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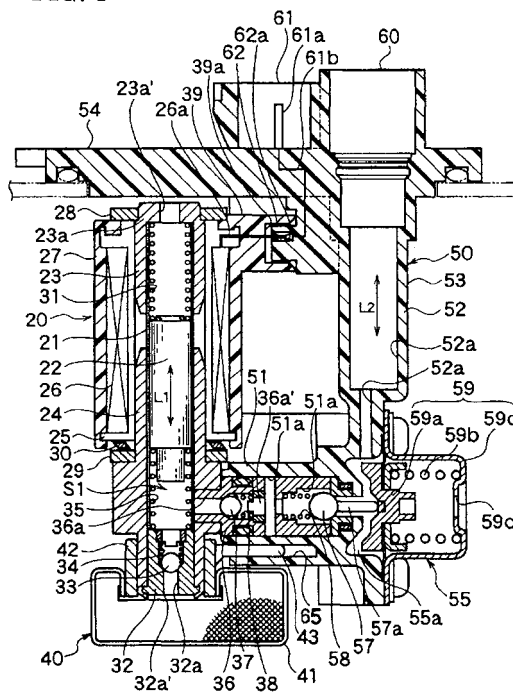
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(54) **FUEL FEEDER**

(57) An object of the present invention is to reduce the size of a fuel supply device which is disposed inside the fuel tank of a two-wheeled vehicle or the like. A positive displacement plunger pump 20 comprising a plunger which performs a linearly reciprocating motion so as to suction and pressure feed fuel, and an entrance control-type fuel pressure regulator 50 which is connected to a discharge port 36a' of this plunger pump 20, and which adjusts the pressure of the fuel supplied to an injector 4, are integrally coupled to form a module which serves as a fuel supply device 10 disposed inside a fuel tank 1. By such means, the overall size of the fuel supply device 10 can be reduced (compacted), making the device particularly suited to installation in a small fuel tank of a two-wheeled vehicle or the like.

FIG. 4



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a fuel supply device which is used to supply fuel to an injector of an internal combustion engine (hereafter referred to as "engine"), and more particularly to a fuel supply device which is disposed in a fuel tank of a vehicle such as a two-wheeled vehicle equipped with a small displacement engine.

2. Description of the Related Art

[0002] Fuel supply devices in which a fuel pump, fuel pressure regulator, filter and so on are incorporated integrally and disposed inside a fuel tank are known as systems for supplying fuel to an engine mounted in a four-wheeled vehicle or the like. A circumferential flow type turbine pump, for example, is employed as the fuel pump which constitutes this fuel supply device.

[0003] A turbine pump has a comparatively large and complicated structure comprising a pump portion, a motor portion and so on, and furthermore, since the turbine pump itself has no self-priming ability, it is disposed inside the fuel tank. Accordingly, these conventional fuel supply devices are suited to being stored in comparatively large fuel tanks such as the fuel tanks of four-wheeled vehicles and the like.

[0004] However, in small displacement engines such as engines mounted in two-wheeled vehicles and the like of around 50cc-250cc per cylinder, the fuel tank is comparatively small and there are restrictions as to shape and the like thereof. It is therefore difficult to store a fuel supply device such as that described above in the fuel tank.

[0005] Furthermore, in two-wheeled vehicles and the like, the engine, fuel tank and so on are disposed in comparatively proximal regions, and hence it must be ensured that the fuel supply system is as little affected as possible by radiation heat from the engine, and further, in order to avoid damage and the like if the vehicle overturns or such, the system must be simplified as far as possible by reducing the number of parts, or it must be ensured that there is no exposure to the outside.

SUMMARY OF THE INVENTION

[0006] The present invention has been designed in consideration of the aforementioned points, and it is an object thereof to provide a fuel supply device in which size has been reduced, structure has been simplified, and functional reliability has been improved, and particularly one which is suited to a vehicle such as a two-wheeled vehicle which is equipped with a small displacement engine.

[0007] The fuel supply device of the present invention is disposed inside a fuel tank and supplies fuel toward the injector of an internal combustion engine, and comprises: a positive displacement plunger pump consisting of a pump main body which demarcates a suction port and a discharge port, a plunger which performs suction and pressure feeding of fuel by means of a linearly reciprocating motion within the pump main body, and an electromagnetic coil for driving the plunger; and a fuel pressure regulator consisting of a regulator main body which demarcates an influx channel connected to the discharge port and a supply channel for supplying fuel toward the injector, and an adjustment valve disposed between the influx channel and the supply channel for adjusting the fuel pressure, wherein the pump main body and the regulator main body are integrally coupled.

[0008] According to this constitution, the plunger pump itself, which is capable of pressure feeding fuel by means of the reciprocating motion of the plunger, is formed in a comparatively small size, and this small size plunger pump and the fuel pressure regulator are formed integrally (modularized). As a result, a fuel supply device with an overall small (compact) size, and which is therefore convenient from the point of view of handling, is provided, this device being particularly suited to installation in a small size fuel tank of a two-wheeled vehicle or the like.

[0009] In the aforementioned constitution, a constitution may be employed in which the direction of reciprocating motion of the plunger and the direction of extension of the supply channel are formed so as to be substantially parallel.

[0010] According to this constitution, the plunger and the supply channel are formed so as to be substantially parallel, or in other words, the longitudinal direction of the pump main body and the longitudinal direction of the regulator main body are formed so as to be substantially parallel. Hence, the two bodies are integrated, enabling further size reduction (compacting). In particular, by forming the outer profile of the device into a quadratic prism or substantially cylindrical shape, for example, a profile form which is compact and therefore convenient to handle can be achieved.

[0011] In the above constitution, a constitution may be employed in which the regulator main body has a mounting flange portion formed on the upper side of the direction of extension for mounting the device onto the fuel tank, and the pump main body has the suction port which is formed on the lower side of the direction of reciprocating motion, and a filter which is attached around the suction port.

[0012] According to this constitution, the filter is disposed on the lower side, the pump main body and regulator main body are disposed in an intermediate position, and the mounting flange portion is disposed on the upper side. Consequently, the device can be easily installed inside a fuel tank simply by fixing the mounting flange portion to the upper wall of the fuel tank, for ex-

ample. The device can also be dealt with as a modular item which includes a filter.

[0013] In the above constitution, a constitution may be employed in which a pulsation damper which is connected to the supply channel so as to absorb fuel pulsations is provided in the regulator main body.

[0014] According to this constitution, fuel pulsations or pressure fluctuations (pulsations) generated during fuel injection can be efficiently absorbed and dampened. Furthermore, by providing the pulsation damper in the regulator main body, the components are integrated, and thus the size of the device is reduced.

[0015] In the above constitution, a constitution may be employed in which the pump main body and the regulator main body have a first connecting portion and a second connection portion which are formed so as to be freely attachable and detachable in a direction which is substantially perpendicular to the direction of reciprocating motion and the direction of extension, whereby the first connecting portion doubles as an electrical connector for connecting the electrical wiring provided in the regulator main body and the electrical wiring of the electromagnetic coil, and the second connecting portion doubles as a linking channel to link the discharge port and the influx channel.

[0016] According to this constitution, the plunger pump and the fuel pressure regulator become freely attachable and detachable by means of the first connecting portion and second connecting portion, and thus assembly is ameliorated and the two members can each be formed from a different material; for example, the plunger pump being formed from a metallic material or the like and the fuel pressure regulator being formed from a resinous material or the like. Moreover, since the first connecting portion and second connecting portion double as an electrical connector and a fuel channel respectively, the structure of the device is simplified in comparison with a case in which these connecting portions are formed as separate entities.

[0017] In the above constitution, a constitution may be employed in which the pump main body and the regulator main body are coupled so as to be freely attachable and detachable by means of a snap-fit connection.

[0018] According to this constitution, the two bodies can be connected by means of a simple one-touch operation. As a result, special connecting components such as fastening screws become unnecessary and the structure of the device is simplified, the size is reduced, and the weight is reduced.

[0019] In the above constitution, a constitution may be employed in which the pump main body has adjusting means which are capable of adjusting the spacing between the first connecting portion and second connecting portion.

[0020] According to this constitution, when the pitches of the first connecting portion and the second connecting portion differ on the plunger pump side and the fuel pressure regulator side, this misalignment can be ad-

justed by the adjusting means, thereby ameliorating the assembly of the two bodies.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 is a schematic diagram of a fuel supply system showing the state of the fuel supply device in accordance with the present invention when installed in a fuel tank;

Fig. 2 is a side view of the fuel supply device in accordance with the present invention;

Fig. 3 is a top view of the fuel supply device in accordance with the present invention;

Fig. 4 is a longitudinal cross sectional view of the fuel supply device in accordance with the present invention;

Fig. 5 is a longitudinal cross sectional view showing one part of the fuel pressure regulator;

Fig. 6 is an exploded view showing an exploded state of the plunger pump and the fuel pressure regulator prior to coupling;

Fig. 7 is a partial enlarged perspective view showing snap-fit coupling; and

Fig. 8 is a longitudinal cross sectional view showing another embodiment of the position of attachment of a pulsation damper.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] Embodiments of the present invention will be described below with reference to the attached drawings.

[0023] Figs. 1 through 7 show one embodiment of the fuel supply device in accordance with the present invention. This fuel supply device 10 in accordance with the present invention constitutes one part of a fuel supply system for supplying fuel toward an electromagnetic valve driven injector in an engine in which fuel is injected by means of electronic control. Here, as is illustrated in Fig. 1, the fuel supply device 10 is disposed inside a fuel tank 1 of a two-wheeled vehicle so as to supply fuel through a supply pipe 5 toward an injector 4 which is attached to a suction port 3 of an engine 2.

[0024] As is illustrated in Figs. 2 and 3, the fuel supply device 10 has a positive displacement plunger pump 20 and an inlet control-type fuel pressure regulator 50 for adjusting the pressure of the fuel on the upstream side of the injector 4, which are integrally coupled and modularized without the use of connecting piping or the like. The dimensions of the outer profile of this module are as follows: the height H is approximately 80mm-100mm; the outer diameter D is approximately 70mm-80mm at the attachment flange portion where the diameter is the largest; and the width W of the main body part is approximately 40mm-60mm. By integrating (modularizing) the

device in such a compact fashion, a profile with an overall small size, and which is therefore convenient from the point of view of handling, is formed.

[0025] The plunger pump 20 is an electromagnetically driven positive displacement pump, and as is illustrated in Fig. 4, comprises: a cylinder 21; a plunger 22 which is inserted so as to slide within the cylinder 21, thereby performing a linearly reciprocating motion; an upper side core 23 and a lower side core 24 which are fitted around the periphery of the cylinder 21; an electromagnetic coil 26 wound onto a bobbin 25 which is fitted around the periphery of the upper side core 23 and the lower side core 24; an exterior case 27 formed from a resinous material or the like for covering the periphery of the electromagnetic coil 26; a bracket 28 and a latching plate 29 which are mounted around the exterior case 27 as is illustrated in Figs. 6 and 7; and a wave washer 30 which serves as adjusting means, disposed between the bobbin 25 and latching plate 29, and so on.

[0026] An end face wall 23a is formed on the upper end portion of the upper side core 23, and a through hole 23a' is formed in the center of this end face wall 23a, connecting to the outside. Further, a coil spring 31 is disposed between the end face wall 23a and the plunger 22.

[0027] A channel member 32, which is formed with a channel 32a which has a suction port 32a' on its lower end, is fitted onto the lower end portion of the lower side core 24. The channel member 32 supports a check valve 33 for opening and closing the channel 32a in a state in which this check valve 33 is urged in the closing direction by a spring 34. A coil spring 35 is disposed between the top end surface of the channel member 32 and the plunger 22.

[0028] A coupling member 36 which serves as a second linking portion, and which is formed with a channel 36a having a discharge port 36a' on its tip end, is linked to the side face portion of the lower side core 24, extending in a direction which is perpendicular to the direction of reciprocating motion L1 of the plunger 22. The coupling member 36 supports a check valve 37 for opening and closing the channel 36a in a state in which this check valve 37 is urged in the closing direction by a spring 38.

[0029] Further, a filter 40 is attached to the lower end portion of the lower side core 24 (in other words, around the suction port 32a'). The filter 40 is formed by a filter main body 41, a fitting tube portion 42 for connecting the filter main body 41 to the lower side core 24, and a protruding piece 43 which protrudes outward in a diametrical direction from the periphery of the fitting tube portion 42.

[0030] A female-type electrical connector 39 which serves as a first linking portion, protrudes in a direction perpendicular to the direction of reciprocating motion L1 of the plunger 22, and has a linking hole 39a, is formed on the upper side face of the exterior case 27. The electrical connector 39 supports a terminal 26a serving as

the electrical wiring of the electromagnetic coil 26 in a state in which this terminal 26a is exposed within the linking hole 39a.

[0031] As is illustrated in Figs. 6 and 7, the bracket 28 forms an inverse U shape, and has two engaging pieces 28a which extend from one side face thereof toward the direction H1 which is perpendicular to the direction of reciprocating motion L1. A substantially rectangular latching hole 28a' is formed in each of the latching pieces 28a. Further, the bracket 28 is linked to the latching plate 29 via a latching claw 28c.

[0032] In other words, the pump main body, which is directly connected to the fuel pressure regulator 50, is formed by the exterior case 27 which forms the electrical connector 39, the channel member 32 and the lower side core 24 which demarcate the suction port 32a', the coupling member 36 which demarcates the discharge port 36a', the bracket 28, and so on.

[0033] As concerns an explanation of the operation of the plunger pump 20, first, when the plunger 22 moves upward in the direction of reciprocating motion L1 due to the power supply to the electromagnetic coil 26, the check valve 33 opens in resistance to the urging force of the spring 34 due to pressure difference. Then, fuel is sucked up from the suction port 32a and flows into a space S1.

[0034] Then, when the power supply to the electromagnetic coil 26 is cut, the plunger 22 stops and the check valve 33 closes. Simultaneously, the plunger 22 moves downward in the direction of reciprocating motion L1 due to the urging force of the coil springs 31 and 35, thereby compressing the fuel in the space S1. When the fuel is compressed beyond a predetermined pressure, the check valve 37 opens in resistance to the urging force of the spring 38, and the compressed fuel is discharged from the discharge port 36a'. Then, the urging forces of the coil springs 31 and 35 balance, whereupon the plunger 22 stops.

[0035] Note that the above describes a basic operation in which the plunger 22 performs one reciprocal motion; however, during normal operations, the plunger 22 performs continuous reciprocal motions, whereby fuel is continuously suctioned and pressure fed in prescribed volumes according to these movement strokes.

[0036] The fuel pressure regulator 50 is an inlet control type regulator for adjusting the pressure of fuel (fuel pressure) upstream of the injector 4 and, as is illustrated in Fig. 4, comprises: a regulator main body 53, in which a horizontal tube portion 51 which demarcates an influx channel 51a and a vertical tube portion 52 which demarcates a supply channel 52a, and so on, are molded using a resinous material; a mounting flange portion 54 which is formed integrally with the upper end portion of the regulator main body 53; an adjustment valve 55 disposed between the influx channel 51a and the supply channel 52a for opening and dosing both of these channels and thereby adjusting the fuel pressure; and a support bracket 56 which is formed integrally with the reg-

ulator main body 53 as illustrated in Fig. 6, and so on.

[0037] As is illustrated in Fig. 4, the influx channel 51a is formed in the horizontal tube portion 51, and the coupling member 36 of the plunger pump 20 is fitted into the opening of the influx channel 51a, thereby functioning as the second connecting portion. Further, the horizontal tube portion 51 supports a check valve 57 for opening and closing the influx channel 51a in a state in which this check valve 57 is driven to the closing direction by a spring 58. The check valve 57 and the spring 58 constitute one part of the adjustment valve 55.

[0038] Further, an inserting hole 65 for inserting the protruding piece 43 of the filter 40 is formed on the lower side of the horizontal tube portion 51.

[0039] As is illustrated in Fig. 4, a diaphragm 59 which constitutes one part of the adjustment valve 55 is disposed in the space in which the horizontally extending influx channel 51a and the vertically extending supply channel 52a intersect. The diaphragm 59 is formed from a diaphragm main body 59a, a spring 59b, and a cover cap 59c with a through hole 59c'. One part of the diaphragm main body 59a abuts against a needle 57a of the check valve 57, whereby the check valve 57 is caused to open in resistance to the urging force of the spring 58.

[0040] In other words, the adjustment valve 55 which adjusts the pressure of the fuel in the supply channel 52a and the influx channel 51a is constituted by the check valve (needle 57a) 57, spring 58, and diaphragm 59. To explain the operation of the adjustment valve 55, when the pressure inside the supply channel 52a or the diaphragm chamber 55a reaches or exceeds a predetermined pressure, the check valve 57 closes the influx channel 51a by means of the urging force of the spring 58.

[0041] In this state, when the fuel pressure inside the supply channel 52a reaches or falls below a predetermined pressure, the diaphragm 59 is activated by the urging force of the spring 59b to push down the needle 57a and open the check valve 57.

[0042] As a result, the fuel on the upstream side of the influx channel 51a flows into the diaphragm chamber 55a and is led to the supply channel 52a. Then, when the pressure of the fuel inside the supply channel 52a reaches or exceeds a predetermined pressure, the diaphragm 59 is activated by this pressure to close the check valve 57.

[0043] A connecting portion 60 for connecting the connector of the supply pipe 5 is formed at the top end portion of the supply channel 52a, and a connector 61 for making an electrical connection and having a terminal 61a exposed in its interior space is formed to the side of the connecting portion 60. Further, a male-type electrical connector 62 is formed on the lower side of the mounting flange portion 54 so as to protrude in the horizontal direction.

[0044] The electrical connector 62 has a female-type terminal 62a which is connected from the terminal 61a

via electrical wiring 61b buried inside the regulator main body 51. The terminal 26a is connected to the female-type terminal 62a by fitting the electrical connector 62 into the electrical connector 39 of the plunger pump 20.

[0045] As is illustrated in Fig. 5, a channel 63 and a damper chamber 64 which are linked to the supply chamber 52a are formed in the regulator main body 53. Further, a pulsation damper 70 for absorbing and thereby dampening fuel pulsations (pressure fluctuations) is housed in the damper chamber 64. The pulsation damper 70 is a hollow body which is capable of altering its form through elasticity. A latticed framework of supports 71 is provided in the interior of the pulsation damper 70, and a rubber shape-altering film 72 is mounted over the exterior of the supports 71.

[0046] Accordingly, when a pulsation (pressure fluctuation) occurs in the fuel inside the supply channel 52a, the pressure inside the damper chamber 64 also fluctuates, whereby the volume occupied (demarcated) by the shape-altering film 72 increases or decreases in accordance with the pressure of this fluctuation. Thus, pulsations generated in the fuel are efficiently absorbed and dampened.

[0047] Here, the direction of extension L2 of the supply channel 52a and the direction of extension L3 of the damper chamber 64 (pulsation damper 70) are formed so as to be substantially parallel, and hence the two can be placed close to each other and integrated, thereby contributing to the narrowing and size reduction of the device.

[0048] As is illustrated in Figs. 6 and 7, two support brackets 56 are formed extending from the regulator main body 53 in the horizontal direction H1 and facing each other. Flexible pieces 56a which are demarcated by inverted "C"-shaped helical grooves are also formed, and latching claws 56a' are formed facing inward on the tip end portions of these flexible pieces 56a.

[0049] Further, the width of the inner walls W1 of the two support brackets 56 is formed so as to be substantially equal to the width of the outer walls W2 of the two engaging pieces 28a formed on the bracket 28. Thus, when the engaging pieces 28a are inserted inside the support brackets 56, the flexible pieces 56a are pushed so as to bend outward, and when the latching claws 56a' enter the latching holes 28b, a secure snap-fit connection is made between the two bodies.

[0050] In other words, by means of a simple one-touch operation, namely, pushing in the engaging pieces 28a of the plunger pump 20, the two bodies can be connected, and hence special connecting components such as fastening screws become unnecessary, and the structure of the device is simplified, reduced in size, and reduced in weight. Moreover, the two bodies can also be separated by means of a simple operation of opening the flexible parts 56a outward so that the latching claws 56a' are separated from the latching holes 28b.

[0051] As is illustrated in Fig. 6, the assembly of the plunger pump 20 and the fuel pressure regulator 50 be-

gins with the attachment of the filter 40 to the plunger pump 20.

[0052] Next, the two bodies are brought into proximity in the horizontal direction H1 which is perpendicular to the direction of reciprocating motion L1 and the direction of extension L2. Then the female-type electrical connector 39 and male-type electrical connector 62, which serve as the first connecting portion, are caused to engage, and the male-type coupling member 36 and the female-type horizontal tube portion 51, which serve as the second connecting portion, are also caused to engage.

[0053] At this time, the protruding part 43 is assembled by insertion into the inserting hole 65. Furthermore, the flexible pieces 56a (latching claws 56a') of the support brackets 56 are caused to latch with the latching holes 28b of the engaging pieces 28a to conclude the snap-fit connection.

[0054] In this case, if the spacing (pitch) between the electrical connector 39 and the coupling member 36, and the spacing (pitch) between the electrical connector 62 and the horizontal tube portion 51 do not match, and especially if the pitch of the former is larger, the amount of shape alteration of the wave washer 30 (which serves as the adjustment means) can be appropriately adjusted such that the pitch is aligned, whereby assembly can be performed with ease.

[0055] Furthermore, when the two bodies are in an assembled state, the protruding piece 43 of the filter 40 is in a state of insertion inside the inserting hole 65, and therefore even if the coupling force of the fitting tube portion 42 were to weaken, the filter 40 could be prevented from falling off the plunger pump 20. As a result, special fastening components such as fastening screws are not used, and the fuel supply device 10 can be dealt with as a modular item with the filter 40 built-in.

[0056] Moreover, when the plunger pump 20 and the fuel pressure regulator 50 are coupled together, the direction of reciprocating motion L1 of the plunger 22 and the direction of extension L2 of the supply channel 52a are formed so as to be substantially parallel. More specifically, the plunger pump 20 itself forms a profile elongated in the direction of reciprocating motion L1 of the plunger 22, and the regulator main body 53 itself of the fuel pressure regulator 50 is formed lengthwise in the direction of extension L2 of the supply channel 52a, and thus both directions L1 and L2 become substantially parallel. As a result, the constituent components can be integrated in the central portion, thus enabling the formation of a narrow profile, which in turn enables reductions in the width and size of the fuel supply device 10.

[0057] Furthermore, by placing the plunger pump 20 vertically, disposing the suction port 32a' and filter 40 at the lower end portion thereof, providing the discharge port 36a' on the side face near the lower end portion thereof, forming the influx channel 51a which connects to the discharge port 36a' horizontally, and disposing the adjustment valve 55 in the region of intersection be-

tween the influx channel 51a and the supply channel 52a, the fuel suction and pressure feeding functions and the pressure adjusting function can be securely maintained while the length (height) H of the device can be kept as low as possible and the fuel supply device 10 can be finished as a compact (small size) modular item.

[0058] As for the connecting portions which connect the plunger pump 20 and the fuel pressure regulator 50, the first connecting portion doubles as the electrical connectors 39 and 62, which connect the electrical wiring, and the second connecting portion doubles as a linking channel linking the discharge port 36a' and the influx channel 51a, and hence the structure of the device is simplified when compared with a case in which connecting portions are provided as separate entities. Moreover, a snap-fit coupling is employed as a connecting portion, and hence the two bodies can be coupled more securely when compared with a case in which the first and second connecting portions alone are coupled.

[0059] Fig. 8 shows another embodiment in which the position of attachment of the pulsation damper 70 has been altered. Note that identical structures from the aforementioned embodiment have been assigned identical notations and explanations thereof have been omitted.

[0060] In this embodiment, as is illustrated in Fig. 8, the channel 63 which leads into the damper chamber 64 is formed upstream, rather than downstream of the adjustment valve 55, or in other words, so as to connect with the influx channel 51a.

[0061] Consequently, when a pulsation (pressure fluctuation) occurs in the fuel inside the influx channel 51a, the pressure inside the damper chamber 64 also fluctuates, whereby the volume occupied (demarcated) by the shape-altering film 72 increases or decreases in accordance with the pressure of this fluctuation. As a result, pulsations generated in the fuel can be absorbed and dampened more efficiently than in the case shown in Fig. 5.

[0062] In the aforementioned embodiments, a case was described in which the fuel supply device 10 of the present invention is disposed inside the fuel tank 1 of a two-wheeled vehicle. However, the present invention is not limited to this case, and may be satisfactorily applied to other vehicles such as three-wheeled or four-wheeled carts, lawnmowers, multipurpose engines such as power generators, or any vehicles which are equipped with a small displacement engine and a comparatively small fuel tank, for example marine vessels such as leisure boats, snowmobiles and so on.

[0063] As described above, according to the fuel supply device of the present invention, a plunger pump equipped with a plunger for suctioning and pressure feeding fuel by means of a lineally reciprocating motion, and a fuel pressure regulator which is linked to the discharge port of this plunger pump, and which adjusts the pressure at the time when fuel is supplied toward the injector, are integrally coupled to form a module. As a

result, a fuel supply device with an overall small (compact) size, and one which is particularly suited to being disposed in a small fuel tank of a two-wheeled vehicle or the like, can be provided.

[0064] In particular, by forming the direction of reciprocating motion of the plunger and the direction of extension of the supply channel of the fuel pressure regulator so as to be substantially parallel, the two bodies can be effectively integrated so that the size of the entire device can be further reduced (compacted).

[0065] Furthermore, by disposing the filter on the lower side of the device, the pump main body and regulator main body in an intermediate position, and the mounting flange portion on the upper side of the device, the device can be easily disposed inside a fuel tank simply by, for example, fixing the mounting flange portion to the wall of the fuel tank. Furthermore, the device can be dealt with as a modular item with a filter included.

[0066] Moreover, by making the pump main body of the plunger pump and the regulator main body of the fuel pressure regulator connectable using the first connecting portion and the second connecting portion, and by having the first connecting portion and the second connecting portion function respectively as an electrical connection and a linking channel, assembly is ameliorated and secured, and the structure of the device is simplified in comparison with a case in which entities that function merely as connecting portions are provided separately. Also, by employing a snap-fit connection, the two bodies can be securely connected with a simple one-touch operation, and since special connecting components such as fastening screws are unnecessary, the structure can be simplified, reduced in size and reduced in weight.

[0067] Furthermore, by employing adjusting means capable of adjusting the spacing between the first connecting portion and the second connecting portion, the two bodies can be easily assembled even if pitch misalignment occurs.

Claims

1. A fuel supply device which is disposed inside a fuel tank, and which supplies fuel toward an injector of an internal combustion engine, comprising:

a positive displacement plunger pump including a pump main body which demarcates a suction port and discharge port, a plunger for suctioning and pressure feeding fuel by performing a linearly reciprocating motion inside said pump main body, and an electromagnetic coil for driving said plunger; and

a fuel pressure regulator including a regulator main body which demarcates an influx channel linked to said discharge port and a supply channel for supplying fuel toward the injector, and

an adjustment valve disposed between said influx channel and supply channel, and which adjusts the fuel pressure,

wherein said pump main body and regulator main body are integrally coupled.

2. The fuel supply device according to claim 1, wherein the direction of reciprocating motion of said plunger and the direction of extension of said supply channel are formed so as to be substantially parallel.

3. The fuel supply device according to claim 2, wherein said regulator main body has a mounting flange portion formed on the upper side of said direction of extension for mounting said fuel supply device onto a fuel tank, and

said pump main body has said suction port which is formed on the lower side of said direction of reciprocating motion, and a filter which is mounted around said suction port.

4. The fuel supply device according to any of claims 1 through 3, wherein a pulsation damper, which communicates with said supply channel in order to absorb fuel pulsations, is provided in said regulator main body.

5. The fuel supply device of claim 3 or claim 4, wherein said pump main body and regulator main body have a first connecting portion and a second connecting portion formed, so as to be freely attachable and detachable, in a direction which is substantially perpendicular to said direction of reciprocating motion and direction of extension,

said first connecting portion doubling as an electrical connector for connecting the electrical wiring provided in said regulator main body and the electrical wiring of said electromagnetic coil, and

said second connecting portion doubling as a linking channel for linking said discharge port and said influx channel.

6. The fuel supply device according to claim 5, wherein said pump main body and said regulator main body are coupled so as to be freely attachable and detachable by means of a snap-fit connection.

7. The fuel supply device according to claim 5 or claim 6, wherein said pump main body has adjusting means capable of adjusting the spacing between said first connecting portion and second connecting portion.

FIG. 1

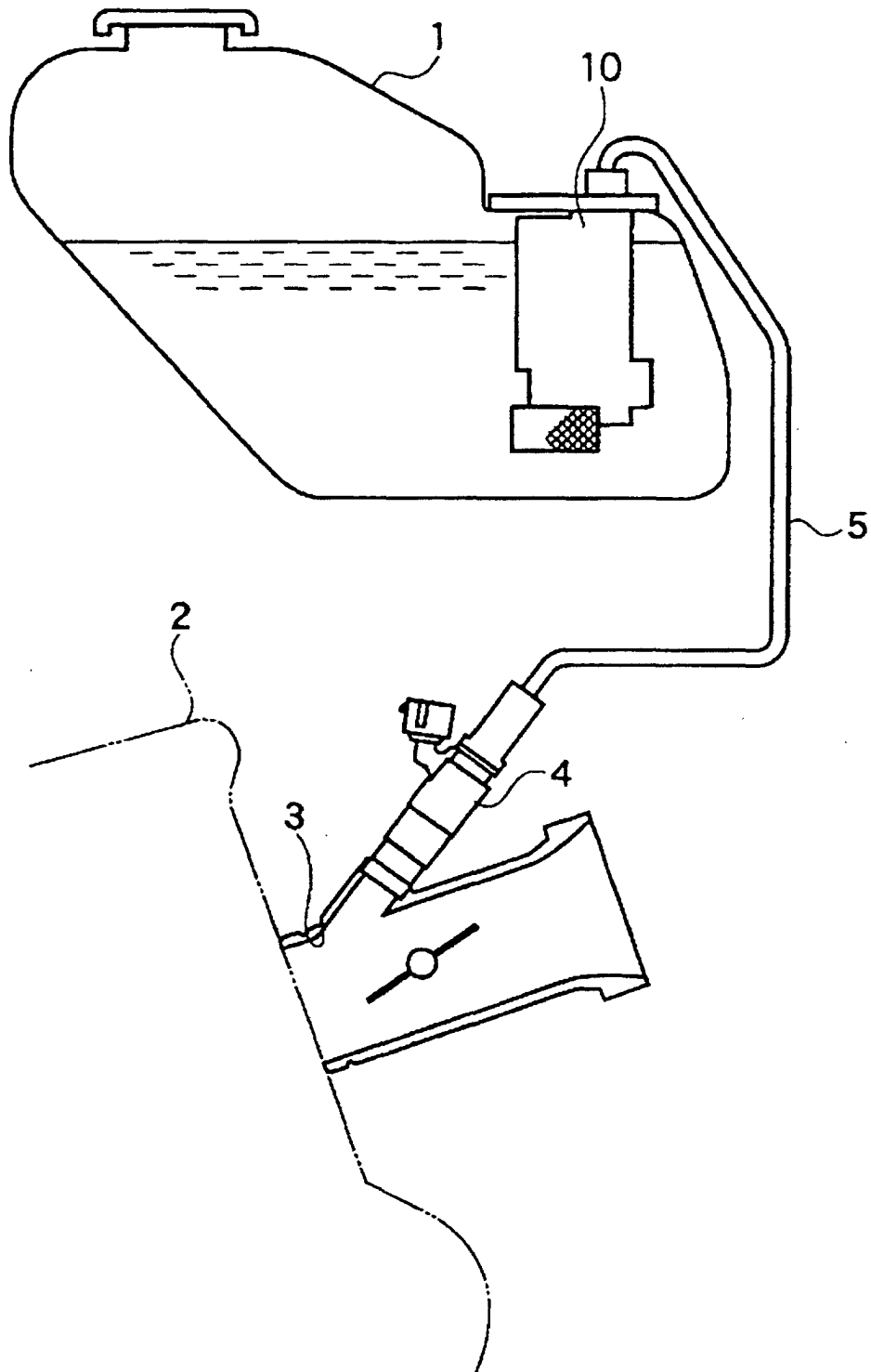


FIG. 2

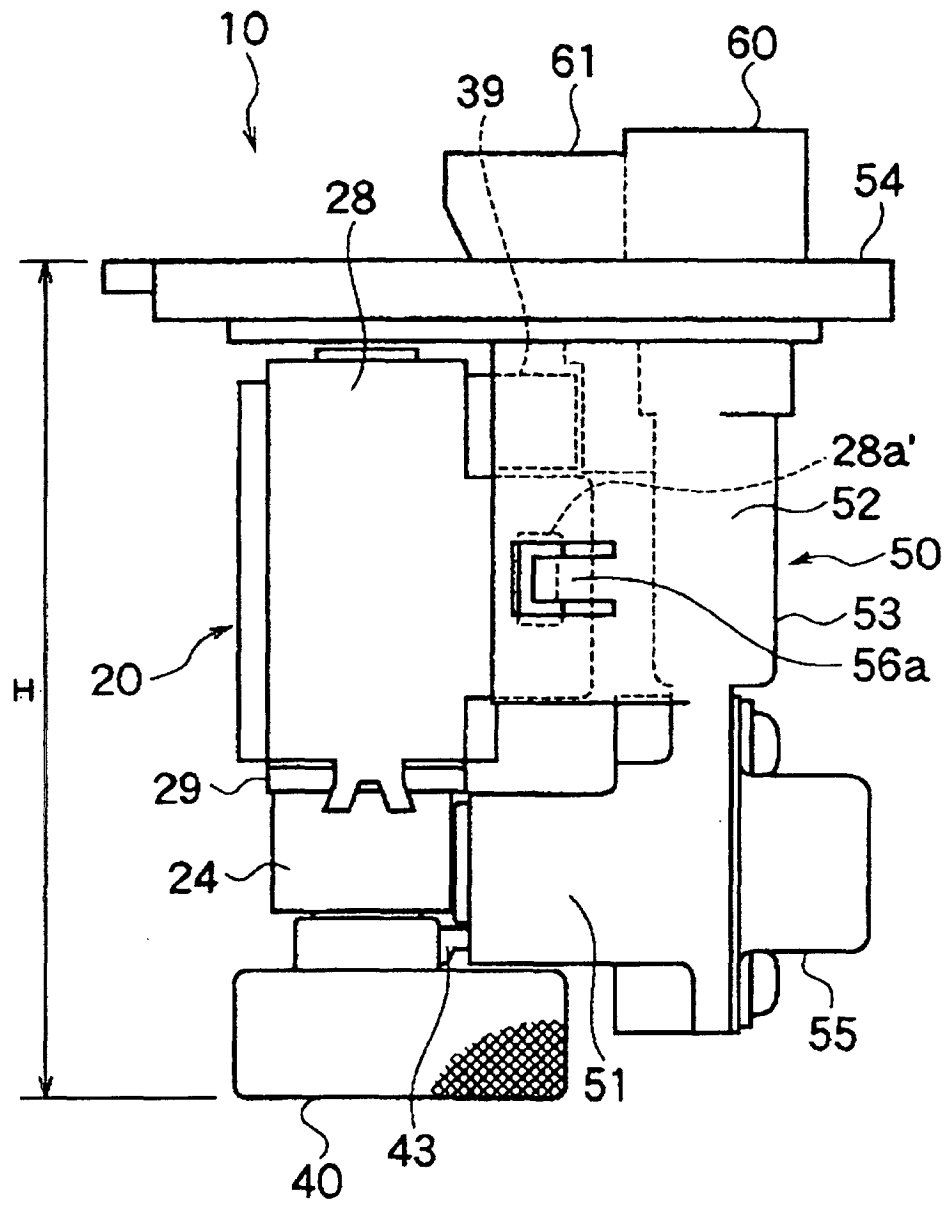


FIG. 3

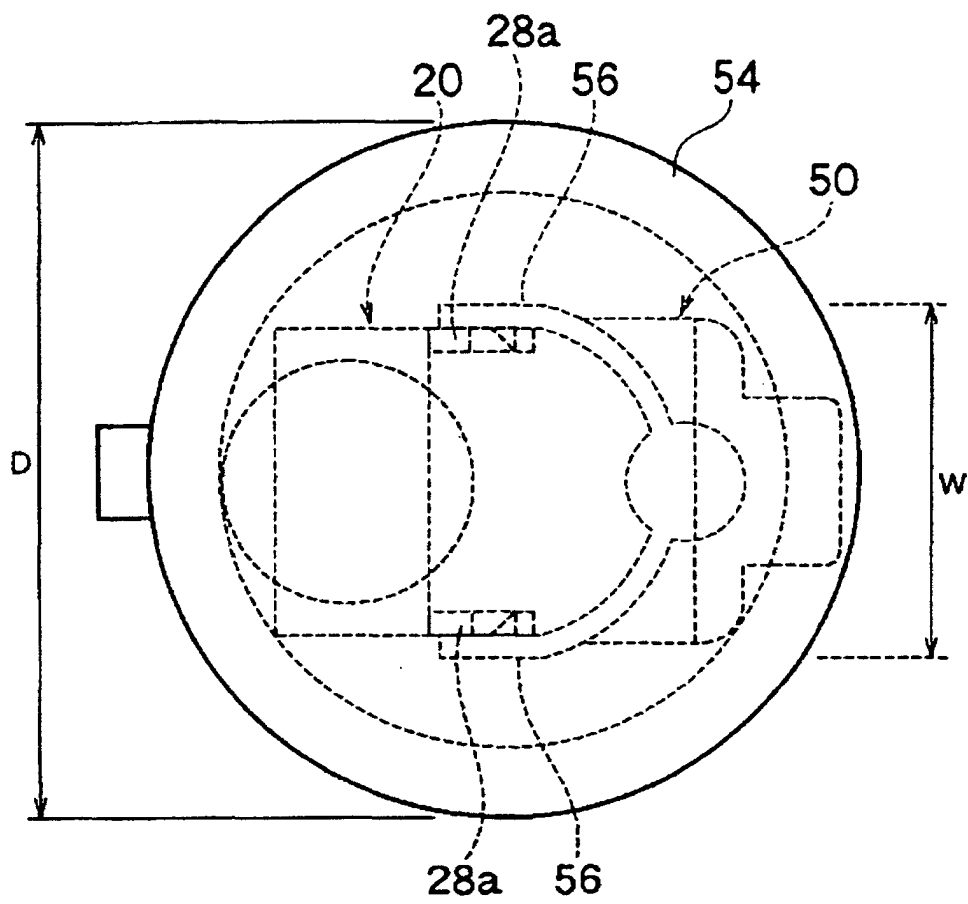


FIG. 4

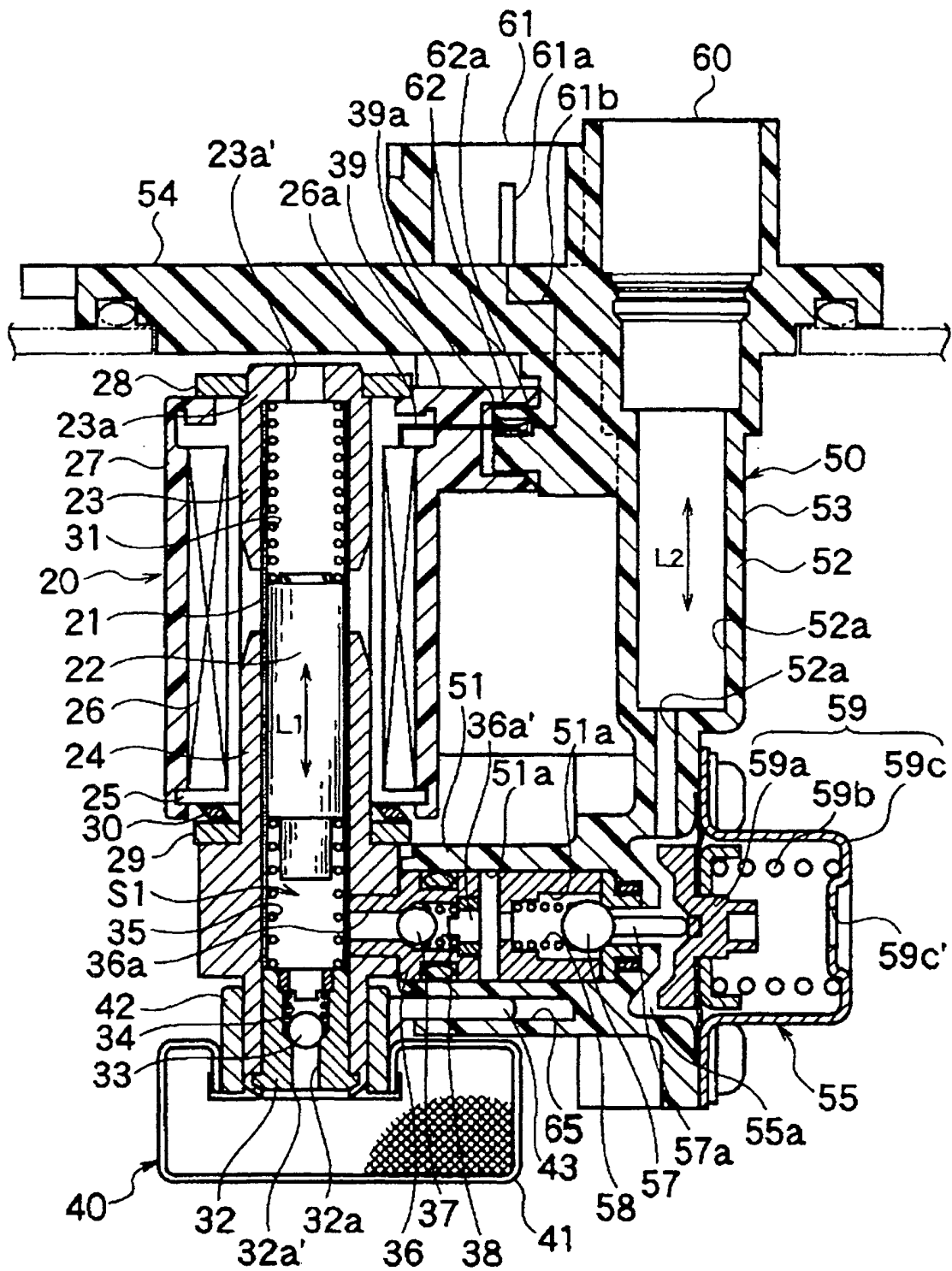


FIG. 5

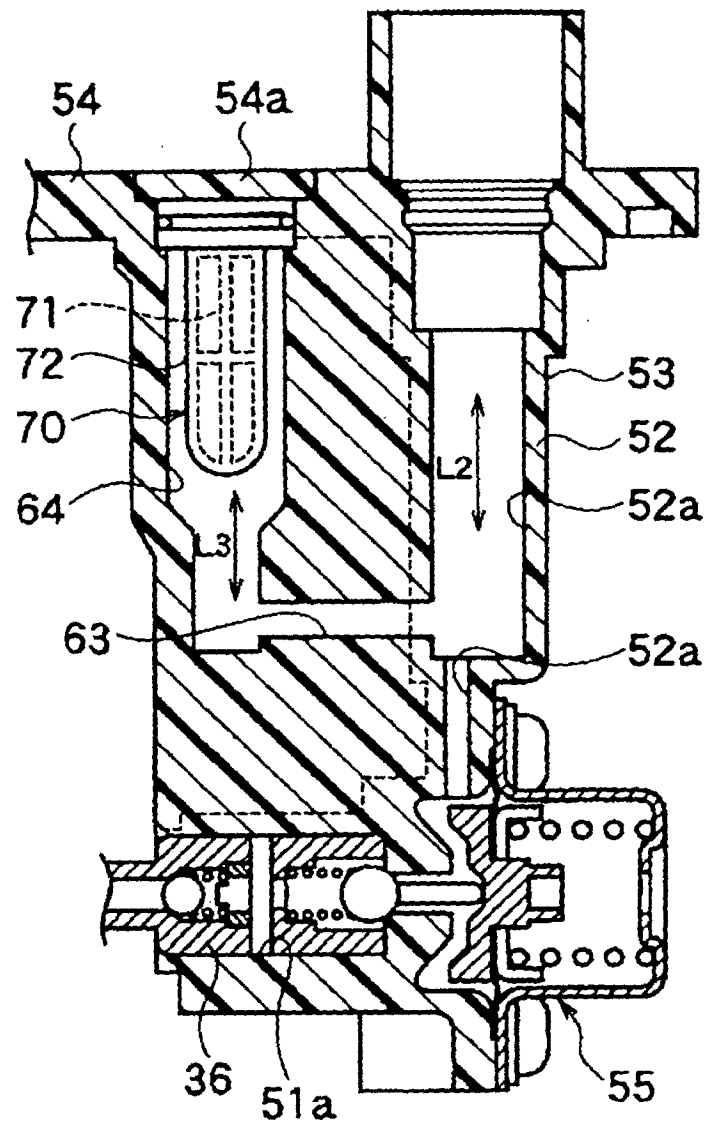


FIG. 6

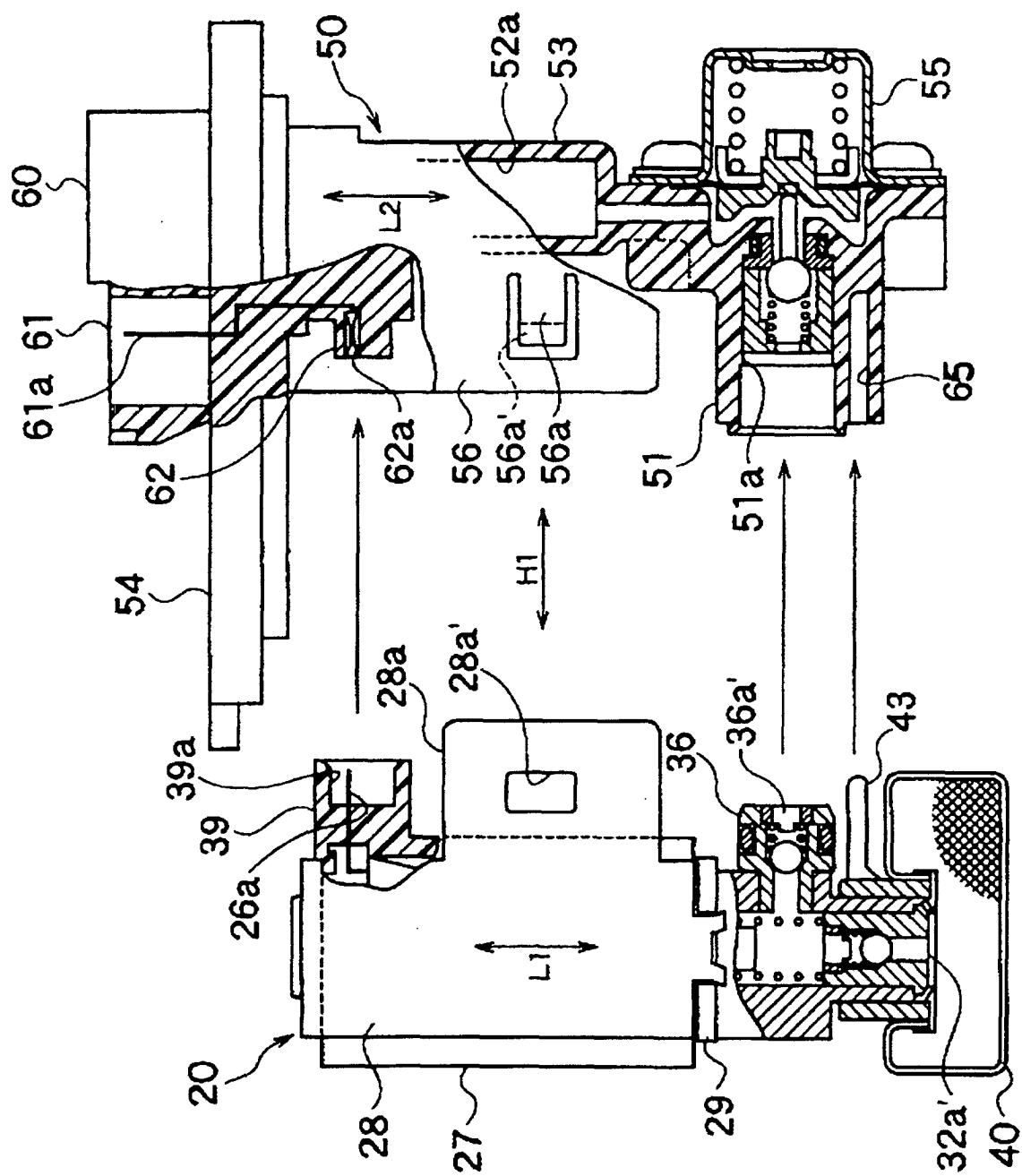


FIG. 7

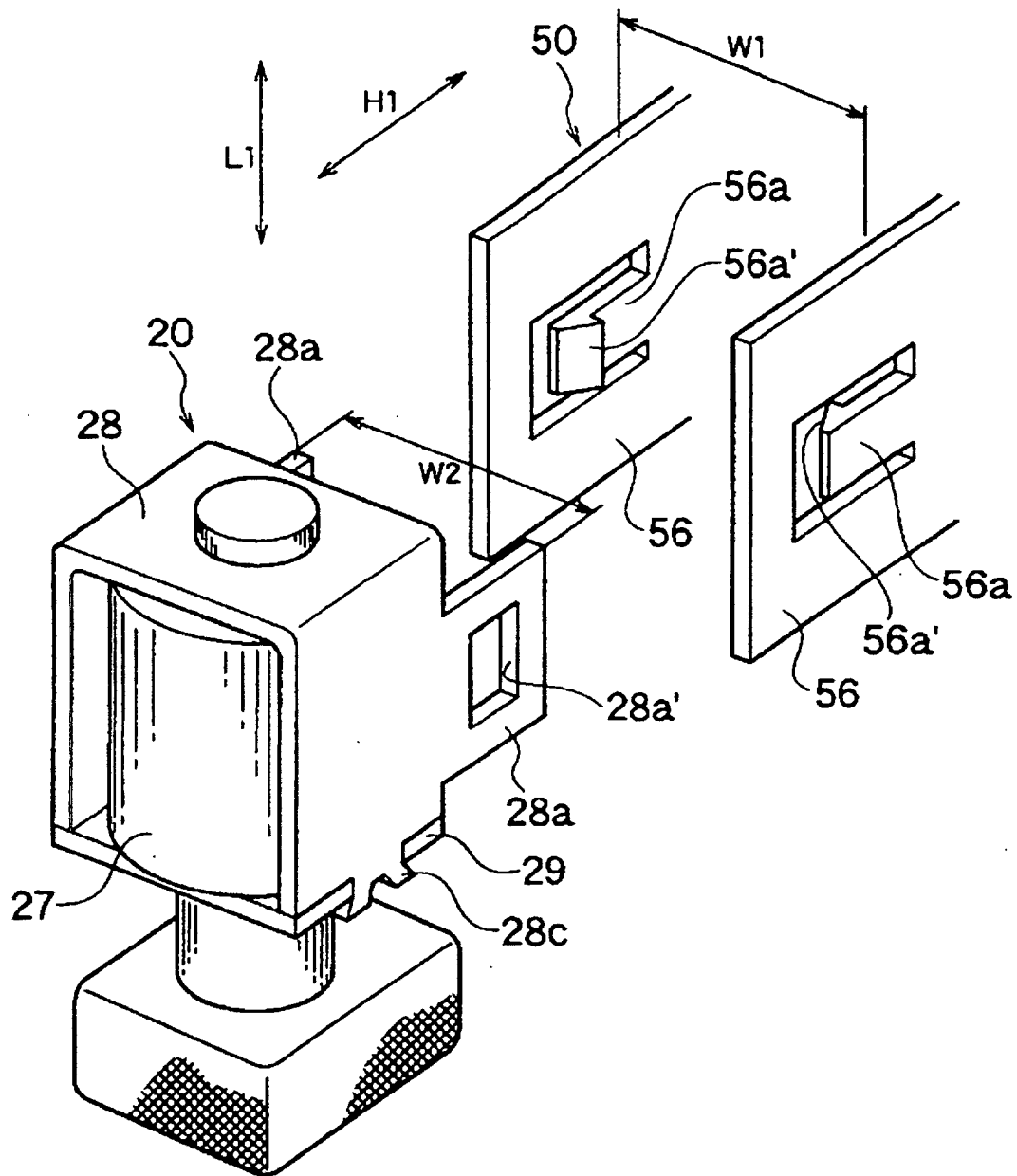
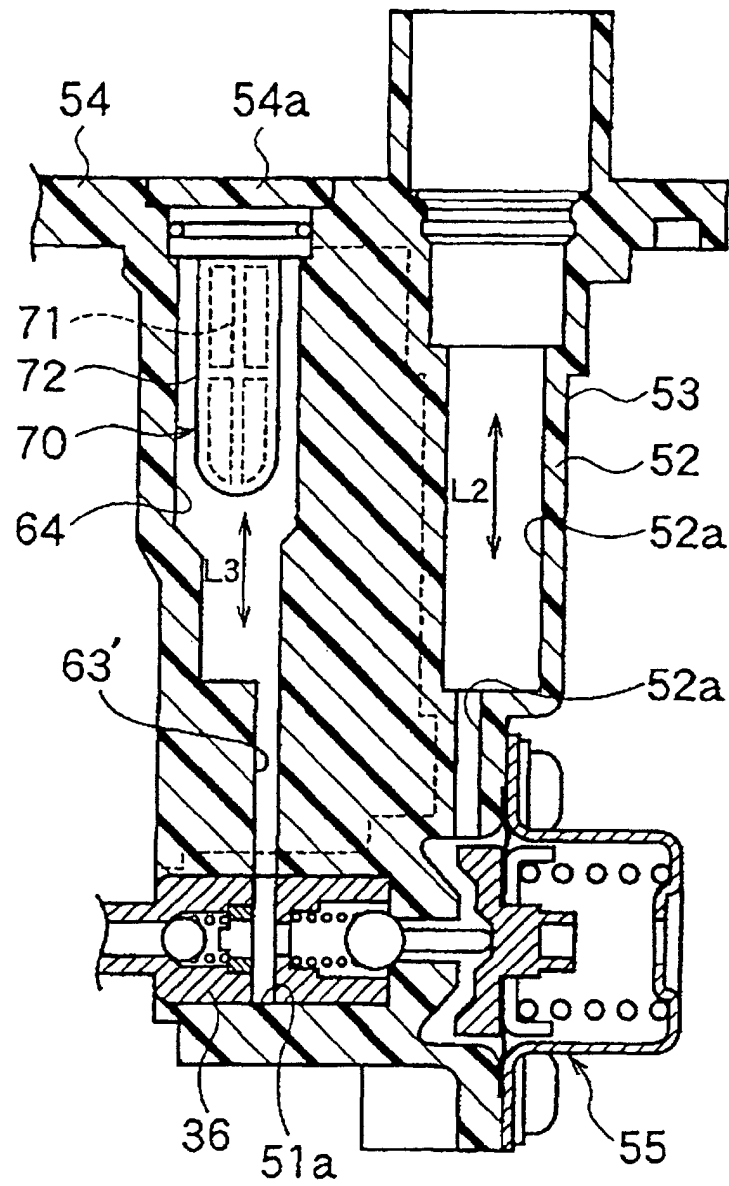


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/07470

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ F02M37/10		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) Int.Cl. ⁷ F02M37/10, F02M37/08, F02M37/06		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2002 Kokai Jitsuyo Shinan Koho 1971-2002 Jitsuyo Shinan Toroku Koho 1996-2002		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6253790 B1 (Honda Giken Kogyo Kabushiki Kaisha), 03 July, 2001 (03.07.01), Column 3, line 43 to column 4, line 58; Figs. 1 to 5 & IT T0990704 A1 & DE 19938273 A & JP 2000-072074 A	1
Y	JP 1-257686 A (Yamaha Motor Co., Ltd.), 13 October, 1989 (13.10.89), Page 2, lower right column, line 16 to page 3, upper left column, line 15; Figs. 1 to 6 (Family: none)	1
Y	JP 55-148958 A (Yamaha Motor Co., Ltd.), 19 November, 1980 (19.11.80), Full text; Figs. 1 to 3 (Family: none)	1
☒ Further documents are listed in the continuation of Box C. ☐ 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 document 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 25 October, 2002 (25.10.02)		Date of mailing of the international search report 12 November, 2002 (12.11.02)
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/JP02/07470

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2-163455 A (Japan Electronic Control Systems Co., Ltd.), 22 June, 1990 (22.06.90), Full text; Figs. 1 to 4 (Family: none)	4
A	US 5649514 A (Nippondenso Co., Ltd.), 22 July, 1997 (22.07.97), All pages; Figs. 1 to 11 & US 5778926 A & US 5782223 A & US 5785032 A & US 5900148 A & WO 96/14506 A1 & WO 96/23569 A1 & WO 96/23966 A1 & WO 96/23967 A1 & WO 96/23969 A1 & DE 19581421 T & DE 19581549 T & DE 19581548 T & DE 19680164 T & EP 754483 A1 & CN 1145104 A & CN 1147209 A & AU 704754 B & KR 201197 B & KR 233022 B & JP 8-210212 A	3, 5-6

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