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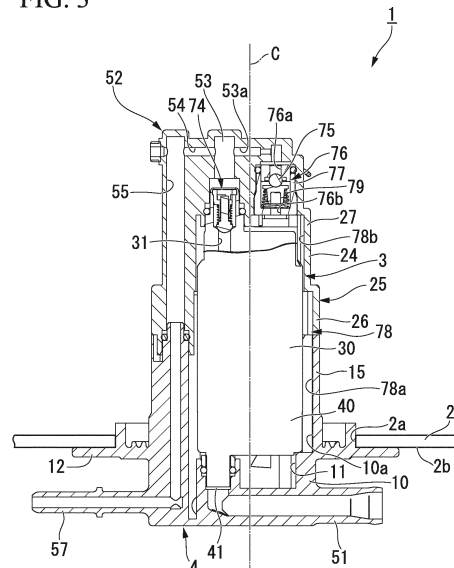
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(54) **FUEL SUPPLY DEVICE**

(57) Provided is a pressure regulator (76) that is provided with a return flow path (78). The return flow path (78) is provided in the inner side of an upper cup (25) and is disposed on the plane of projection of a fuel pump (3) when viewed from an axial direction. The return flow path (78) that communicates between a pressure regulator (76) and a reservoir portion (11), and guides fuel discharged from the pressure regulator (76) to the reservoir portion (11) between the fuel pump (3) and the upper cup (25) and between the fuel pump (3) and a flange unit (4).

FIG. 3



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## Description

[Technical Field]

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

Priority is claimed on Japanese Patent Application Nos. 2010-288798 and 2010-288799 filed on December 24, 2010, the contents of which are incorporated herein by reference.

[Background Art]

**[0002]** In general, as a fuel supply device for a vehicle such as a motorcycle or a four-wheel vehicle, a so-called in-tank type fuel supply device in which a fuel pump is set up in a fuel tank is used.

The ink tank type fuel supply device includes a structure (hereinafter referred to as an "upper mount type") in which a flange unit is disposed at an upper portion of the fuel pump and is mounted on an upper portion of the fuel tank, and a structure (hereinafter referred to as an "lower mount type") in which the flange unit is disposed at a lower portion of the fuel pump and is mounted on the bottom of the fuel tank.

**[0003]** The lower mount type fuel supply device is equipped with a fuel pump, a flange unit that is set up at a lower end of the fuel pump and is mounted on the fuel tank, and an upper cup that covers the fuel pump from the outside. Further, the fuel pump is equipped with an impeller at a lower portion thereof and a motor unit at an upper portion thereof which rotatably drives the impeller. Thus, if the impeller is rotatably driven, fuel in the fuel tank is pumped, passes through a reservoir portion of the flange unit and the motor unit, and is fed from the upper portion of the fuel pump under pressure (e.g. see Patent Literature 1). Further, the reservoir portion has a function of storing the fuel in the flange unit. Accordingly, for instance, even when a vehicle is inclined during traveling and the fuel in the fuel tank leans to one side, the fuel is allowed to be fed from the reservoir portion to an internal combustion engine.

**[0004]** Here, in the lower mount type fuel supply device as in Patent Literature 1, the fuel pumped by the fuel pump is led from a bottom wall side of the fuel tank to the outside, and is fed toward the engine under pressure. For this reason, a fuel flow path unit made up of first and second flow path pipes for leading the fuel from the upper portion of the fuel pump to the bottom wall of the fuel tank is integrally formed in the upper cup.

**[0005]** Further, a pressure regulator is installed on a tip (i.e. a tip of the upper cup) of the first flow path pipe of Patent Literature 1 (corresponding to a "second flow path" of the present application) at the opposite side of a side at which the second flow path pipe (corresponding to a "third flow path" of the present application) is connected. The pressure regulator is a member for returning the fuel in a fuel flow path to the fuel tank when a surplus

pressure is applied in the fuel flow path and constantly maintaining a fuel pressure in the fuel flow path at all times.

**[0006]** On the other hand, in the ink tank type fuel supply device, a pump assembly in which the electric motor and the fuel pump are integrated is sandwiched by the upper cup and the flange unit, and is fixed by claw fitting (e.g., see Patent Literature 2).

**[0007]** The flange unit of Patent Literature 2 is equipped with a cylindrical case portion and a flange portion.

A terminal case (corresponding to a harness connecting portion of the present application) to which harnesses are connected is installed in the case portion in an upright state. Further, a bottom of the case portion forms a reservoir portion. The reservoir portion is installed below a base of the fuel tank, and the fuel flows into the reservoir portion from a fuel inflow port formed in a side of the upper cup.

**[0008]** The harnesses electrically connects power supply terminals and the electric motor. Specifically, one-end sides of the harnesses are connected to terminal strips (corresponding to motor terminals of the present application) of the electric motor at an upper end of the pump assembly. Further, the other-end sides of the harnesses are connected to the power supply terminals (corresponding to connector terminals of the present application) in a terminal case. Here, when the other-end sides of the harnesses are connected to the power supply terminals in the terminal case, the other-end sides of the harnesses are inserted into the fuel inflow port.

[Citation List]

[Patent Literature]

**[0009]**

[Patent Literature 1] Japanese Unexamined Patent Application, First Publication No. 2010-116793

[Patent Literature 2] Japanese Unexamined Patent Application, First Publication No. 2009-052427

[Summary of Invention]

[Problem to be Solved by the Invention]

**[0010]** Incidentally, in the fuel supply device of Patent Literature 1, the pressure regulator is disposed in a state in which it is exposed to the tip of the upper cup. For this reason, when the fuel pressure in the fuel flow path is raised, the fuel is discharged from the pressure regulator, and then directly returns into the fuel tank. Afterwards, the fuel passes through the reservoir portion of the flange unit and the motor unit again, and is fed from the upper portion of the fuel pump under pressure.

**[0011]** Here, since the fuel discharged from the pressure regulator is accumulated in the reservoir portion via

the inside of the fuel tank again, the fuel cannot be put in efficient circulation. Accordingly, for example, when the vehicle is inclined during traveling and the fuel in the fuel tank leans to one side, the fuel discharged from the pressure regulator is not sufficiently accumulated in the reservoir portion.

**[0012]** Further, in the fuel supply device of Patent Literature 2, to secure insulation properties of the individual terminals, terminal holes having a small diameter are formed in the terminal case. For this reason, a worker cannot efficiently insert the other-end sides of the harnesses into predetermined terminal holes, so that working efficiency during assembly of the harnesses is reduced.

Further, an edge may be formed at an opening edge of the fuel inflow port. For this reason, if the harnesses rattle with the vibration of a vehicle body, the harnesses rub against the edge, and service life of the harnesses is shortened.

**[0013]** Therefore, the present invention is directed to provide a fuel supply device capable of putting fuel in efficient circulation.

**[0014]** Further, the present invention is directed to provide a fuel supply device capable of achieving extension of service life of harnesses while improving working efficiency during assembly of the harnesses.

[Means for Solving the Problems]

**[0015]** To accomplish the objects, a fuel supply device according to a first aspect of the present invention includes a fuel pump that is disposed in a fuel tank, pumps fuel in the fuel tank, and feeds the fuel to an internal combustion engine under pressure, an upper cup that is externally inserted into the fuel pump from an upper side of an axial direction of the fuel pump and has a fuel flow path through which the fuel discharged from the fuel pump flows, a flange unit that is mounted on a bottom wall of the fuel tank, supports the fuel pump in cooperation with the upper cup, and has a reservoir portion that accumulates the fuel, and a pressure regulator that constantly maintains a fuel pressure inside the fuel flow path. The pressure regulator is disposed inside the upper cup and on a projection plane of the fuel pump when viewed from the axial direction. Further, the fuel pump is configured so that an outer circumference thereof is covered by the upper cup. Furthermore, a return flow path is provided between the fuel pump and the upper cup and between the fuel pump and the flange unit, communicates between the pressure regulator and the reservoir portion, and guides the fuel discharged from the pressure regulator to the reservoir portion.

**[0016]** According to the fuel supply device according to the first aspect of the present invention, the pressure regulator is disposed inside the upper cup and on the plane of projection of the fuel pump. Thereby, the fuel discharged from the pressure regulator can flow along the outer circumferential surface of the fuel pump while

being radially scattered by running against the fuel pump. Accordingly, the fuel discharged from the pressure regulator can be efficiently guided to the return flow path. Furthermore, since the return flow path communicates between the pressure regulator and the reservoir portion, the fuel discharged from the pressure regulator can be directly guided to the reservoir portion. Accordingly, the fuel can be efficiently circulated.

**[0017]** Further, in a fuel supply device according to a second aspect of the present invention, the pressure regulator is directed to the fuel accumulating reservoir portion of the flange unit, and is mounted on the upper cup. According to the fuel supply device according to the second aspect of the present invention, since the fuel discharged from the pressure regulator can positively return to the reservoir portion, the fuel can be efficiently circulated.

**[0018]** Further, in a fuel supply device according to a third aspect of the present invention, the upper cup is formed with a fuel path leading from the fuel pump to an injector and a fuel path leading from the fuel pump to the pressure regulator.

According to the fuel supply device according to the third aspect of the present invention, the upper cup that covers almost all the pressure regulator and effectively secures the fuel is used as the fuel path. Thereby, a compact layout can be obtained.

**[0019]** Further, in a fuel supply device according to a fourth aspect of the present invention, the fuel path leading from the fuel pump to the pressure regulator protrudes upward from the upper cup.

According to the fuel supply device according to the fourth aspect of the present invention, the fuel path can be disposed in the upper cup in a compact way, and an axial length of the fuel supply device can be shortened. For this reason, miniaturization of the fuel supply device can be realized. Further, when the fuel supply device is inserted and assembled from an opening formed at a lower side of the fuel tank, the pressure regulator can be protected even if the fuel supply device comes into contact with an edge of the opening of the fuel tank. Similarly, there is no problem even in the event of package or transportation. Furthermore, this fuel pressure regulating device is a precise part that constantly regulates a fuel pressure with precision. For this reason, the fuel pressure regulating device is protected, and thereby a high-precision fuel pressure regulating function of the fuel supply device can be maintained for a long period of time.

**[0020]** Further, in a fuel supply device according to a fifth aspect of the present invention, a check valve is provided between the fuel path provided in the upper cup and the fuel pump, and the check valve and the pressure regulator are disposed in parallel at an upper side of the fuel pump.

According to the fuel supply device according to the fifth aspect of the present invention, since the check valve and the pressure regulator are disposed in parallel, the compact layout can be obtained.

**[0021]** Further, in a fuel supply device according to a sixth aspect of the present invention, the pressure regulator and the check valve are located on a projection plane of the fuel pump.

According to the fuel supply device according to the sixth aspect of the present invention, the check valve and the pressure regulator can be disposed in a space-saving way, and downsizing of the fuel pump unit can be realized.

**[0022]** Further, in a fuel supply device according to a seventh aspect of the present invention, the fuel path leading from the fuel pump to the injector is located on an opposite side of the pressure regulator having the check valve in between.

According to the fuel supply device according to the seventh aspect of the present invention, the fuel path can be efficiently disposed using the upper cup.

**[0023]** Further, in a fuel supply device according to an eighth aspect of the present invention, the fuel path leading from the fuel pump to the injector, the check valve, and the pressure regulator are disposed in alignment.

According to the fuel supply device according to the eighth aspect of the present invention, the fuel path can be easily formed, and the check valve and the pressure regulator can be connected within the shortest distance.

**[0024]** Further, in a fuel supply device according to a ninth aspect of the present invention, the fuel supply device includes a fuel pump that is disposed in a fuel tank, pumps fuel in the fuel tank, and feeds the fuel to an internal combustion engine under pressure, motor terminals that are provided in the fuel pump and supply an electric current to an electric motor of the fuel pump, an upper cup that is formed so as to include the fuel pump, a flange unit that fixes the upper cup to the fuel tank and has a reservoir portion accumulating the fuel, connector terminals that are provided in the flange unit and that conducts inside and outside of the fuel tank, and harnesses having connection terminals, which are capable of being connected to the motor terminals and the connector terminals, at opposite ends thereof, and electrically connects the motor terminals and the connector terminals. In one of the upper cup and the flange unit, a wall portion that guides insertion of the connection terminals into harness-side terminal portions of the connector terminals is provided in an upright state at a position that becomes a radial inner side from the harness-side terminal portions.

According to the fuel supply device according to the ninth aspect of the present invention, the wall portion guiding the insertion of the connection terminals is provided at the radial inner side from the harness-side terminal portions of the connector terminals. Thereby, the connection terminals can be inserted into the connector terminals along the wall portion. As a result, working efficiency during assembly of the harnesses is improved.

Further, even when an edge is formed at the opening of the fuel tank, the harnesses adjacent to the harness-side terminal portions of the connector terminals are in surface

contact with a wall surface of the wall portion. As such, the harnesses can be inhibited from rubbing against the edge.

**[0025]** Further, in a fuel supply device according to a tenth aspect of the present invention, a plurality of terminal storage walls, which is aligned along the wall portion and is disposed apart from the wall portion, is provided at a radial outer side of the wall portion in an upright state. The harness-side terminal portions of the connector terminals are disposed between the plurality of wall portions. Further, the wall portions include groove portions recessed to the radial inner side at positions corresponding to the plurality of terminal storage walls, and a slit causing the fuel reservoir portion to communicate with an outer side of the wall portions.

According to the fuel supply device according to the tenth aspect of the present invention, the plurality of terminal storage walls is provided in the upright state, and the harness-side terminal portions of the connector terminals are disposed between the plurality of terminal storage walls. As a result, even when stress is applied to the connector terminals by pulling of the harnesses, the connector terminals can be prevented from being bent and short-circuited.

Further, the terminal storage walls are disposed apart from the wall portions. Furthermore, the wall portions are formed so that the groove portions are recessed to the radial inner side at the positions corresponding to the terminal storage walls and so that the slit causes the fuel reservoir portion to communicate with the outside of the wall portions. Accordingly, the fuel around the harness-side terminal portions of the connector terminals can easily flow from the outside of the wall portions into the fuel reservoir portion. As a result, the fuel is not accumulated around the harness-side terminal portions of the connector terminals.

**[0026]** Further, in a fuel supply device according to an eleventh aspect of the present invention, the harnesses are routed along the wall portion, and are located at radial inner sides of the upper cup and the flange unit.

According to the fuel supply device according to the eleventh aspect of the present invention, the harnesses are routed along the wall portion, so that the harnesses can be inhibited from rubbing against the edge. Further, the harnesses are located at radial inner sides of the upper cup and the flange unit. Thereby, when the fuel supply device is assembled into the fuel tank, the harnesses can be inhibited from being caught in the fuel tank and surrounding parts of the fuel tank. Accordingly, the service life of the harnesses is prolonged while the working efficiency during the assembly of the harnesses is being improved, and the assemblability of the fuel supply device is improved.

**[0027]** Further, in a fuel supply device according to a twelfth aspect of the present invention, the upper cup is provided with a clip portion regulating movement of the harnesses. Further, the clip portion includes a base portion formed at the radial inner side from an outer circum-

ferential surface of the upper cup, and a holding portion disposed apart from and along the base portion, and is configured so that one end thereof is connected to the base portion and so that the other end thereof is open. The holding portion is formed so that a surface thereof is located at the radial inner side from the outer circumferential surface of the upper cup.

According to the fuel supply device according to the twelfth aspect of the present invention, since the clip portion is provided, instability of the harnesses can be prevented. As a result, the harnesses can be inhibited from rubbing against the edge, and the service life of the harnesses can be prolonged.

Further, the surface of the holding portion is disposed at the radial inner side from the outer circumferential surface of the upper cup. For this reason, when the fuel supply device is assembled into the fuel tank, the clip portion or the harnesses can be inhibited from being caught in the fuel tank and surrounding parts of the fuel tank. Accordingly, the working efficiency during the assembly of the harnesses is improved, and the service life of the harnesses is prolonged. Furthermore, the assemblability of the fuel supply device is improved.

**[0028]** Further, in a fuel supply device according to a thirteenth aspect of the present invention, the wall portion is provided in the flange unit in an upright state, and an outer surface of the wall portion and an outer surface of the base portion are formed so as to be approximately flush with each other.

According to the fuel supply device according to the thirteenth aspect of the present invention, the outer surface of the wall portion and the outer surface of the base portion are formed so as to be approximately flush with each other. Thereby, the harnesses can be reliably inhibited from rubbing against the edge formed by the edge of the wall portion and the edge of the base portion. Accordingly, the working efficiency during the assembly of the harnesses is improved, and the service life of the harnesses is prolonged. Furthermore, the assemblability of the fuel supply device is improved.

Further, in comparison with a case when the wall portion is provided in the upper cup, when the wall portion is not provided in the upper cup, the size of the metal mold of the upper cup can be made small. On the other hand, at the side of the flange unit, the size of the metal mold is not changed regardless of whether or not the wall portion is present. Accordingly, without providing the wall portion in the upper cup, the wall portion is provided in the flange unit in an upright state. Thereby, the manufacturing facility cost of the fuel supply device is reduced.

#### [Effects of the Invention]

**[0029]** According to the fuel supply device according to the aspects of the present invention, the pressure regulator is disposed inside the upper cup and on the plane of projection of the fuel pump. Thereby, the fuel discharged from the pressure regulator can flow along the

outer circumferential surface of the fuel pump while being radially scattered by running against the fuel pump. Accordingly, the fuel discharged from the pressure regulator can be efficiently guided to the return flow path. Furthermore, since the return flow path communicates between the pressure regulator and the reservoir portion, the fuel discharged from the pressure regulator can be directly guided to the reservoir portion. Accordingly, the fuel can be efficiently circulated.

**[0030]** Further, according to the fuel supply device according to the aspects of the present invention, the wall portion guiding the insertion of the connection terminals is provided at the radial inner side from the harness-side terminal portions of the connector terminals. Thereby, the connection terminals can be inserted into the connector terminals along the wall portion. As a result, the working efficiency during the assembly of the harnesses is improved.

Further, even when the edge is formed at the opening of the fuel tank, the harnesses adjacent to the harness-side terminal portions of the connector terminals are in surface contact with a wall surface of the wall portion. As such, the harnesses can be inhibited from rubbing against the edge.

#### [Brief Description of Drawings]

##### [0031]

FIG. 1 is a perspective view of a fuel supply device according to an embodiment of the present invention.

FIG. 2 is a plan view of the fuel supply device according to the embodiment of the present invention when viewed from a direction of the central axis of a fuel pump.

FIG. 3 is a cross-sectional view taken along line A-A of FIG. 2.

FIG. 4 is a side view of the fuel supply device according to the embodiment of the present invention.

FIG. 5 is a perspective view of a wall portion and a clip portion in the fuel supply device according to the embodiment of the present invention.

FIG. 6 is an explanatory view of the wall portion and the clip portion when viewed from an axial direction.

FIG. 7 is an enlarged view of a flange unit of the fuel supply device according to the embodiment of the present invention, and an explanatory view of the wall portion, a terminal storage wall, a groove portion, and a slit.

#### [Description of Embodiments]

**[0032]** Hereinafter, a fuel supply device according to an embodiment of the present invention will be described with reference to FIGS. 1 to 3. In the present embodiment, a central axis of a fuel pump is defined as a central axis C, and axial relative positions of the fuel pump are simply

expressed as upper and lower sides. Further, as described above, the in-tank type fuel supply device includes the upper mount type in which it is mounted on the top of the fuel tank and the lower mount type in which it is mounted on the bottom of the fuel tank. However, the fuel supply device of the present embodiment is the lower mount type.

(Fuel pump)

[0033]

FIG. 1 is a perspective view of a fuel supply device 1. FIG. 4 is a side view of the fuel supply device.

As shown in FIGS. 1 and 4, the fuel supply device 1 of the present embodiment is equipped with a fuel pump 3 that is disposed in a fuel tank 2 (see FIG. 3), pumps fuel in the fuel tank 2, and feeds the fuel to an internal combustion engine under pressure. The fuel pump 3 is formed in an approximately columnar shape, and includes a motor unit 30 disposed at an upper side thereof and a pump unit 40 disposed at a lower side thereof. An outer circumferential surface of the fuel pump 3 is formed by a cylindrical housing made of, for instance, a metal.

(Motor unit)

[0034] In the motor unit 30, for instance, a direct current motor with brushes (not shown) is used. A pair of motor terminals 32 electrically connected with the brushes is provided at an upper side of the motor unit 30 in an upright state along the central axis C at the upper side of the fuel pump 3.

As shown in FIG. 2, the pair of motor terminals 32 is disposed at both sides of the central axis C of the fuel pump 3. In detail, the motor terminals 32 are disposed near the outer circumferential surface of the fuel pump 3 so as to be symmetric with respect to the central axis C. For this reason, a sufficient clearance can be secured between the motor terminals 32. Further, connection terminals 33a provided at one side of harnesses 6 to be described below are connected to the pair of motor terminals 32. Furthermore, external terminal portions 34a of connector terminals 34 are electrically connected with an external power supply (not shown). Accordingly, the external power supply and the motor unit 30 are electrically connected by the harnesses 6, and power for driving the motor unit 30 is supplied from the external power supply. Meanwhile, connection between connection terminals 33b and harness-side terminal portions 34b of the connector terminals 34 will be described below.

[0035] In the pump unit 40, for instance, a non-displacement type pump having an impeller (not shown) is used. The impeller is driven by the motor unit 30. An intake port 41 into which the fuel is taken is provided at a lower side of the pump unit 40. The intake port 41 communicates with a fuel reservoir portion 11 (see FIG. 4)

formed at the lower side of the fuel pump 3 via a filter outlet pipe (not shown), a filter unit (not shown) provided separately from the fuel supply device 1, and a filter inlet pipe 51, all of which will be described below. Further, the pump unit 40 is provided with a discharge port (not shown) at the upper side thereof which discharges the fuel. The fuel pump 3 pumps the fuel accumulated in the fuel reservoir portion 11 from the intake port 41 of the pump unit 40 via the filter inlet pipe 51, the filter unit, and the filter outlet pipe. Then, the pump unit 40 feeds the fuel to an outflow port 31 (see FIG. 3) disposed at the upper side of the motor unit 30 under pressure.

[0036] Further, the fuel pump 3 is provided with a check valve 74 at the upper side thereof. In detail, the check valve 74 is installed between an outflow port 31 disposed at the upper side of the motor unit 30 and a first flow path 53 of a fuel flow path unit 52 to be described below. The check valve 74 is a member for preventing the fuel from flowing backward from the first flow path 53 into the fuel pump 3. A detailed operation of the check valve 74 is as follows.

[0037] If the fuel pump 3 is operated, the fuel in the fuel tank 2 is pumped by the fuel pump 3, and is ejected from the outflow port 31 at the upper side of the motor unit 30. Then, a pressure of the fuel ejected from the outflow port 31 is raised, and a flap of the check valve 74 is pushed upward, so that the check valve 74 is switched into an opened state. Afterwards, the fuel is fed into the fuel flow path (the first flow path 53), which will be described below, via the check valve 74 under pressure.

On the other hand, if the fuel pump 3 is stopped, the pressure of the fuel ejected from the outflow port 31 is lowered, and the check valve 74 is switched into a closed state. In this case, the fuel is held in the fuel flow path without being ejected via the check valve 74.

(Flange unit)

[0038] The fuel supply device 1 is equipped with a flange unit 4 that is disposed at the lower side of the fuel pump 3 and is mounted on a bottom wall 2b of the fuel tank 2. The flange unit 4 is a member that is formed of a resin having high oil resistance and is formed by injection. The flange unit 4 is made up of a unit body 10, a flange portion 12 of an approximate disc shape, a connector 14 formed at an outer side of the flange portion 12, and a hooking portion 15 formed at an upper side of the flange portion 12. Furthermore, the filter inlet pipe 51, the filter outlet pipe, and a fuel extraction pipe 57, which form a flow path of the fuel, are formed at a lower side of the flange portion 12.

[0039] The unit body 10 is formed in a bottomed tube shape. The unit body 10 is formed with a space in an inner side thereof which is surrounded by an inner circumferential surface thereof and a bottom surface thereof. The space functions as the reservoir portion 11 (see FIG. 3) in which the fuel is accumulated. Further, the unit

body 10 is formed with the filter inlet pipe (not shown), the filter outlet pipe 51, and the fuel extraction pipe 57 at an outer side thereof which communicates with the reservoir portion 11 and which form the flow path of the fuel.

**[0040]** Further, the unit body 10 is externally fitted to the fuel pump 3 from the lower side of the fuel pump 3. The inner circumferential surface 10a of the unit body 10 is formed so as to be greater than an outer diameter of the fuel pump 3. Thus, a lower return flow path 78a is formed by a clearance between the inner circumferential surface 10a of the unit body 10 and the outer circumferential surface of the fuel pump 3.

A lower end side of the lower return flow path 78a communicates with the reservoir portion 11. Further, an upper end side of the lower return flow path 78a communicates with an upper return flow path 78b formed in an upper cup 25 to be described below.

**[0041]** The filter inlet pipe and the filter outlet pipe 51 communicate with the filter unit (not shown) provided separately from the fuel supply device 1. The fuel accumulated in the reservoir portion 11 is introduced into the filter unit through the filter inlet pipe.

The fuel filtered and ejected by the filter unit is introduced into the intake port of the pump unit 40 via the filter outlet pipe 51. Afterwards, the fuel is pumped from the intake port 41 of the pump unit 40 by the fuel pump 3.

Then, the fuel is fed to the upper side of the motor unit 30 under pressure, and flows through the check valve 74 and each of fuel flow paths (the first flow path 53, a second flow path 54, and a third flow path 55) formed in the upper cup 25 to be described below. Then, the fuel is fed to an internal combustion engine (not shown) through the fuel extraction pipe 57.

**[0042]** The flange portion 12 of an approximate disc shape is formed on a circumferential wall of the lower side of the unit body 10. Thus, the fuel supply device 1 is mounted on the fuel tank 2, and thereby the lower side from the flange portion 12 is exposed to the outside of the fuel tank 2. Further, the upper side from the flange portion 12 is immersed in the fuel in the fuel tank 2. A seal member (not shown) formed of rubber is provided between the flange portion 12 and the bottom wall 2b of the fuel tank 2. For this reason, the sealing characteristics between the fuel supply device 1 and the fuel tank 2 can be reliably secured.

**[0043]** A connector 14 is integrally formed at the lower side of the flange portion 12. The connector 14 is a tubular member with a bottom, and has a connector fitting face that is open to a radial outer side. The connector 14 is formed by injection at the same time when the unit body 10 is formed.

Connector terminals 34 conducting the inside and outside of the fuel tank 2 are provided in the connector 14. One-end sides 34a of the connector terminals 34 protrude to an inner side of the connector 14. An external connector (not shown), which is electrically connected to an external power supply (not shown), is fitted into the one-end sides 34a of the connector terminals 34.

**[0044]** Further, the other-end sides 34b of the connector terminals 34 protrude to the upper side of the flange portion 12. The harnesses 6 are connected to the other-end sides 34b of the connector terminals 34. The harnesses 6 are electrically connected with the motor unit 30 and a liquid-level detector 60, and the power is supplied from the external power supply to the motor unit 30 and the liquid-level detector 60.

**[0045]** A hooking portion 15, which is hooked on hooking claws 25a formed at the upper cup 25 to be described below, is provided at the upper side of the flange portion 12. The hooking portion 15 is formed in an approximately circular shape when viewed from the axial direction. A plurality of hooking pieces 15a (four in the present embodiment) protruding to the upper side is formed at a circumferential edge of the hooking portion 15. The hooking pieces 15a are formed so as to be able to undergo elastic deformation in a direction in which upper ends thereof are enlarged in diameter. Further, each hooking piece 15a is formed with a hooking hole that is allowed to be hooked on the hooking claw 25a formed at the upper cup 25. The hooking portion 15 is snap-fitted to the upper cup 25, so that the flange unit 4 and the upper cup 25 are fixed.

**[0046]** At a radial inner side of a connected portion between the other-end sides 34b of the connector terminals 34 and the harnesses 6, a wall portion 81 is formed in the axial direction in an upright state. The wall portion 81 is formed by indenting an outer circumferential surface of the hooking portion 15. Thus, the wall portion 81 forms a space disposing the connected portion between the other-end sides 34b of the connector terminals 34 and the harnesses 6.

A slit 82 is provided between the wall portion 81 and the hooking portion 15. The slit 82 is formed in a lateral portion of one side of the wall portion 81. Alternatively, the slit 82 may be formed in a lateral portion of the other side of the wall portion 81. The slit 82 is provided in the axial direction, and has approximately the same length as the wall portion 81. The slit 82 causes the reservoir portion 11 of the flange unit 4 to communicate with an outer side of the wall portion 81 (i.e., the interior of the fuel tank 2). If the fuel supply device 1 is immersed in the fuel in the fuel tank 2, the fuel flows from the slit 82 into the reservoir portion 11 and is accumulated in the reservoir portion 11.

(Upper cup)

**[0047]** The fuel supply device 1 includes the upper cup 25 externally inserted from the upper side of the fuel pump 3 into the fuel pump 3. The upper cup 25 is formed of a resin having high oil resistance, and is a tubular member having a bottom. The upper cup 25 is formed by, for instance, injection.

A mounting portion 61 of the liquid-level detector 60 is formed at an upper side of the upper cup 25. The mounting portion 61 is formed in a shape of a plate that extends toward a radial outer side, and is formed by injection at

the same time when the upper cup 25 is formed. The liquid-level detector 60 is fixed to the mounting portion 61 by snap-fitting.

**[0048]** The upper cup 25 has a tubular portion 24 externally inserted into the fuel pump 3. The tubular portion 24 includes a large-diameter portion 26 disposed at a lower side thereof, and a small-diameter portion 27 disposed at an upper side thereof. The small-diameter portion 27 is externally fitted to the upper side of the fuel pump 3. An inner circumferential surface of the small-diameter portion 27 is formed so as to be approximately equal to or slightly greater than the same as the outer diameter of the fuel pump 3. The outer circumferential surface of the fuel pump 3 is internally fitted to the inner circumferential surface of the small-diameter portion 27, so that the fuel pump 3 is supported.

The large-diameter portion 26 is formed by radially enlarging a lower side of the small-diameter portion 27 to provide a step.

An outer circumferential surface of the large-diameter portion 26 of the tubular portion 24 is formed with the hooking claws 25a at the positions corresponding to the hooking holes of the hooking pieces 15a formed at the flange unit 4. Both the hooking claws 25a of the upper cup 25 and the hooking pieces 15a of the flange unit 4 are snap-fitted, so that the upper cup 25 and the flange unit 4 become unified.

**[0049]** The tubular portion 24 of the upper cup 25 is provided with a fuel flow path unit 52 (fuel flow path) at an inner side thereof through which the fuel discharged from the fuel pump 3 passes. The fuel flow path unit 52 is formed from an upper end face 27a of the small-diameter portion 27 of the tubular portion 24 throughout an outer circumferential surface of the tubular portion 24 in an approximately L-shaped cross section. The fuel flow path unit 52 is made up of the first flow path 53, the second flow path 54, the third flow path 55, and each fuel flow path of a sub-flow path 53a, along with the pressure regulator 76 and the return flow path 78.

**[0050]** The first flow path 53 is formed at an upper side of the check valve 74 along the central axis C. The fuel ejected from the fuel pump 3 via the check valve 74 flows into the first flow path 53. The second flow path 54 is horizontally formed from an upper end of the first flow path 53 so as to protrude from an outer circumferential surface of the small-diameter portion 27. The third flow path 55 vertically extends along the outer circumferential surface of the small-diameter portion 27. Further, the first flow path 53 and the third flow path 55 are connected by the second flow path 54.

(Pressure regulator)

**[0051]** Further, at an inner side of the small-diameter portion 27 of the upper cup 25, the pressure regulator 76 is provided at an opposite side of the third flow path 55 and the check valve 74 across the central axis C. The pressure regulator 76 is a member for constantly

maintaining a fuel pressure in each fuel flow path, and ejects the fuel in each fuel flow path to the reservoir portion 11 when a surplus fuel pressure occurs in each fuel flow path.

**[0052]** The pressure regulator 76 has a configuration in which a steel ball 75 and a valve spring 79 are held in a housing 77 formed of a cylindrical metal. Further, the housing 77 is configured as an inflow port 76a into which the fuel flows at one end side thereof, and an outflow port 76b out of which the fuel flows at the other end side thereof.

**[0053]** The pressure regulator 76 is disposed so as to be approximately parallel with the check valve 74 and to run along the central axis C of the fuel pump 3 toward the inflow port 76a at an upper side thereof and toward the inflow port 76a at a lower side thereof. Further, the pressure regulator 76 is disposed on a projection plane of the fuel pump 3 when viewed from an axial upper side, i.e. at a radial inner side from the outer circumferential surface of the fuel pump 3.

**[0054]** The inflow port 76a of the pressure regulator 76 communicates with each of the fuel flow paths of the first flow path 53, the second flow path 54, and the third flow path 55 via the sub-flow path 53a. When a surplus pressure is applied to each of the fuel flow paths, the fuel flows from the inflow port 76a of the pressure regulator 76 into the pressure regulator 76.

(Return flow path)

**[0055]** The outflow port 76b of the pressure regulator 76 communicates with an upper end side of the upper return flow path 78b. The upper return flow path 78b is formed by a clearance between the inner circumferential surface of the tubular portion 24 of the upper cup 25 and the outer circumferential surface of the fuel pump 3. In detail, a part of the inner circumferential surface of the small-diameter portion 27 of the tubular portion 24 and a part of the inner circumferential surface of the large-diameter portion 26 are formed so as to be greater than the outer diameter of the fuel pump 3, thereby providing the upper return flow path 78b.

**[0056]** A lower end side of the upper return flow path 78b communicates with an upper end side of the lower return flow path 78a. Here, as described above, the lower end side of the lower return flow path 78a communicates with the reservoir portion 11. Accordingly, the return flow path 78 causing the outflow port 76b of the pressure regulator 76 to communicate with the reservoir portion 11 is formed by the upper return flow path 78b and the lower return flow path 78a.

(Hooking portion)

**[0057]** As shown in FIG. 1, the hooking portion 15, which is hooked on the hooking claws 25a formed in the large-diameter portion 26 of the upper cup 25 as described below, is provided at the upper side of the flange

portion 12. The hooking portion 15 is formed in an approximately circular shape having a smaller diameter than an annular portion 13 when viewed from the upper side. Further, the plurality of hooking pieces 15a (four in the present embodiment) protruding to the upper side is formed at the circumferential edge of the hooking portion 15. The hooking pieces 15a are formed so as to be able to undergo elastic deformation in the direction in which upper ends thereof are enlarged in diameter. Further, the hooking pieces 15a are formed with the hooking holes that are allowed to be hooked on the hooking claws 25a formed at the upper cup 25. The hooking pieces 15a of the hooking portion 15 are snap-fitted to the large-diameter portion 26 of the upper cup 25, so that the flange unit 4 and the upper cup 25 are fixed.

(Filter inlet pipe, filter outlet pipe, and fuel extraction pipe)

**[0058]** The filter inlet pipe 51, the filter outlet pipe, and the fuel extraction pipe 57 are provided at the lower side of the flange portion 12.

The filter inlet pipe 51 and the filter outlet pipe communicate with the filter unit provided separately from the fuel supply device 1. The fuel in the fuel tank 2 flows into the filter unit through the filter inlet pipe 51. Further, the fuel filtered and ejected by the filter unit flows into the intake port of the pump unit 40 through the filter outlet pipe.

The fuel extraction pipe 57 communicates with the internal combustion engine (not shown). The fuel accumulated in the fuel reservoir portion 11 flows through the filter unit, and then is pumped from the intake port of the pump unit 40.

Then, the fuel is fed to the upper side of the motor unit 30 under pressure, and is delivered to the internal combustion engine through the fuel extraction pipe 57.

(Connector)

**[0059]** The connector 14 is integrally formed at the lower side of the flange portion 12. The connector 14 is a tubular member having an approximately rectangular shape when viewed from a radial direction. The connector 14 has a connector fitting face that is open to a radial outer side. The connector 14 is formed at the same time when the unit body 10 is formed. An external connector (not shown) connected to an external power supply or a control device is fitted to the connector 14.

(Connector terminals)

**[0060]** The connector terminals 34 conducting the inside and outside of the fuel tank 2 are provided in the connector 14. The connector terminals 34 are members made of a metal such as copper, and are formed by press working. The connector terminals 34 are formed by, for instance, insert molding when the connector 14 is formed. The connector terminals 34 are electrically connected to a motor driving power supply and a power supply

of the liquid-level detector 60. The connector terminals 34 are formed approximately in an L shape. The external terminal portions 34a of the connector terminals 34 protrude to the inner side of the connector 14. The harness-side terminal portions 34b of the connector terminals 34 are disposed in the harness connecting portion 80 that is located at the radial inner side from the outer circumferential surface of the hooking portion 15 and is formed at the upper side of the flange portion 12. Meanwhile, details of the harness connecting portion 80 will be described below.

(Harnesses)

**[0061]** The harnesses 6 are members for connecting the connector terminals 34, the motor terminals 32, and the terminals of the liquid-level detector 60. The harnesses 6 are formed by a core made of a metal such as copper, and a sheath that is made of an insulating material having oil resistance such as cross-linked polyethylene or vinyl chloride and covers the core. Furthermore, each harness 6 is provided with a connection terminal 33a at one end side thereof and a connection terminal 33b at the other end side thereof.

**[0062]** The four harnesses 6 are provided, and the connection terminals 33a of the one end side thereof are connected with the motor terminals 32 and the terminals of the liquid-level detector 60. On the other hand, the connection terminals 33b of the other end side of the harnesses 6 are connected to the harness-side terminal portions 34b of the connector terminals 34 inside the harness connecting portion 80. Accordingly, the external power supply can supply power to the motor unit 30 and the liquid-level detector 60 via the harnesses 6.

(Wall portion)

**[0063]**

FIG. 5 is a perspective view of a wall portion 81 and a clip portion 65.

FIG. 6 is an explanatory view of the wall portion 81 and the clip portion 65 when viewed from the axial direction. Note that, to facilitate understanding of the figure, the harnesses 6 are omitted in FIG. 6.

As shown in FIGS. 5 and 6, the wall portion 81 is formed at the flange unit 4 in an upright state in an upward direction.

The wall portion 81 is formed at a position corresponding to the harness-side terminal portions 34b of the connector terminals 34, within the outer circumferential surface of the hooking portion 15 formed in the approximately circular shape. In detail, at the position corresponding to the harness-side terminal portions 34b, a pair of lateral portions 16a and 16b extending from the outer circumferential surface of the hooking portion 15 toward the radial inner side is formed. Radial inner side tips of the

pair of lateral portions 16a and 16b are connected, and thereby the wall portion 81 is formed. Accordingly, the wall portion 81 is formed at the radial inner side of the outer circumferential surface of the hooking portion 15.

**[0064]** Here, a recessed space is formed at the radial inner side from the outer circumferential surface of the hooking portion 15 by the wall portion 81 and the pair of lateral portions 16a and 16b. The harness-side terminal portions 34b of the connector terminals 34 are disposed in this space. Accordingly, the wall portion 81 is disposed at the radial inner side from the harness-side terminal portions 34b of the connector terminals 34. Further, in the space formed by the wall portion 81 and the pair of lateral portions 16a and 16b, the connection terminals 33b of the harnesses 6 and the harness-side terminal portions 34b are connected. That is, the harness connecting portion 80 is formed by the wall portion 81 and the pair of lateral portions 16a and 16b.

**[0065]** An upper end of the wall portion 81 is formed at a height at which it is in contact with a lower end of the upper cup 25. For this reason, no gap is formed between the wall portion 81 and the upper cup 25, and there is no edge caused by edges of the wall portion 81 and the upper cup 25.

(Terminal storage walls)

**[0066]** FIG. 7 is an enlarged view of a flange unit 4, and an explanatory view of a wall portion 81, terminal storage walls 86, groove portions 84, and a slit 82.

As shown in FIG. 7, a plurality of terminal storage walls 86 (four in the present embodiment) are formed along the wall portion 81 at a radial outer side of the wall portion 81. The plurality of terminal storage walls 86 is disposed along the wall portion 81 at approximately regular intervals in a direction perpendicular to an upward direction. The harness-side terminal portions 34b of the connector terminals 34 and the connection terminals 33b are disposed between the plurality of terminal storage walls 86. As a result, even when stress is applied to each terminal by pulling of the harnesses 6, each terminal is prevented from being bent and short-circuited.

Further, the plurality of terminal storage walls 86 is disposed apart from the wall portion 81. Accordingly, a space is formed between the wall portion 81 and the terminal storage walls 86.

(Groove portions)

**[0067]** Further, a plurality of groove portions 84 are formed in an outer surface of the wall portion 81. The groove portions 84 are formed at positions corresponding to the plurality of terminal storage walls 86, respectively. That is, the groove portions 84 are formed parallel with a direction in which the terminal storage walls 86 are provided in an upright state (an upward direction in the present embodiment). The groove portions 84 are formed in the wall portion 81, the space between the wall portion

81 and the terminal storage walls 86 can be widely secured.

Since the groove portions 84 are formed at the positions corresponding to the plurality of terminal storage walls 86, the wall portion 81 between the groove portions 84 is formed in a state in which the positions corresponding to the harness-side terminal portions 34b protrude toward the harness-side terminal portions 34b. When the connection terminals 33b are connected to the harness-side terminal portions 34b, the connection terminals 33b are aligned along the outer surface of the protruding wall portion 81, and the harness-side terminal portions 34b and the connection terminals 33b are connected.

15 (Slit)

**[0068]** Further, the slit 82 is provided in the wall portion 81. The slit 82 is formed at a side of the lateral portion 16a of one side of the wall portion 81. Alternatively, the slit 82 may be provided in the lateral portion 16b of the other side of the wall portion 81. The slit 82 is provided along the upward direction, and has approximately the same length as the wall portion 81. The slit 82 causes the fuel reservoir portion 11 of the flange unit 4 to communicate with the outer side of the wall portion 81.

(Clip portion)

**[0069]** Further, the clip portion 65 is integrally formed with a circumferential wall of the tubular portion 24 of the upper cup 25. The clip portion 65 is formed at the upper side of the harness connecting portion 80 in the large-diameter portion 26 of the tubular portion 24.

The clip portion 65 is made up of a base portion 67 and a holding portion 66 connected with the base portion 67. The base portion 67 is formed at the aforementioned position corresponding to the wall portion 81, within the large-diameter portion 26 of the tubular portion 24. In detail, like the wall portion 81, a pair of lateral portions extending from the large-diameter portion 26 of the tubular portion 24 toward the radial inner side is formed, and radial inner side tips of the pair of lateral portions are connected. Thereby, the base portion 67 is formed. The base portion 67 is formed so that an outer surface thereof is configured to be approximately flush with the outer surface of the aforementioned wall portion 81. Further, the base portion 67 is formed so that a lower side thereof is in contact with the upper side of the wall portion 81. As the base portion 67 is formed in this way, no edge is formed adjacent to a boundary between the wall portion 81 and the base portion 67 by edges of the wall portion 81 and the base portion 67.

**[0070]** The holding portion 66 has an approximately rectangular shape when viewed from the radial direction, and is configured so that one end 66b thereof is connected to the base portion 67 and so that the other end 66a thereof is open. The base portion 67 has a circumferential length set to a length greater than a width thereof when

the plurality of harnesses 6 held therein is disposed in parallel in a circumferential direction one by one. Further, the holding portion 66 is disposed apart from and along the base portion 67. A clearance between the holding portion 66 and the base portion 67 is set to be approximately equal to or greater than diameters of the held harnesses 6. As the holding portion 66 is formed in this way, the harnesses 6 are inserted between the holding portion 66 and the base portion 67 from an opening of the other end 66a of the holding portion 66, so that the plurality of harnesses 6 are disposed between the holding portion 66 and the base portion 67. Further, an outer surface of the holding portion 66 is disposed at a radial inner side from the outer circumferential surface of the large-diameter portion 26 of the upper cup 25. As a result, the harnesses 6 are allowed to be disposed at an inner side from the outer circumferential surface of the large-diameter portion 26 of the upper cup 25 while preventing slackness of the harnesses 6.

(Operation)

**[0071]** Next, an operation of the fuel supply device 1 according to the embodiment of the present invention will be described.

First, operations of the fuel supply device 1 and the return flow path 78 will be described.

If the fuel supply device 1 is immersed in the fuel, the fuel in the fuel tank 2 flows from the slit 82 between the wall portion 81 and the hooking portion 15 of the flange unit 4 into the reservoir portion 11, and is accumulated in the reservoir portion 11.

Then, if the motor unit 30 of the fuel pump 3 is driven, the impeller (not shown) coupled with a rotating shaft of the motor unit 30 so as to be unable to cause relative rotation is rotated. If the impeller is rotated, the fuel in the reservoir portion 11 flows through the filter inlet pipe, the filter unit, and the filter outlet pipe 51 in that order and is filtered. Then, the fuel is pumped from the intake port 41 of the pump unit 40 by the fuel pump 3.

**[0072]** The fuel flows through the interiors of the pump unit 40 and the motor unit 30, and is ejected from the outflow port 31 disposed at the upper side of the motor unit 30. Afterwards, a pressure of the fuel is raised. As a result, the check valve 74 is opened. In this way, the fuel flowing through the check valve 74 flows through the first flow path 53, the second flow path 54, and the third flow path 55, and then is delivered to the internal combustion engine (not shown) through the fuel extraction pipe 57.

**[0073]** Here, the pressure regulator 76, which communicates with each of the fuel flow paths of the first flow path 53, the second flow path 54, and the third flow path 55, is in a closed state in which the ball 75 is brought into contact with the side of the inflow port 76a under pressure by a biasing force of the valve spring 79.

However, if a fuel pressure in each fuel flow path exceeds a predetermined value, the fuel pressure is superior to the biasing force of the valve spring 79. As a result, the

ball 75 moves toward the outflow port 76b, and a gap occurs between the inflow port 76a and the ball 75. Thereby, the pressure regulator 76 is switched to an opened state.

**[0074]** Afterwards, the fuel in each fuel flow path flows from the inflow port 76a of the pressure regulator 76 into the pressure regulator 76 via the sub-flow path 53a, and is discharged from the outflow port 76b of the pressure regulator 76. Then, the discharged fuel flows along the outer circumferential surface of the fuel pump 3 while being radially scattered by running against the fuel pump. The fuel flows into the reservoir portion 11 via the return flow path 78, and is accumulated in the reservoir portion 11 again.

As the pressure regulator is operated as described above, if the fuel pressure in each fuel flow path is equal to or less than a predetermined pressure value, the biasing force of the valve spring 79 is superior to the fuel pressure. As a result, the ball 75 is brought in contact with the side of the inflow port 76a again, so that the pressure regulator 76 is shifted to the closed state.

**[0075]** Next, an operation when the harnesses 6 are mounted on the fuel supply device 1 according to the embodiment of the present invention will be described.

The harnesses 6 are connected after the hooking pieces 15a of the flange unit 4 and the hooking claws 25a of the upper cup 25 are hooked. Further, any one of the connection terminals 33a of one end side of the harnesses 6 and the connection terminals 33b of the other side of the harnesses 6 may be connected first. Hereinafter, a case in which the connection terminals 33b of the other side of the harnesses 6 are connected first will be described as an example.

**[0076]** The connection terminals 33b of the other side of the harnesses 6 are connected to the harness-side terminal portions 34b of the connector terminals 34 installed in the harness connecting portion 80 in an upright state.

First, the side of the harnesses 6 of the connection terminals 33b is grasped, and tips of the connection terminals 33b are brought into contact with the wall portion 81. Subsequently, the connection terminals 33b move to the lower side while being aligned along the wall portion 81. In this state, the connection terminals 33b are inserted into and connected to the harness-side terminal portions 34b of the connector terminals 34. In this way, the connection terminals 33b can be inserted into the harness-side terminal portions 34b of the connector terminals 34 only by aligning the tips of the connection terminals 33b along the wall portion 81 and moving the connection terminals 33b to the lower side.

**[0077]** Next, the harnesses 6 are held by the clip portion 65. In detail, the harnesses 6 are inserted from the open other end 66a of the holding portion 66, so that the harnesses 6 are disposed between the holding portion 66 and the base portion 67. The surface of the holding portion 66 is disposed at the radial inner side from the outer circumferential surface of the upper cup 25. Ac-

cordingly, the harnesses 6 are held at the radial inner side from the outer circumferential surface of the upper cup 25 by the holding portion 66.

**[0078]** Finally, the connection terminals 33a of one end side of the harnesses 6 are connected to the motor terminals 32 and the terminals of the liquid-level detector 60. Thereby, the external power supply can supply power to the motor unit 30 and the liquid-level detector 60 via the harnesses 6.

As described above, the connection terminals 33a and 33b of the harnesses 6 are connected to the connector terminals 34, the motor terminals 32, and the terminals of the liquid-level detector 60, and the harnesses 6 are held in the clip portion 65. Thereby, the harnesses 6 are mounted.

**[0079]** The fuel supply device 1 assembled in this way is mounted in the fuel tank 2. If the fuel is filled in the fuel tank 2, the fuel flows into the fuel reservoir portion 11 via the slit 82.

Here, as described above, the plurality of terminal storage walls 86 is disposed apart from the wall portion 81. Furthermore, the groove portions 84 are formed at the position corresponding to the plurality of terminal storage walls 86, respectively. For this reason, a space is formed between the wall portion 81 and the terminal storage walls 86. As shown in FIG. 7, the space communicates with the space around the harness-side terminal portions 34b and the slit 82. That is, such a space forms a fuel distribution path 88 (see an arrow of FIG. 7) that distributes the fuel around the harness-side terminal portions 34b toward the slit 82. For this reason, the fuel is not accumulated around the harness-side terminal portions 34b, and the fuel flows into the reservoir portion 11.

(Effects)

**[0080]** In the fuel supply device 1 of the present embodiment, the pressure regulator 76 is disposed inside the upper cup 25 and on the projection plane of the fuel pump 3. For this reason, the fuel discharged from the pressure regulator 76 can flow along the outer circumferential surface of the fuel pump 3 while being radially scattered by running against the fuel pump 3. Accordingly, the fuel discharged from the pressure regulator 76 can be efficiently guided to the return flow path 78. Furthermore, since the return flow path 78 communicates between the pressure regulator 76 and the reservoir portion 11, the fuel discharged from the pressure regulator 76 can be directly guided to the reservoir portion 11. Accordingly, the fuel can be efficiently circulated.

**[0081]** In the fuel supply device 1 of the present embodiment, when the fuel discharged from the pressure regulator 76 runs against the fuel pump 3 and is radially scattered, the fuel can be prevented from being scattered to the outside of the upper cup 25. Accordingly, the fuel discharged from the pressure regulator 76 can return to the reservoir portion 11 without any loss. For this reason, the fuel can be more efficiently circulated.

**[0082]** In the fuel supply device 1 of the present embodiment, the wall portion 81 guiding the insertion of the connection terminals 33b is provided at the radial inner side from the harness-side terminal portions 34b of the connector terminals 34. Thereby, the connection terminals 33b can be inserted into the connector terminals 34 along the wall portion 81.

Further, in the fuel supply device 1 of the present embodiment, the harnesses 6 adjacent to the harness-side terminal portions 34b of the connector terminals 34 are in surface contact with the wall surface of the wall portion 81. As such, the harnesses 6 can be inhibited from rubbing against the edge.

**[0083]** In the fuel supply device 1 of the present embodiment, the plurality of terminal storage walls 86 is provided in an upright state, and the harness-side terminal portions 34b of the connector terminals 34 are disposed between the plurality of terminal storage walls 86. For this reason, even when stress is applied to the connector terminals 34 by pulling of the harnesses 6, the connector terminals 34 can be prevented from being bent and short-circuited.

Further, the terminal storage walls 86 are disposed apart from the wall portion 81. Furthermore, the wall portion 81 is formed so that the groove portions 84 are recessed to the radial inner side at the positions corresponding to the terminal storage walls 86 and so that the slit 82 causes the fuel reservoir portion 11 to communicate with the outside of the wall portion 81. Accordingly, the fuel around the harness-side terminal portions 34b of the connector terminals 34 can easily flow from the outside of the wall portion 81 into the fuel reservoir portion 11. Thus, the fuel is not accumulated around the harness-side terminal portions 34b of the connector terminals 34.

**[0084]** Further, in the fuel supply device 1 of the present embodiment, since the clip portion 65 is provided, instability of the harnesses 6 can be prevented. Thereby, the harnesses 6 can be inhibited from rubbing against the edge, and service life of the harnesses 6 can be prolonged.

Further, the surface of the holding portion 66 is disposed at the radial inner side from the outer circumferential surface of the upper cup 25. For this reason, when the fuel supply device 1 is assembled into the fuel tank 2, the clip portion 65 or the harnesses 6 can be inhibited from being caught in the fuel tank 2 and surrounding parts of the fuel tank 2. Accordingly, working efficiency during assembly of the harnesses 6 is improved, and the service life of the harnesses 6 is prolonged. Assemblability of the fuel supply device 1 is improved.

**[0085]** Further, in the fuel supply device 1 of the present embodiment, since the outer surface of the wall portion 81 is configured to be approximately flush with the outer surface of the base portion 67, the harnesses 6 can be reliably inhibited from rubbing against the edge formed by the edge of the wall portion 81 and the edge of the base portion 67. Accordingly, the working efficiency during the assembly of the harnesses 6 is improved. The

service life of the harnesses 6 is prolonged, and the assemblability of the fuel supply device 1 is improved.

**[0086]** Further, in comparison with a case when the wall portion 81 is provided in the upper cup 25, when the wall portion 81 is not provided in the upper cup 25, the total length of the upper cup 25 is reduced. Accordingly, in comparison with the case when the wall portion 81 is provided in the upper cup 25, the size of a metal mold of the upper cup 25 can be made small, and a pulling stroke of the metal mold can be shortened. On the other hand, at the side of the flange unit 4, the size of the metal mold is not changed regardless of whether or not the wall portion 81 is present. Accordingly, without providing the wall portion 81 in the upper cup 25, the wall portion 81 is provided in the flange unit 4 in an upright state. Thereby, a manufacturing facility cost of the fuel supply device 1 is reduced.

**[0087]** The present invention is not limited to the aforementioned embodiment.

The fuel supply device 1 of the present embodiment has the filter unit filtering the fuel on the outside thereof. However, the filter unit may also be installed inside the fuel supply device 1. When the filter unit is installed inside the fuel supply device 1, the filter unit is disposed in the reservoir portion 11. In this case, the filter inlet pipe and the filter outlet pipe 51 are not required.

**[0088]** Further, in the fuel supply device 1 of the present embodiment, the wall portion 81 guiding the connection terminals 33b is provided at the side of the flange unit 4. However, the wall portion 81 may be provided at the side of the upper cup 25. From the point of view that the metal mold of the upper cup 25 is made small, that the pulling stroke of the metal mold is shortened, and that the cost is low, an advantage is given to the present embodiment.

**[0089]** The slit 82 of the present embodiment is provided in the one-side lateral portion 16a that is the boundary between the hooking portion 15 and the wall portion 81 of the flange unit 4 at one place. However, the slit 82 may also be provided in the other-side lateral portion 16b. A plurality of slits 82 may be provided. A place at which the slit 82 is provided is not limited to the lateral portions 16a and 16b. For example, the slit 82 may be provided in the wall portion 81. However, as the slit 82 is formed at the side of the one-side lateral portion 16a of the wall portion 81 which is distant from the harnesses 6, contact between the edge formed at the edge of the slit 82 and the harnesses 6 can be reliably avoided. In this respect, an advantage is given to the present embodiment.

**[0090]** In the fuel supply device 1 of the present embodiment, the filter unit is configured as a separate part of the fuel supply device 1. However, for example, the filter unit and the fuel supply device 1 may be integrally configured by disposing the filter unit in the fuel reservoir portion 11.

**[0091]** In the fuel supply device 1 of the present embodiment, the clip portion 65 is provided at the upper side of the harness-side terminal portions 34b of the connec-

tor terminals 34 at one place. However, a plurality of clip portions 65 may be formed at places corresponding to routing positions of the harnesses 6.

**[0092]** In the present embodiment, the case in which the aforementioned structure is applied to the so-called lower mount type fuel supply device 1 has been described. However, the aforementioned structure may be applied to a so-called upper mount type fuel supply device.

[Industrial Applicability]

**[0093]** According to the present invention, the fuel discharged from the pressure regulator can be efficiently guided to the return flow path. Furthermore, according to the present invention, the fuel can be efficiently circulated.

[Reference Signs List]

**[0094]**

- 1...fuel supply device
- 2...fuel tank
- 2b...bottom wall
- 3...fuel pump
- 4...flange unit
- 6...harness
- 11... reservoir portion
- 25...upper cup
- 32... motor terminal
- 33...connection terminal
- 34... connector terminal
- 34b...harness-side terminal portion
- 53 ... first flow path (fuel flow path)
- 53a... sub-flow path (fuel flow path)
- 54... second flow path (fuel flow path)
- 55...third flow path (fuel flow path)
- 65 ... clip portion
- 66... holding portion
- 66a... other end
- 66b... one end
- 67...base portion
- 76...pressure regulator
- 78...return flow path
- 78a... upper return flow path (return flow path)
- 78b...lower return flow path (return flow path)
- 81... wall portion
- 82...slit
- 86...terminal storage wall

**Claims**

1. A fuel supply device comprising:

a fuel pump disposed in a fuel tank, the fuel pump that pumps fuel in the fuel tank and feeds

the fuel to an internal combustion engine under pressure;

an upper cup externally inserted into the fuel pump from an upper side of an axial direction of the fuel pump and having a fuel flow path through which the fuel discharged from the fuel pump flows;

a flange unit mounted on a bottom wall of the fuel tank, that supports the fuel pump in cooperation with the upper cup, and having a reservoir portion that accumulates the fuel; and

a pressure regulator that constantly maintains a fuel pressure inside the fuel flow path,

wherein the pressure regulator is disposed inside the upper cup and on a projection plane of the fuel pump when viewed from the axial direction,

the fuel pump is configured so that an outer circumference thereof is covered by the upper cup, and

a return flow path is provided between the fuel pump and the upper cup and between the fuel pump and the flange unit, communicates between the pressure regulator and the reservoir portion, and guides the fuel discharged from the pressure regulator to the reservoir portion.

2. The fuel supply device according to Claim 1, wherein the pressure regulator is directed to the fuel accumulating reservoir portion of the flange unit, and is mounted on the upper cup.

3. The fuel supply device according to Claim 2, wherein the upper cup is formed with a fuel path leading from the fuel pump to an injector and a fuel path leading from the fuel pump to the pressure regulator.

4. The fuel supply device according to Claim 3, wherein the fuel path leading from the fuel pump to the pressure regulator protrudes upward from the upper cup.

5. The fuel supply device according to Claim 4, further comprising:

a check valve being provided between the fuel path provided in the upper cup and the fuel pump;

wherein the check valve and the pressure regulator are disposed in parallel at an upper side of the fuel pump.

6. The fuel supply device according to Claim 5, wherein the pressure regulator and the check valve are located on a projection plane of the fuel pump.

7. The fuel supply device according to any one of Claims 4 to 6, wherein the fuel path leading from the fuel pump to the injector is located on an opposite

side of the pressure regulator having the check valve in between.

8. The fuel supply device according to any one of Claims 4 to 7, wherein the fuel path leading from the fuel pump to the injector, the check valve, and the pressure regulator are disposed in alignment.

9. The fuel supply device according to Claim 1, further comprising:

motor terminals provided in the fuel pump; connector terminals provided to the flange unit and that conducts inside and outside of the fuel tank; and

harnesses having connection terminals, which are capable of being connected to the motor terminals and the connector terminals, at opposite ends thereof, and electrically connects the motor terminals and the connector terminals,

wherein in one of the upper cup and the flange unit, a wall portion that guides insertion of the connection terminals into harness-side terminal portions of the connector terminals is provided in an upright state at a position that becomes a radial inner side from the harness-side terminal portions.

10. The fuel supply device according to Claim 9, further comprising:

a plurality of terminal storage walls, which is aligned along the wall portion and is disposed apart from the wall portion, being provided at a radial outer side of the wall portion in an upright state, wherein harness-side terminal portions of the connector terminals are disposed between the plurality of wall portions, and each wall portion includes:

groove portions recessed to the radial inner side at positions corresponding to the plurality of terminal storage walls, and a slit that communicates the fuel reservoir portion with an outer side of the wall portion.

11. The fuel supply device according to Claim 9 or 10, wherein the harnesses are routed along the wall portion, and are located at radial inner sides of the upper cup and the flange unit.

12. The fuel supply device according to any one of Claims 9 to 11, wherein the upper cup is provided with a clip portion regulating movement of the harnesses, and the clip portion includes:

a base portion formed at the radial inner side

from an outer circumferential surface of the upper cup, and  
a holding portion disposed apart from and along the base portion, and is configured so that one end thereof is connected to the base portion and so that the other end thereof is open, and

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a surface of the holding portion is disposed at the radial inner side from the outer circumferential surface of the upper cup.

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**13.** The fuel supply device according to Claim 12, wherein the wall portion is provided in the flange unit in an upright state, and an outer surface of the wall portion and an outer surface of the base portion are formed so as to be approximately flush with each other.

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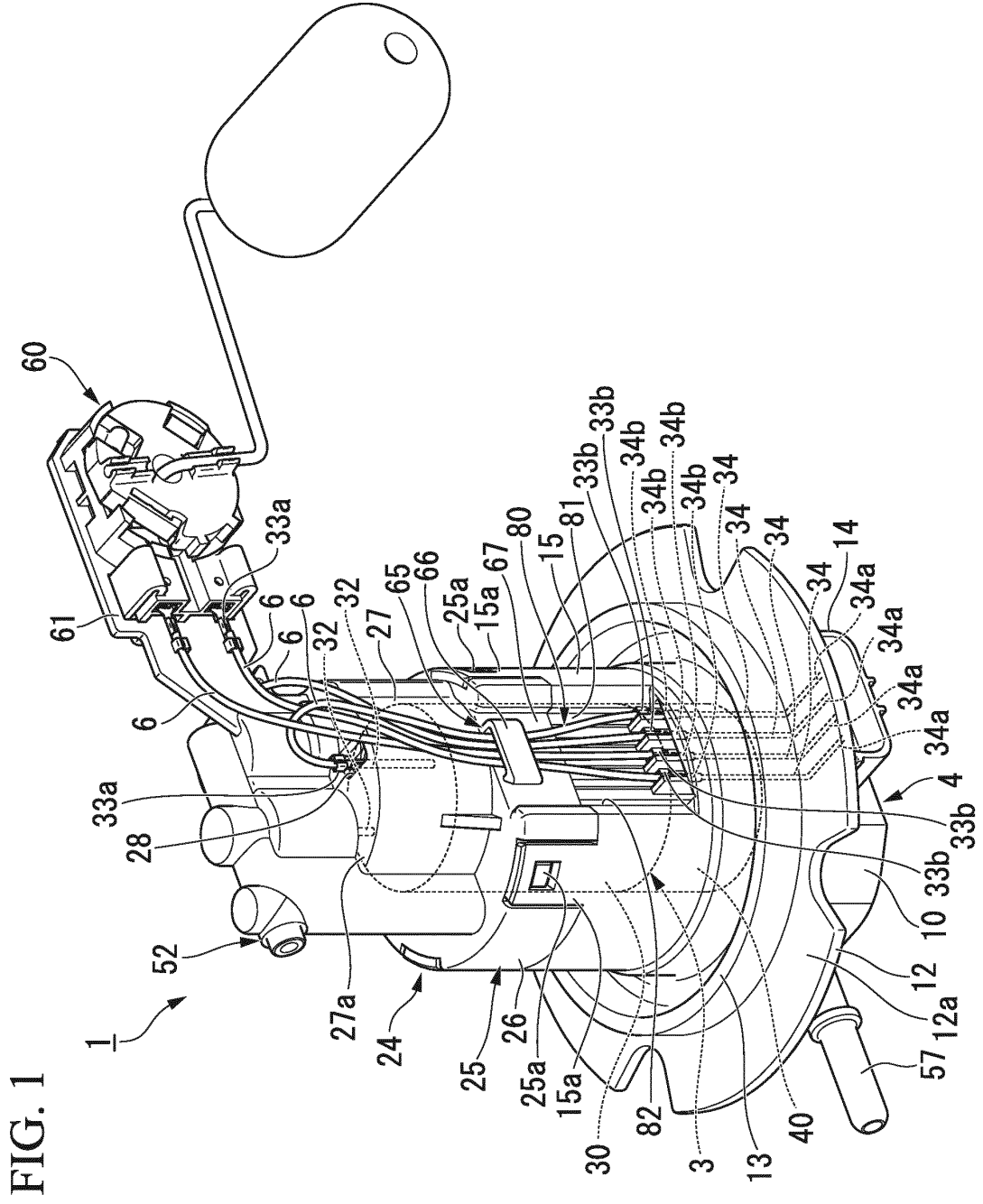


FIG. 1

FIG. 2

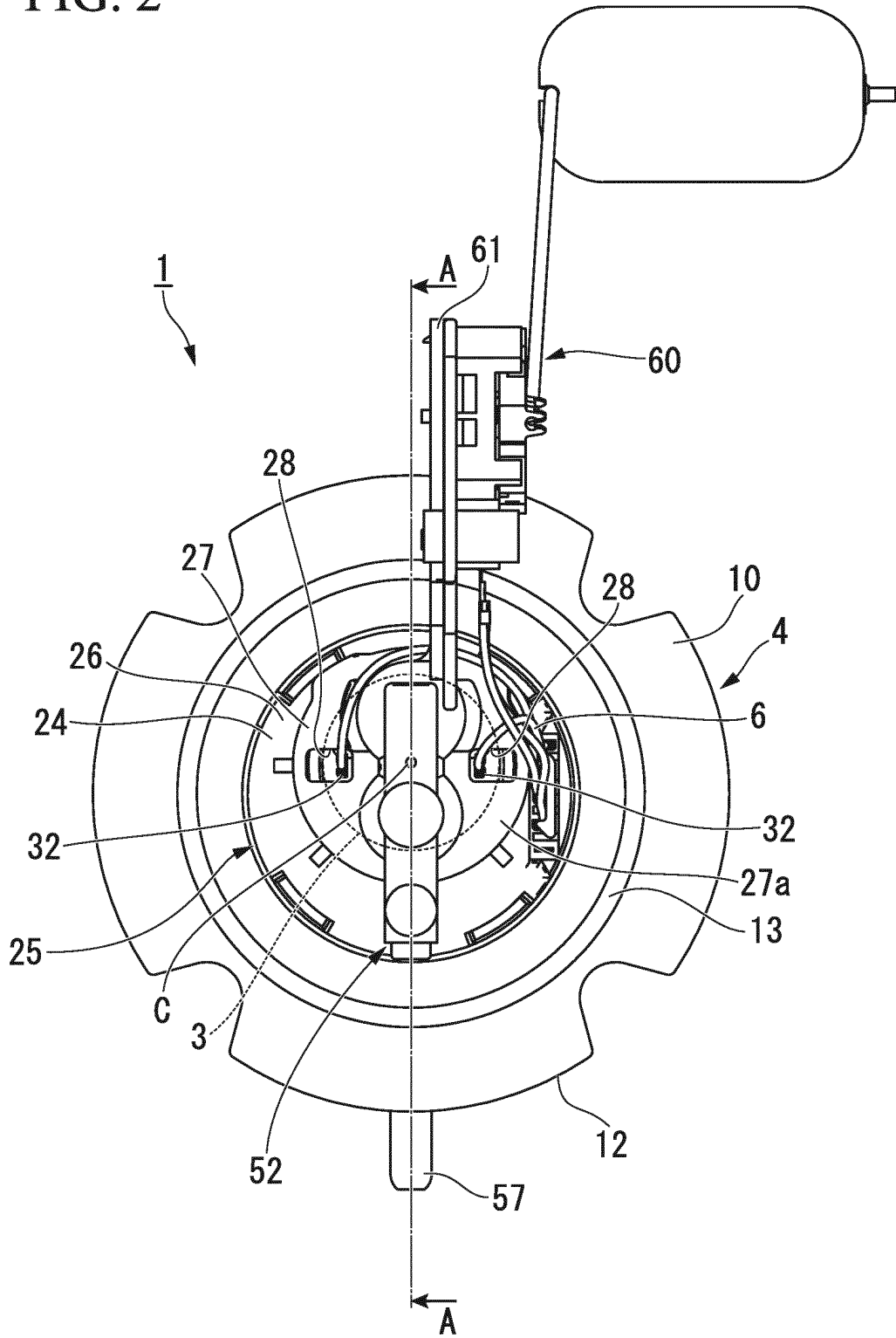


FIG. 3

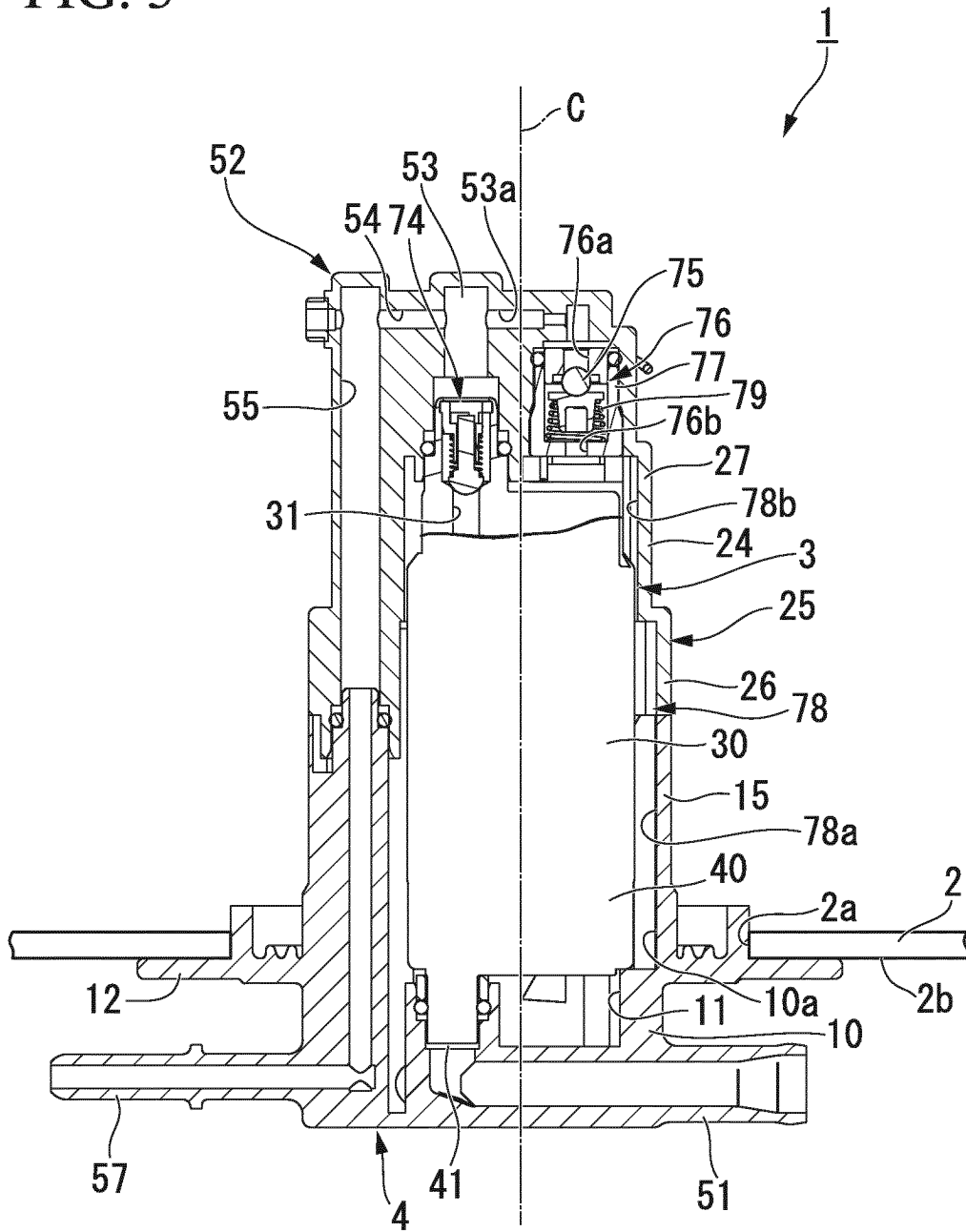


FIG. 4

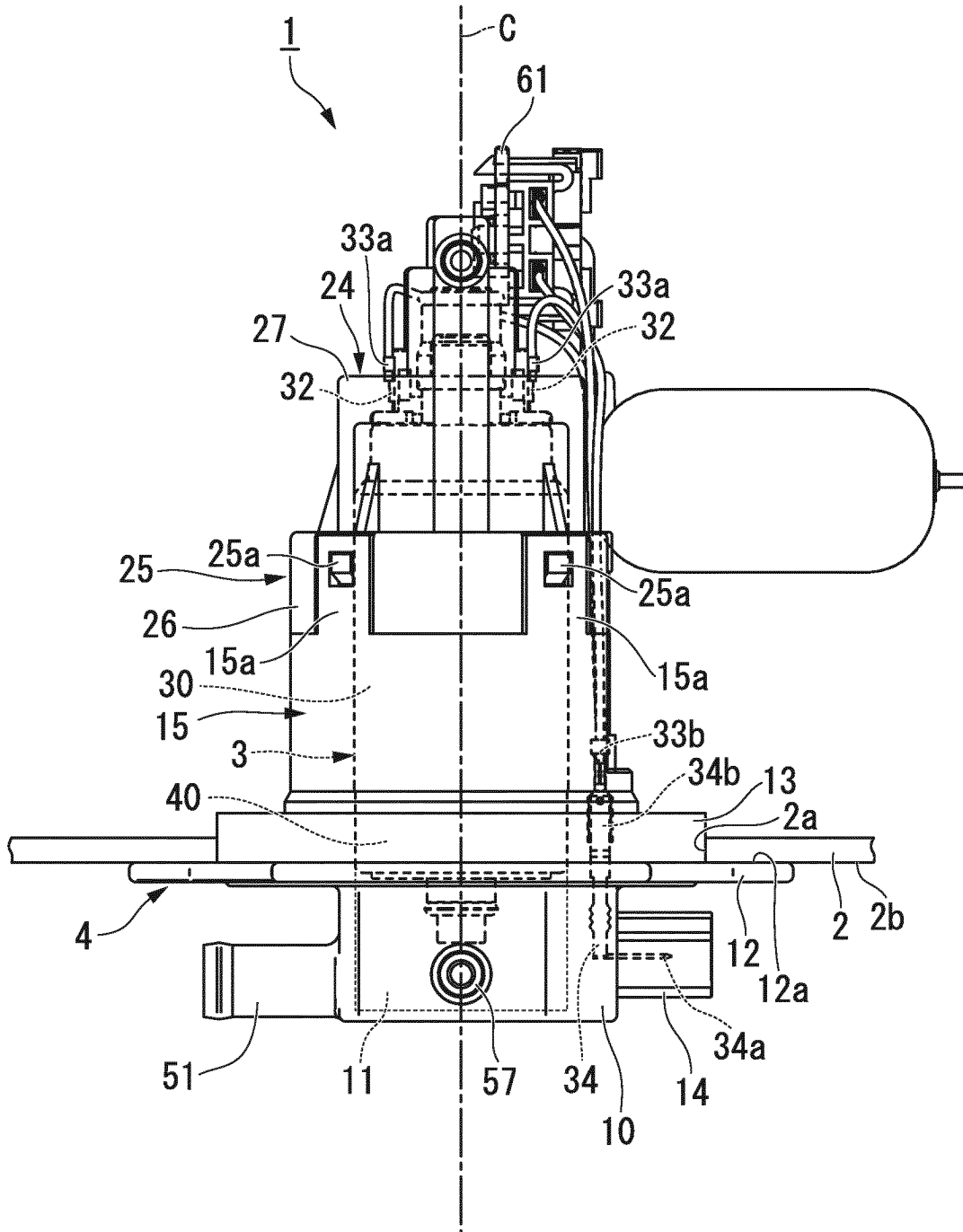


FIG. 5

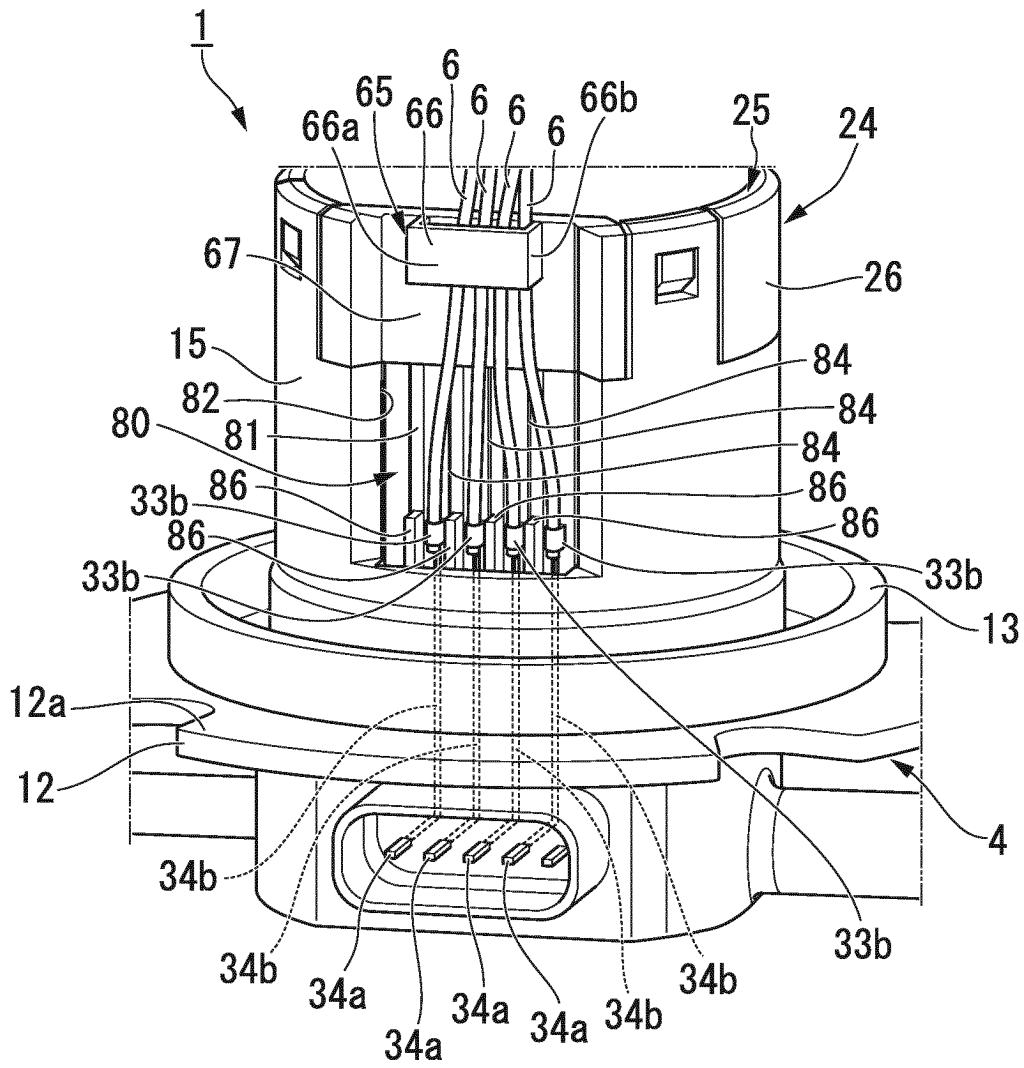
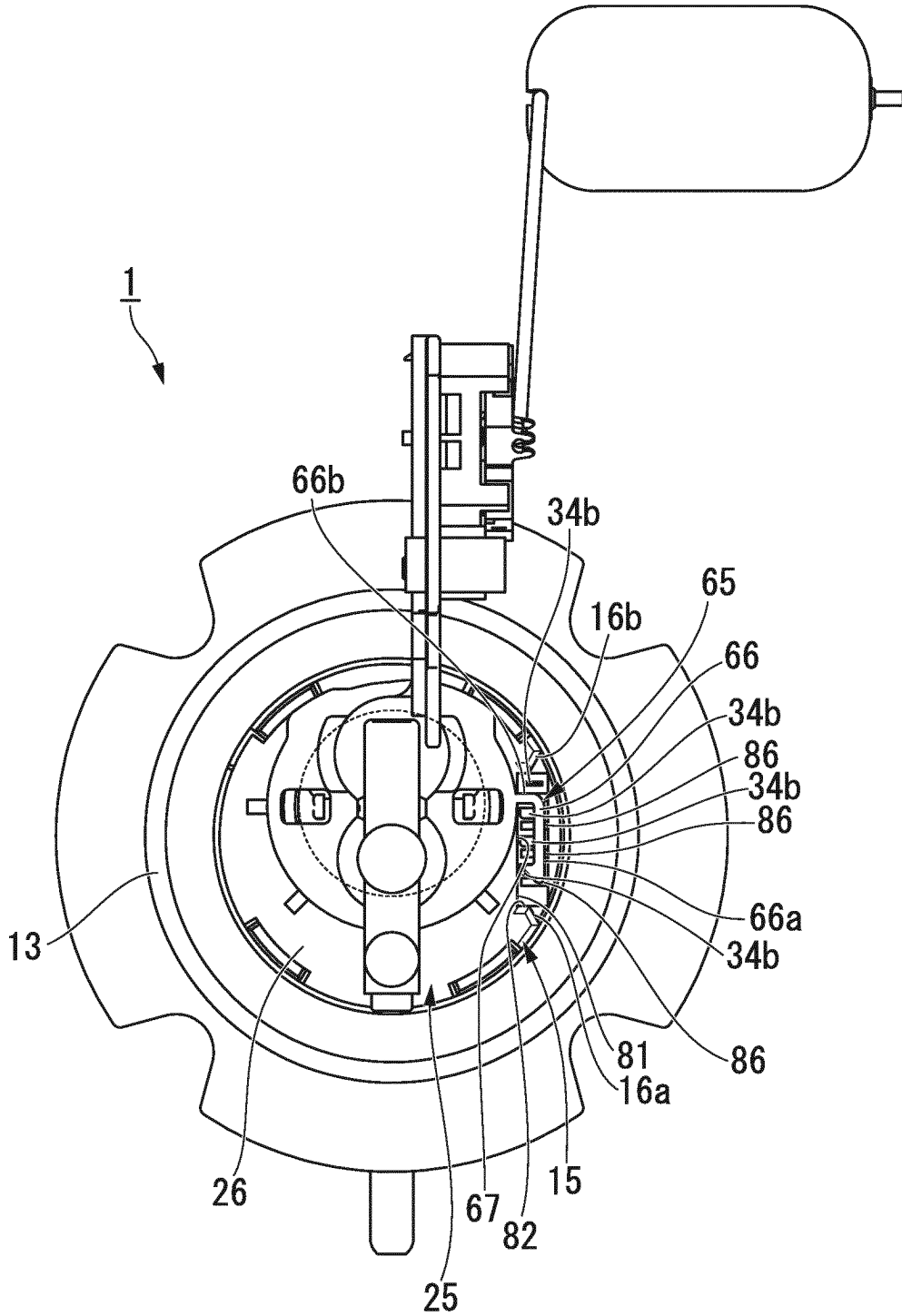


FIG. 6





## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/079824

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> <i>F02M37/10</i> (2006.01) i, <i>F02M37/00</i> (2006.01) i  According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) <i>F02M37/10</i> , <i>F02M37/00</i>  Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012 Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012  Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2010/104058 A1 (Mitsuba Corp.), 16 September 2010 (16.09.2010), paragraphs [0020], [0041]; fig. 5 to 6 (Family: none)	1-13
A	JP 2010-180856 A (Mitsuba Corp.), 19 August 2010 (19.08.2010), paragraphs [0018], [0038]; fig. 3 (Family: none)	1-13
A	JP 2010-133263 A (Mitsuba Corp.), 17 June 2010 (17.06.2010), fig. 2 to 3 (Family: none)	1-13
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 30 March, 2012 (30.03.12)		Date of mailing of the international search report 10 April, 2012 (10.04.12)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/079824

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010-38131 A (Mitsuba Corp.), 18 February 2010 (18.02.2010), fig. 1 (Family: none)	1-13

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**REFERENCES CITED IN THE DESCRIPTION**

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