



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.07.2007 Bulletin 2007/27

(51) Int Cl.:
F02M 37/10 (2006.01)

(21) Application number: **06127014.6**

(22) Date of filing: **22.12.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **28.12.2005 JP 2005377403**

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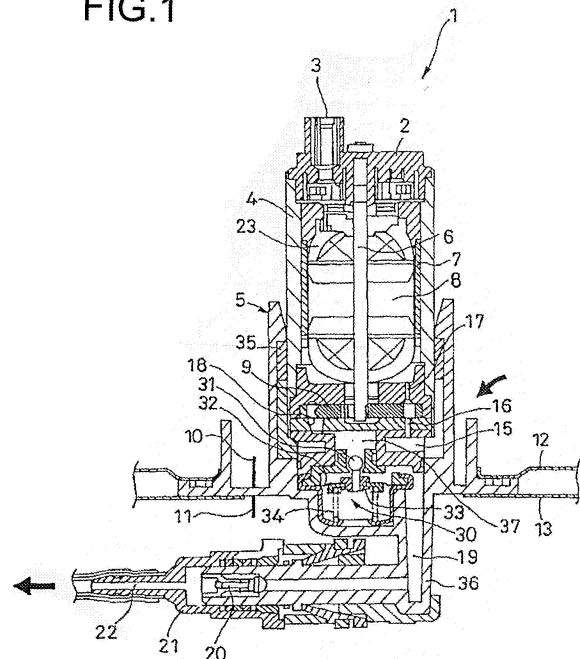
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(54) **Fuel pump module**

(57) A fuel pump module (1) is provided in which a fuel passage (19) is shortened, the loss of pressure is inhibited and the whole module (1) can be small-sized.

The fuel pump module (1) is attached to a bottom plate (12, 13) of a fuel tank and is provided with a drive motor (7, 8) having an output shaft (6), an impeller (9) attached on the side of one end of the output shaft (6) and an on-demand pressure regulator (30) for controlling pressure generated in a fuel passage (19). An inlet (15) is provided on the side of a lower end of an upper case (4) forming the fuel pump module (1). The impeller (9) practices a counter flow system in which fuel is taken in from the side of the bottom plate (12, 13) of the fuel tank and is discharged from the side of the bottom plate (12, 13) of the fuel tank, and the on-demand pressure regulator (30) is arranged in a lower case (36) in the vicinity of the impeller (9). The upper case (4) and the lower case (36) are detachably connected by the fitting of a snap fitting (5) and a stopper (35).

FIG.1



Description

[0001] The present invention relates to a fuel pump module, particularly relates to a fuel pump module that reduces a fuel passage, inhibits the loss of pressure and can small-size the whole module.

[0002] So far, the configuration of a motor-driven fuel pump for pressure-feeding fuel to a fuel injection system and others that the whole fuel pump or the substantial whole fuel pump is arranged in a fuel tank is known.

[0003] In patent document JP-A No. 2003-97375 there is disclosed a motor-driven fuel pump for a vehicle which is attached on the side of a top plate of a fuel tank, at a lower end of which an inlet is provided, in which fuel is sucked upward by revolving an impeller fixedly supported by a rotation shaft of a drive motor and in which the fuel is discharged from a discharge port provided at an upper end of the fuel pump, lubricating each part configuring the drive motor.

[0004] However, there is a case in which structure that a fuel pump is attached on the side of a bottom plate of a fuel tank and fuel is taken in from the bottom side of the fuel tank is adopted. In this case, when the structure of the fuel pump disclosed in the above-mentioned patent document is utilized as it is, a fuel passage for discharging fuel once sucked on the upside of the fuel pump outside from the bottom side of the fuel tank is required to be provided. Hereby, a problem that the fuel passage having substantially equal length to the full height of the fuel pump is required and the whole fuel pump is simply large-sized because of the increase of components occurs.

[0005] The object of the invention is to provide a fuel pump module that addresses the above-mentioned problem of the related art, reduces a fuel passage, inhibits the loss of pressure and can small-size the whole module.

[0006] This object is achieved by the full pump module defined in claim 1. To achieve the above object, the invention is based upon a fuel pump module provided with a fuel pump in which an impeller provided in a lower part of the fuel pump is arranged so that its rotation axis is perpendicular and which is attached to the bottom of a fuel tank and an on-demand pressure regulator for regulating the pressure of fuel discharged from the fuel pump, and has such a first aspect that the fuel pump module is provided with the impeller configured according to a counter flow system that taken fuel is guided in a reverse direction to a direction in which the fuel is taken in, an intake passage for leading the fuel from an inlet provided on the downside of the fuel pump to the downside of the impeller and a discharge passage for guiding the fuel discharged from the impeller to the on-demand pressure regulator provided on the downside of the fuel pump.

[0007] Besides, the invention has such a second aspect that the impeller is attached on the side of one end of an output shaft of a drive motor and the on-demand pressure regulator is provided in the vicinity of a discharge port of the impeller.

[0008] Further, the invention has such a third aspect that the fuel pump module is configured by a cylindrical upper case for housing the drive motor and the impeller and a lower case for housing the on-demand pressure regulator, the upper case and the lower case are detachably configured, a snap fitting as a fitting member is formed in the lower case and a stopper fitted to the snap fitting is formed in the upper case.

[0009] According to an aspect of the invention, as the impeller for pressure-feeding fuel is arranged on the side of the bottom plate of the fuel tank according to the counter flow system, a fuel passage from the inlet of fuel to the discharge port can be greatly reduced. Besides, as a long fuel passage is not required, the loss of pressure due to passage resistance is reduced and the fuel pump module can be small-sized. Further, as a long fuel passage is not required, each part can be simplified and small-sized.

[0010] According to another aspect of the invention, as the on-demand pressure regulator can be arranged at the lower end of the fuel pump, the fuel pump module can be further small-sized.

[0011] According to still another aspect of the invention, as the upper case and the lower case can be detached, the assembly of the fuel pump module and the maintenance of the on-demand pressure regulator and the drive motor are facilitated. The upper case and the lower case can be easily attached or detached without using a separate connecting part such as a screw.

[0012] Further features and advantages of the invention will become apparent from the description which follows by way of nonlimiting example with reference to the enclosed drawings wherein:

fig. 1 is a sectional view showing a fuel pump module according to one embodiment of the invention; and fig. 2 is a sectional view showing an on-demand pressure regulator according to one embodiment of the invention.

[0013] Referring to the drawings, a preferred embodiment of the invention will be described in detail below. Fig. 1 is a sectional view showing a fuel pump module 1 according to one embodiment of the invention. The fuel pump module 1 is a device for pressure-feeding gasoline and others in a fuel tank to a fuel injection system by the torque of a drive motor and is attached so that the substantial whole of the fuel pump module 1 is housed in a substantially circular opening provided to steel plates 12, 13 forming a bottom plate of the fuel tank in this embodiment.

[0014] The fuel pump module 1 is provided with a cylindrical upper case 4 and a lower case 36 respectively formed by hard resin and others. In the upper case 4, the drive motor formed by a rotor 8 integrally rotated with an output shaft 6 and a stator 7 arranged inside the upper case 4 is housed. An impeller 9 is fixedly supported at a lower end of the output shaft 6 and can be driven at ar-

bitrary revolution speed by supplying electric power via a power terminal 3 integrated with a lid member 2 arranged on the upper case 4. Electric power is supplied to the power terminal 3 by taking in external electric power by an onboard battery and the like from an electrode 11 provided outside the fuel tank and coupling an electrode 10 integrated with the electrode 11 and the power terminal 3 via a distribution cord (not shown) having a connector at both ends.

[0015] Fuel taken in from an inlet 15 provided to the upper case 4 according to the drive of the impeller 9 is fed to the impeller 9 via an oil passage 16. The fuel discharged from the impeller 9 is pressure-fed from a discharge port 18 into an oil reservoir 37. That is, the impeller 9 practices a counter flow system in which fuel taken in from one side is discharged in the same direction as one side, the inlet 15 and the oil passage 16 function as an intake passage, and the discharge port 18 and the oil reservoir 37 function as a discharge passage.

[0016] On the reverse side to the oil passage 16 with the impeller 9 between the oil passage 16 and an oil passage 17, the oil passage 17 communicating with space 23 for housing the rotor 8 is provided and when the impeller 9 is driven, the housing space 23 is filled with the fuel. Therefore, while the impeller 9 is driven, the rotor 8 and others are lubricated by fuel inside the housing space 23.

[0017] An on-demand pressure regulator 30 for supplying only a required fuel flow rate to control so that pressure generated in a fuel passage 19 is appropriate is arranged between the oil reservoir 37 and the fuel passage 19. The on-demand pressure regulator 30 housed in the lower case 36 is configured by a spherical valve 31, a pressure regulating member 33 that fixedly supports a shaft touched to the valve 31 and a diaphragm 32, and a spring 34 for applying momentum for always pushing up the pressure regulating member 33 upward in the drawing. The pressure regulating member 33 is pushed up upward in the drawing by the momentum of the spring 34 when the pressure generated in the fuel passage 19 is equal to or lower than a predetermined value. At this time, as the valve 31 is not touched to a wall of the oil reservoir 37 because the valve is pushed up upward by the pressure regulating member 33, the oil reservoir 37 and the fuel passage 19 are communicated with each other.

[0018] In the meantime, as the device is configured so that pressing force depending upon pressure applied to the diaphragm 32 exceeds the momentum of the spring 34 when pressure applied to the fuel passage 19 exceeds the predetermined value, the pressure regulating member 33 is pushed down downward in the drawing, and the valve 31 abuts on the wall of the oil reservoir 37. Hereby, the communication of the oil reservoir 37 and the fuel passage 19 is broken and the supply of fuel to the fuel passage 19 is temporarily stopped. When pressure applied to the fuel passage 19 is restored in an appropriate range again, the valve 31 is opened by the mo-

mentum of the spring 34 and the supply of fuel is resumed. Fuel pressure-fed into the fuel passage 19 is discharged from a discharge port 22 formed in a holder 21 for connecting the lower case 36 and a fuel hose after the fuel passes a check valve 20. The check valve 20 is provided to prevent the back flow of fuel and hold pressure generated in a passage on the opposite side of the discharge port 22.

[0019] The upper case 4 and the lower case 36 are configured so that they can be simply detached via a snap fitting structure. In the lower case 36, a snap fitting 5 as a fitting member is formed in a cylindrical part inside the fuel tank. The snap fitting 5 is configured so that the snap fitting is fitted to a stopper 35 formed on a periphery of the upper case 4, when the upper case 4 is pushed into the lower case 36, widening the snap fitting 5 in a peripheral direction, the stopper 35 is fitted to the snap fitting in a predetermined position, and the upper case 4 and the lower case 36 are connected to each other. Similarly, as the upper case 4 can be detached from the lower case 36 when the snap fitting 5 is widened in the peripheral direction, detaching work can be performed without using a connecting part such as a screw.

[0020] Fig. 2 is a sectional view showing an on-demand pressure regulator which can be applied to the fuel pump module according to one embodiment of the invention. In place of the on-demand pressure regulator 30 shown in Fig. 1 and in the fuel pump module 1, the on-demand pressure regulator shown in Fig. 2 may be also used. An oil passage 50 into which fuel pressure-fed by the drive motor is taken in and an oil passage 51 for discharging fuel into fuel injection system and others are provided to an upper casing 41 of the on-demand pressure regulator 40. A valve 43 for breaking the communication of the oil passage 50 and an oil reservoir 52, a spring 44 for applying momentum for always pushing down the valve 43 downward in the drawing, a lower casing 42 connected to the upper casing 41 with a diaphragm 46 between both casings, a pressure regulating member 48 for fixedly supporting a shaft 45 abutting on the valve 43 and the diaphragm 46, and a spring 47 for applying momentum for always pushing up the pressure regulating member 48 upward in the drawing are provided between the oil passage 50 and the oil passage 51.

[0021] When pressure generated in the oil passage 51 is equal to or lower than a predetermined value, the pressure regulating member 48 is pushed up upward in the drawing by the momentum of the spring 47. The reason therefor is that the momentum of the spring 47 is set so that it is larger than the momentum of the spring 44 and at this time, as the valve 43 is pushed up upward by the shaft 45 and the valve does not abut on a sealing part 49 formed in the upper casing 41, the oil passage 50, the oil reservoir 52 and the oil passage 51 are communicated with each other. In the meantime, as pressing force depending upon pressure applied to the diaphragm 46 is set so that the pressing force exceeds the momentum of the spring 47 when pressure applied to the oil passage

51 exceeds the predetermined value, the pressure regulating member 48 is pushed down downward in the drawing, and the valve 43 abuts on the sealing part 49.

[0022] As described above, according to the fuel pump module disclosed in the invention, as the impeller for pressure-feeding fuel is arranged on the side of the bottom plate of the fuel tank according to the counter flow system, the fuel passage from the inlet of the fuel to the discharge port is shortened and as a long fuel passage required when fuel discharged from an upper end of the fuel pump module is led to a lower end of the fuel pump module is not required, the fuel pump module can be small-sized. As the on-demand pressure regulator can be arranged at the lower end of the fuel pump module, the fuel pump module can be further small-sized.

[0023] The form of each part and the fuel passages respectively forming the fuel pump module and a type of the drive motor are not limited to those in the embodiment and it need scarcely be said that various transformations are possible.

Reference Numerals

[0024]

1...	Fuel pump module
2...	Lid member
3...	Power terminal
4...	Upper case
5...	Snap fitting
6...	Output shaft
7 ...	Stator
8 ...	Rotor
9...	Impeller
10, 11...	Electrode
12, 13...	Steel plate (Bottom plate)
15...	Inlet
16, 17...	Oil passage
18.	Discharge port
19...	Fuel passage
23 ...	Housing space
30...	On-demand pressure regulator
31...	Valve
32...	Diaphragm
33...	Pressure regulating member
34...	Spring
35 ...	Stopper
36 ...	Lower case
37...	Oil reservoir
41...	Upper casing
42...	Lower casing
43...	Valve
44, 47...	Springs
45...	Shaft
46...	Diaphragm
48...	Pressure regulation member
49...	Sealing part
50...	Inlet

51...	Outlet
52...	Reservoir

5 Claims

1. A fuel pump module (1) provided with a fuel pump in which an impeller (9) provided in a lower part of the fuel pump is arranged so that its rotation axis is perpendicular and which is attached to the bottom (12, 13) of a fuel tank and an on-demand pressure regulator (30) that regulates the pressure of fuel discharged from the fuel pump, comprising:

the impeller (9) configured according to a counter flow system in which taken fuel is guided in a reverse direction to a direction in which the fuel is taken in;
an intake passage (16) that leads fuel from an inlet (15) provided on the downside of the fuel pump to the downside of the impeller (9); and
a discharge passage (18) that guides the fuel discharged from the impeller (9) to the on-demand pressure regulator (30) provided on the downside of the fuel pump.

2. The fuel pump module (1) according to Claim 1, wherein:

the impeller (9) is attached on the side of one end of an output shaft (6) of a drive motor (7, 8); and
the on-demand pressure regulator (30) is provided in the vicinity of a discharge port of the impeller (9).

3. The fuel pump module (1) according to Claim 1 or 2, wherein:

the fuel pump module (1) comprises a cylindrical upper case (4) that houses the drive motor (7, 8) and the impeller (9) and a lower case (36) that houses the on-demand pressure regulator (30); the upper case (4) and the lower case (36) are detachably configured;
in the lower case (36), a snap fitting (5) as a fitting member is formed; and
in the upper case (4), a stopper (35) fitted to the snap fitting (5) is formed.

FIG.1

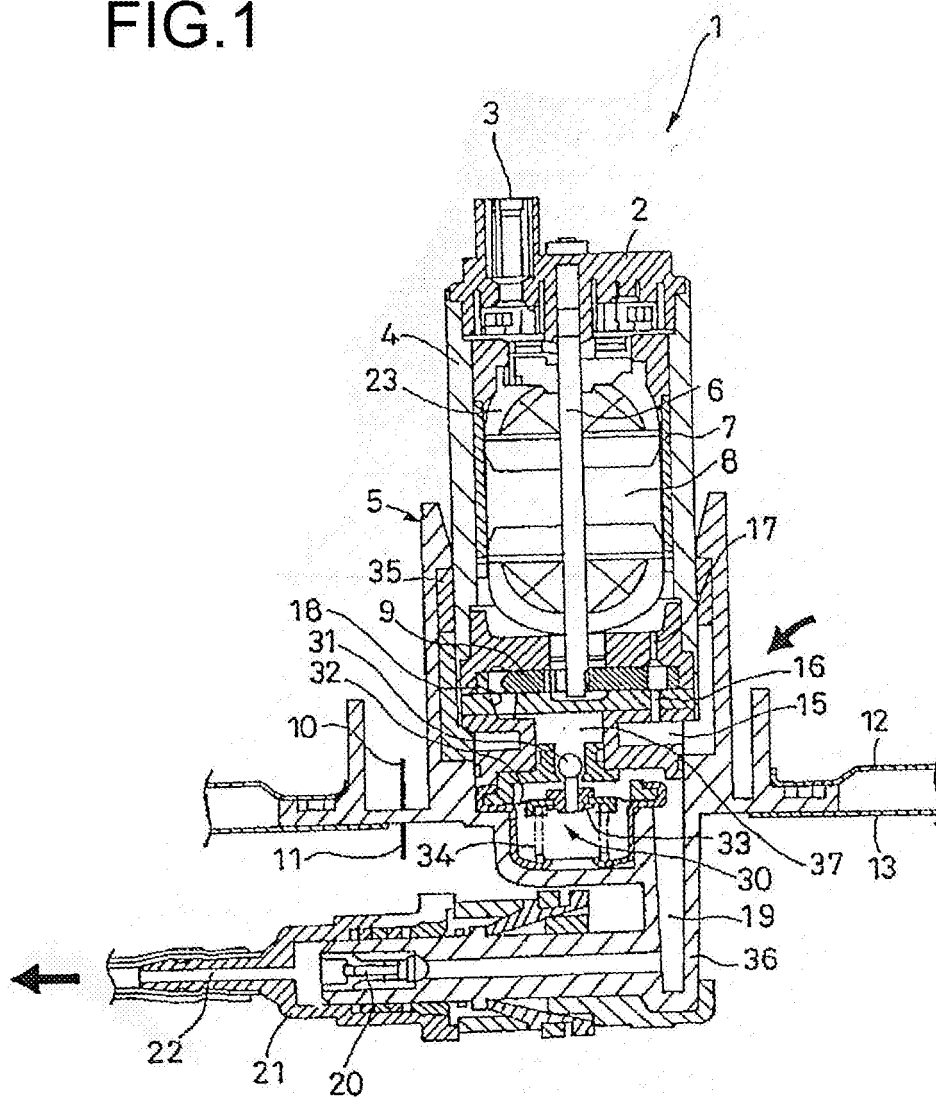
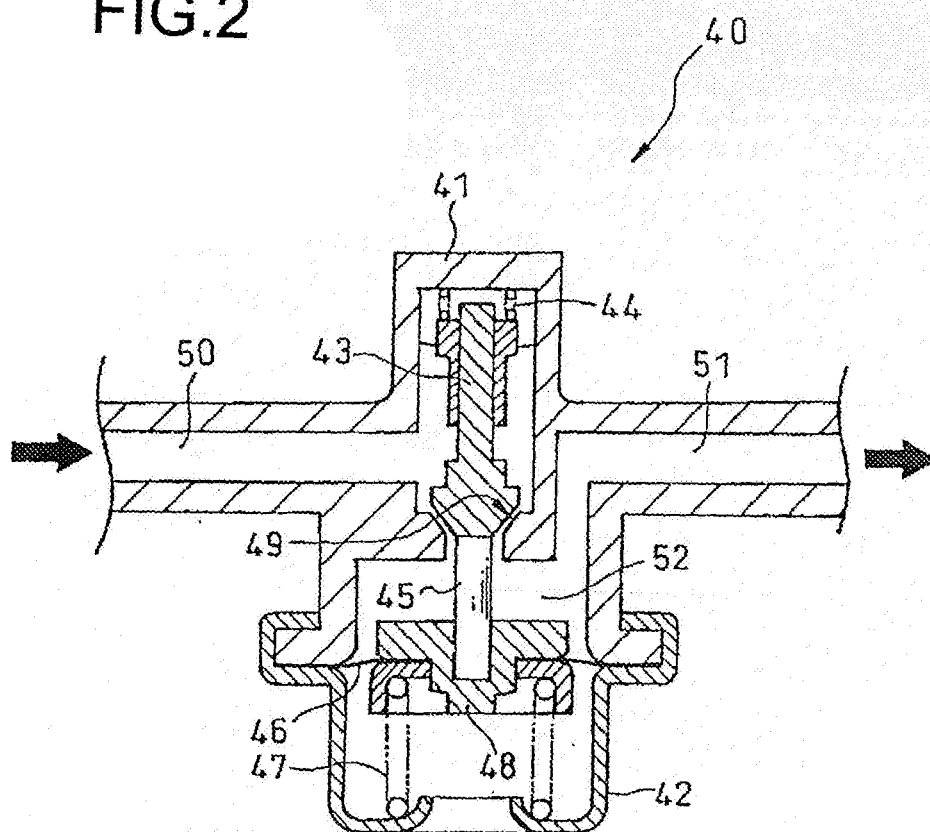


FIG.2





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2005/274361 A1 (IKEYA MASAKI [JP]) 15 December 2005 (2005-12-15)	1	INV. F02M37/10
Y	* paragraph [0140] - paragraph [0154]; figures 16-26 *	2,3	
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A	----- US 4 650 404 A1 (KUSAKAWA YUKIO [JP]) 17 March 1987 (1987-03-17) * column 3, line 1 - column 4, line 44; figures 1,2 *	1	
A	----- EP 1 388 664 A (DENSO CORP [JP]) 11 February 2004 (2004-02-11) * paragraph [0050] - paragraph [0070]; figures 1,2 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 23 March 2007	Examiner Marsano, Flavio
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 06 12 7014

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