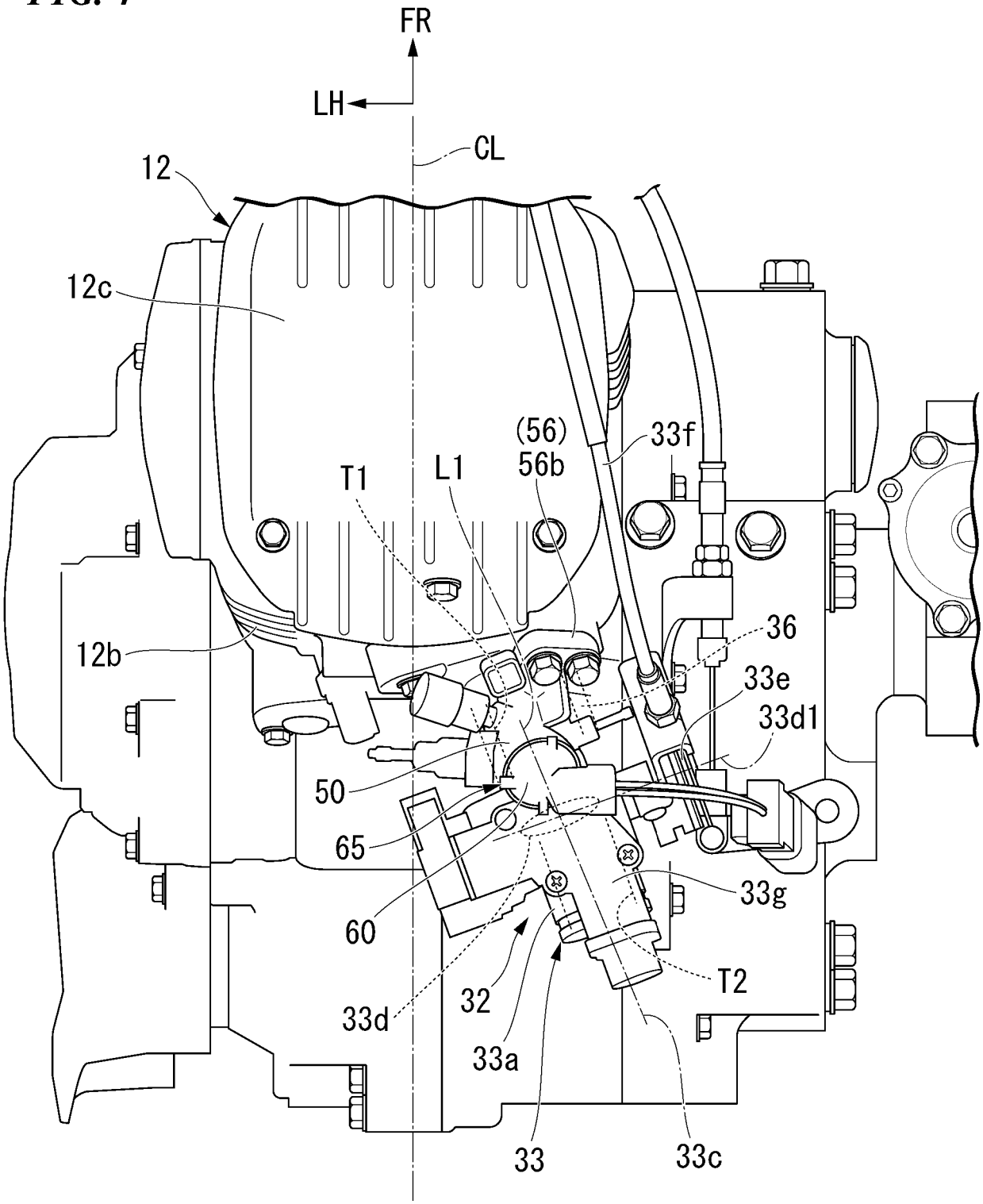
FIG. 4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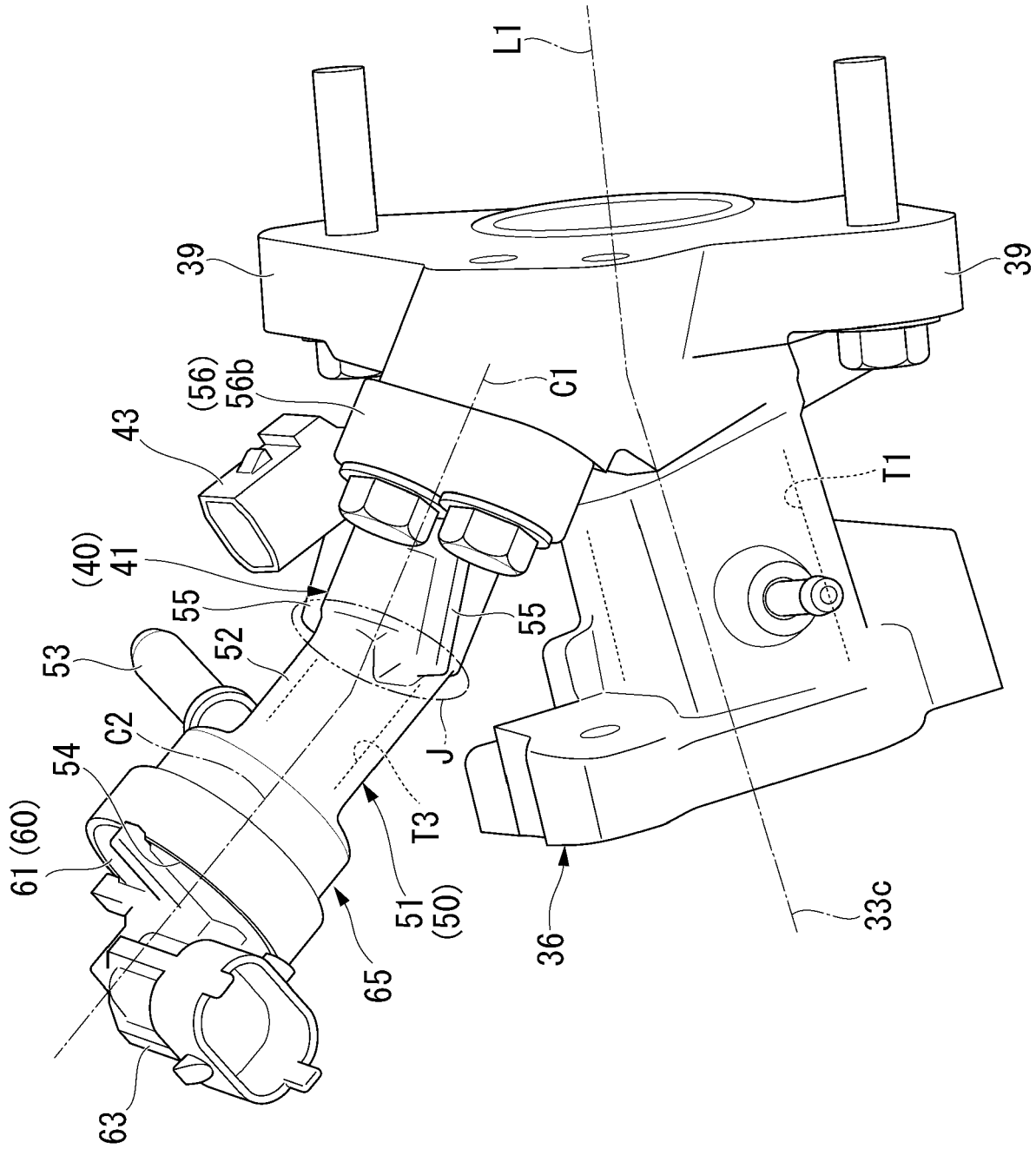
33
33c

FIG. 5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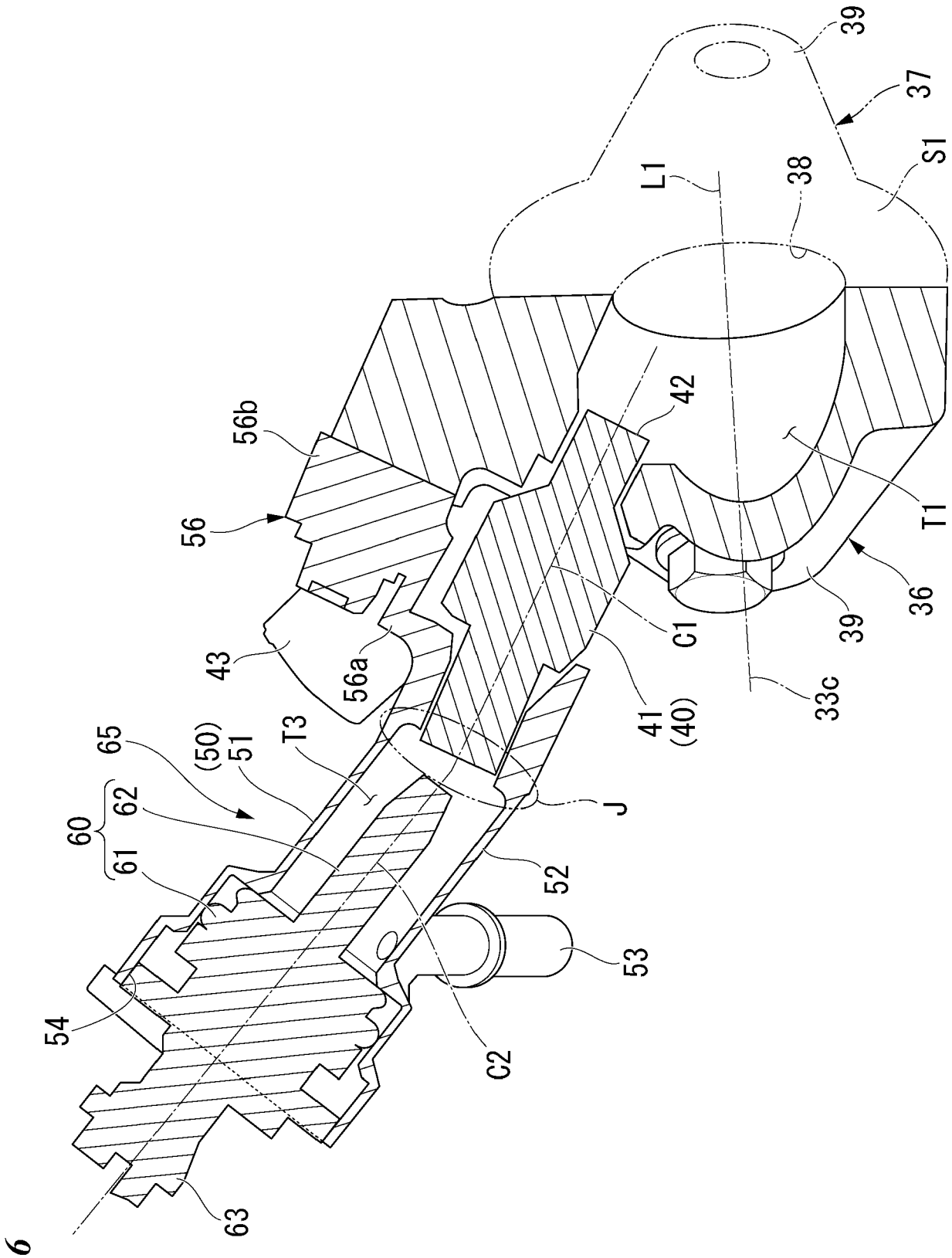
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33c
(50)
51
T3
65
J
60
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53
54
C2
63

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 0266

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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	12 February 2024	Nobre Correia, S

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12-02-2024

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