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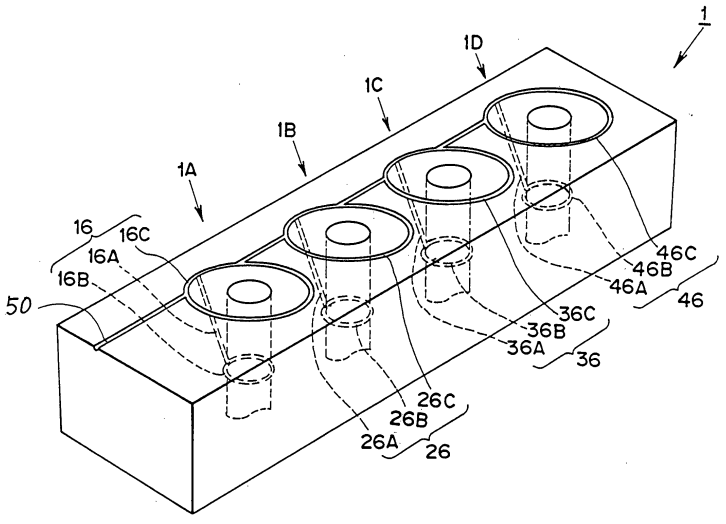
(54) HIGH-PRESSURE FUEL FEED PUMP

(57) A high-pressure fuel supply pump 1 where, in each of plural high-pressure pump portions (1A to 1D) configured to pressurize fuel that has been sucked into the insides of the barrels (11) and to output high-pressure fuel, fuel lubrication between plungers (12) and the barrels (11) is performed by at least some of the high-pressure fuel, wherein each of the high-pressure pump portions (1A to 1D) includes a leak fuel takeout portion (16, 26, 36, 46) for taking out leak fuel generated by the high-pressure fuel for the fuel lubrication from the insides of the barrels (11) to the outside, there is disposed a connecting oil path (50) for collecting and guiding, to a fuel low-pressure side, the leak fuel that has been taken out by the leak fuel takeout portions (16, 26, 36, 46), and the leak fuel is allowed to escape to a fuel tank via the connecting oil path (50).

FIG.3



EP 2 088 309 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a high-pressure fuel supply pump.

BACKGROUND ART

[0002] A high-pressure fuel supply pump that has conventionally come to be used for the purpose of supplying high-pressure fuel to a common rail system, for example, has a configuration where, as shown in FIG. 6, a plunger 102 housed so as to be capable of reciprocal motion inside a barrel 101 reciprocally moves in accordance with the rotation of a cam shaft 103 to pressurize fuel supplied to the inside of the barrel 101 via an inlet/outlet valve 104 and where the thus obtained high-pressure fuel is sent to the outside by the inlet/outlet valve 104. Further, in JP-A-8-68370, there is disclosed a configuration of a high-pressure fuel supply pump that includes two return passages, with one of the two return passages being connected to a fuel tank.

DISCLOSURE OF THE INVENTION

[0003] The conventional high-pressure fuel pump shown in FIG. 6 is configured such that leak fuel, which is some of the high-pressure fuel pressurized inside the barrel 101 used for fuel lubrication of the barrel 101, is supplied back to the barrel 101 through a passage 105, so particularly in an operating state where the discharge fuel amount becomes small, the temperatures of the barrel 101 and the plunger 102 rise because of the above-described circulation of that fuel, and this has been a large factor causing fuel injection efficiency to be lowered. Meanwhile, the configuration disclosed in JP-A-8-68370 has the problem that, in the case of a configuration that includes plural high-pressure pump portions, the configuration of the return passages for handling the leak fuel becomes complicated and causes costs to rise.

[0004] It is an object of the present invention to provide a high-pressure fuel supply pump that can solve the above-described problems in the prior art.

[0005] In order to solve the above-described issues, according to the present invention, there is provided a high-pressure fuel supply pump that includes plural high-pressure pump portions configured to pressurize, with plungers, fuel that has been sucked into the insides of barrels and to discharge high-pressure fuel, and with fuel lubrication between the plungers and the barrels being performed by at least some of the high-pressure fuel in each of the plural high-pressure pump portions, wherein each of the high-pressure pump portions includes a leak fuel takeout portion for taking out leak fuel generated for the fuel lubrication from the insides of the barrels to the outside, and the leak fuel that has been taken out from each of the leak fuel takeout portions is guided to a fuel low-pressure side by a leak separate feed path.

[0006] According to the present invention, the leak fuel, which is some of the fuel used for the fuel lubrication between the plungers and the barrels, is not circulated and supplied to the barrels, a rise in the temperature of the plungers is controlled, and fuel injection efficiency can be improved with a simple configuration.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

FIG. 1 is a general external diagram of an embodiment of the present invention.
FIG. 2 is a cross-sectional diagram of a first high-pressure pump portion shown in FIG. 1.
FIG. 3 is a diagram for describing leak fuel takeout portions shown cross-sectioned by line A-A shown in FIG. 1.
FIG. 4 is a diagram for describing a modification of the embodiment of the present invention.
FIG. 5 is a diagram for describing a modification of the embodiment of the present invention.
FIG. 6 is a diagram for describing a conventional high-pressure fuel supply pump.

BEST MODE FOR CARRYING OUT THE INVENTION

[0008] In order to describe the present invention in greater detail, this will be described in accordance with the attached drawings.

[0009] FIG. 1 is a diagram generally showing the exterior of an embodiment of a high-pressure fuel supply pump to which the present invention has been applied. In the present embodiment, a high-pressure fuel supply pump 1 is used as a supply pump of a common rail system (not shown) that is used as a fuel injection system for a diesel engine, and in a body 2, there are disposed four high-pressure pump portions comprising a first high-pressure pump portion 1A to a fourth high-pressure pump portion 1D that are driven with a predetermined phase difference by a cam shaft (see FIG. 2) that is driven by rotational driving force from the unillustrated diesel engine.

[0010] FIG. 2 is a pump cross-sectional diagram for describing the first high-pressure pump portion 1A. Below, the first high-pressure pump portion 1A will be described in detail with reference to FIG. 2, but the configurations of the second high-pressure pump portion 1B to the fourth high-pressure pump portion 1D are also the same as the configuration of the first high-pressure pump portion 1A.

[0011] What is represented by reference numeral 3 is a pump housing, a common base end portion 3Y of the pump housing 3 is formed in a substantial circular cylinder shape that has an axial line in a direction perpendicular to the page surface, and a cam shaft 4 is disposed on the same axis inside the common base end portion 3Y.

Additionally, a first circular cylinder portion 3A is formed integrally on the common base end portion 3Y of the pump housing 3, and a main structure portion of the first high-pressure pump portion 1A is incorporated inside the first circular cylinder portion 3A.

[0012] Although they are not shown in FIG. 2, second to fourth circular cylinder portions 3B, 3C and 3D are formed integrally on the common base end portion 3Y in the same manner as the first circular cylinder portion 3A for the second high-pressure pump portion 1B, the third high-pressure pump portion 1C and the fourth high-pressure pump portion 1D (see FIG. 1), and the first high-pressure pump portion 1A to the fourth high-pressure pump portion 1D are configured to be driven with a phase difference by the cam shaft 4.

[0013] Next, the configuration of the first high-pressure pump portion 1A will be described. 11 is a barrel that is disposed coaxially inside the first circular cylinder portion 3A, 12 is a plunger that is disposed so as to be capable of reciprocal motion along the axial line thereof inside a plunger chamber 11A of the barrel 11, and the plunger 12 is configured to be guided on an inner wall surface 3Aa of the barrel 11 and movable in the axial line direction of the first circular cylinder portion 3A. A base end portion 12A of the plunger 12 is pushed against a movement guidance member 13 by a resilient spring 14 via a spring seat 14a. A rotating roller 13B that is rotatably fitted together by a support rod 13A is disposed in the movement guidance member 13. The movement guidance member 13 is resiliently energized toward the cam shaft 4 by the resilient spring 14 interposed between the barrel 11 and the movement guidance member 13 such that the rotating roller 13B disposed as mentioned above in the movement guidance member 13 always pressure-contacts the cam shaft 4.

[0014] As a result, when the cam shaft 4 is caused to rotate by the rotational force of the unillustrated diesel engine, the movement guidance member 13 reciprocally moves synchronously with the rotation of the cam shaft 4 such that the plunger 12 can be caused to reciprocally move inside the barrel 11.

[0015] Fuel inside an external fuel tank (not shown) is sucked into the plunger chamber 11A via fuel inlet paths 17, 15C and 15B when the plunger 12 moves back toward the cam shaft 4. This fuel that has been sucked in is pressurized when the plunger 12 rises, and high-pressure fuel is obtained.

[0016] What is represented by reference numeral 15 is an inlet/outlet valve assembly that is fixedly disposed on the distal end portion of the barrel 11 in order to take out the high-pressure fuel from the plunger chamber 11A. Inside a casing 15A of the inlet/outlet valve assembly 15, there are disposed the passage 15B and the passage 15C, and the high-pressure fuel that has been obtained by fuel pressurization inside the plunger chamber 11A is discharged to the outside from a valve body 15D through the passage 15B.

[0017] A leak fuel takeout portion 16 for taking out, to the outside, leak fuel generated as a result of the high-pressure fuel being supplied to the inside of the plunger chamber 11A in order to lubricate the area between the barrel 11 and the plunger 12 with fuel is disposed in the barrel 11. In the present embodiment, the leak fuel takeout portion 16 is configured by a fuel leak hole 16A, an annular port 16B that is disposed in an end portion on the plunger 12 side of the fuel leak hole 16A and is for accumulating the leak fuel inside the barrel, and an annual leak separate feed oil chamber 16C that is formed by an annular groove formed in an outer peripheral wall of the barrel 11 at the other end portion of the fuel leak hole 16A.

[0018] FIG. 3 is a cross-sectional diagram along line A-A of FIG. 1. As shown in FIG. 3, in the second high-pressure pump portion 1B to the fourth high-pressure pump portion 1D, there are disposed leak fuel takeout portions 26, 36 and 46 that are the same as the leak fuel takeout portion 16. That is, the leak fuel takeout portion 26 is configured by a fuel leak hole 26A, an annular port 26B and a leak separate feed oil chamber 26C. The leak fuel takeout portion 36 is configured by a fuel leak hole 36A, an annular port 36B and a leak separate feed oil chamber 36C. The leak fuel takeout portion 46 is configured by a fuel leak hole 46A, an annular port 46B and a leak separate feed oil chamber 46C.

[0019] Additionally, the leak separate feed oil chambers 16C, 26C, 36C and 46C are interconnected as shown in figures by a connecting transport path 50. The connecting transport path 50 is a leak separate feed path for collecting and guiding, toward a fuel low-pressure side, the leak fuel that has been taken out by each of the leak fuel takeout portions 16, 26, 36 and 46. Consequently, each of the quantities of the leak fuel that has been taken out by the leak fuel takeout portions 16, 26, 36 and 46 of the high-pressure pump portions is fed to the connecting transport path 50 from the corresponding leak separate feed oil chambers 16C, 26C, 36C and 46C and is separately fed to a fuel low-pressure side such as, for example, a fuel tank.

[0020] The high-pressure fuel pump 1 is configured as described above, so the leak fuel generated by the high-pressure fuel for the lubrication between the barrels and the plungers is fed to a fuel low-pressure portion such as a fuel tank via the leak fuel takeout portions 16, 26, 36 and 46 disposed in the high-pressure pump portions, respectively. As a result, the temperature of the fuel supplied to the plungers 11 does not rise because of the leak of the high-pressure fuel, and fuel injection efficiency can be remarkably improved in comparison to convention.

[0021] In FIG. 3, there is shown a case where the leak fuel of each of the high-pressure pump portions is fed to a fuel tank via the connecting transport path 50 from the four leak separate feed oil chambers 16C, 26C, 36C and 46C. FIG. 4 is a diagram schematically showing this. However, the way that the leak fuel is allowed to escape is not limited to this configuration.

[0022] FIG. 5 is a diagram showing another example

of the way that the leak fuel is allowed to escape. According to the configuration shown in FIG. 5, the leak fuel is allowed to escape by disposing a dedicated escape passage 70 that interconnects the leak separate feed oil chambers 16C, 26C, 36C and 46C and connects the leak separate feed oil chambers 16C, 26C, 36C and 46C to another return passage inside a high-pressure pump. According to the configuration shown in FIG. 5, there is obtained the advantage that a new pipe is not required outside the high-pressure pump. It will be noted that, although in FIG. 4 there is shown a case where the connecting transport path 50 passes through the centers of the leak separate feed oil chambers 16C, 26C, 36C and 46C, this configuration is only one example, and it is not invariably necessary for the connecting transport path 50 to pass through the centers of the leak separate feed oil chambers 16C, 26C, 36C and 46C.

INDUSTRIAL APPLICABILITY

[0023] As described above, the leak fuel used for the fuel lubrication between the plungers and the barrels is not circulated and supplied to the barrels, so the high-pressure fuel supply pump according to the present invention controls a rise in the temperature of the plungers, can thus improve fuel injection efficiency, and is useful for the improvement of a high-pressure fuel supply pump.

Claims

1. A high-pressure fuel supply pump that includes plural high-pressure pump portions configured to pressurize, with plungers, fuel that has been sucked into the insides of barrels and to discharge high-pressure fuel, and with fuel lubrication between the plungers and the barrels being performed by at least some of the high-pressure fuel in each of the plural high-pressure pump portions,
wherein each of the high-pressure pump portions includes a leak fuel takeout portion for taking out leak fuel generated for the fuel lubrication from the insides of the barrels to the outside, and
the leak fuel that has been taken out by each of the leak fuel takeout portions is guided to a fuel low-pressure side by a leak separate feed path.

2. The high-pressure fuel supply pump according to claim 1, wherein each of the leak fuel takeout portions comprises a fuel leak hole, an annular port that is disposed in an end portion on the plunger side of the fuel leak hole and is for collecting the leak fuel inside the barrel, and an annular leak separate feed oil chamber that is formed by an annular groove formed in an outer peripheral wall of the barrel at the other end portion of the fuel leak hole.

3. The high-pressure fuel supply pump according to claim 2, wherein the leak separate feed path is a connecting oil feed path that interconnects each of the leak separate feed oil chambers of the plural high-pressure pump portions.

4. The high-pressure fuel supply pump according to claim 2, wherein the leak separate feed path is a dedicated escape passage connected to another return passage inside a high-pressure pump, and the escape passage is connected to each of the leak separate feed oil chambers of the plural high-pressure pump portions.

FIG.1

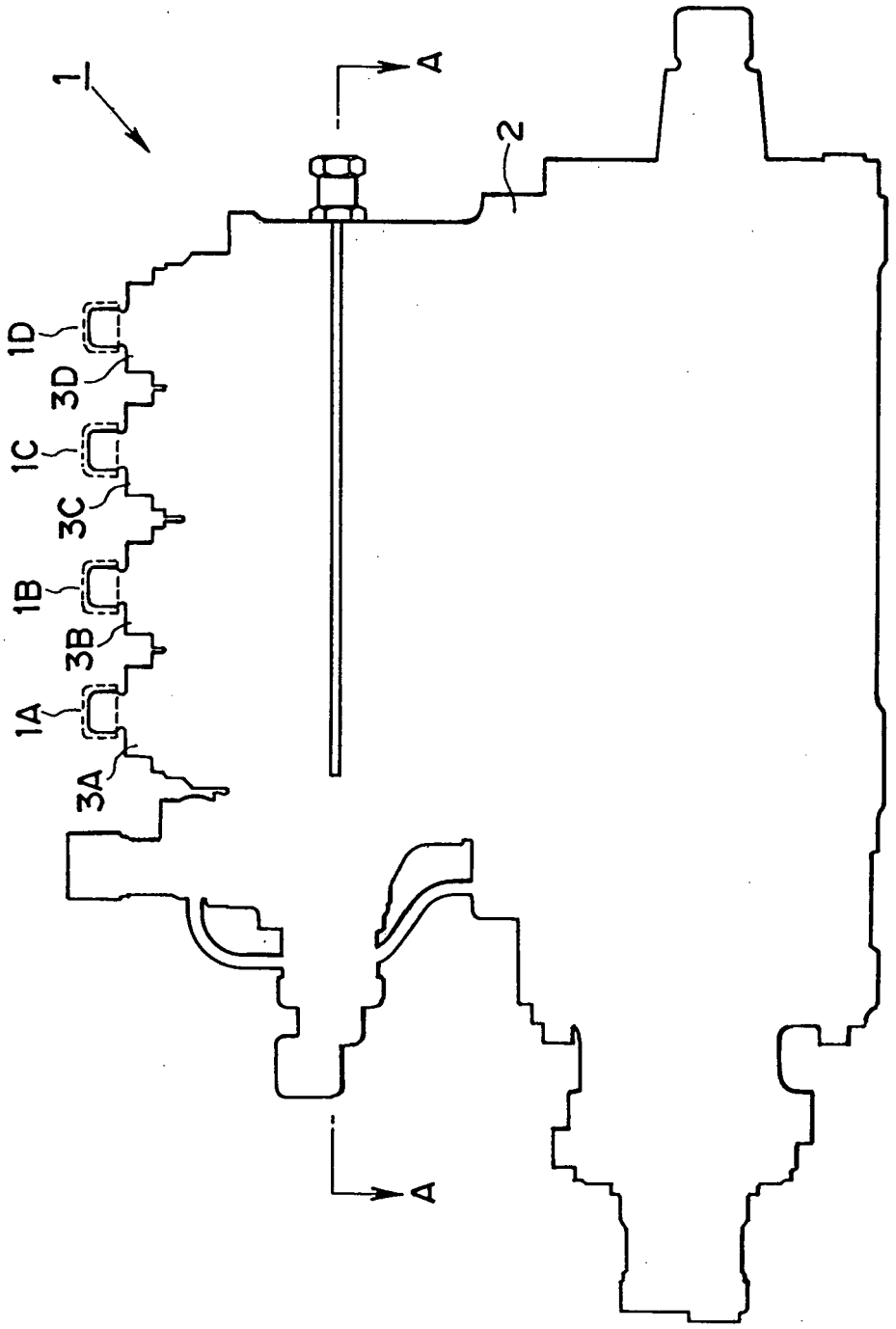


FIG.2

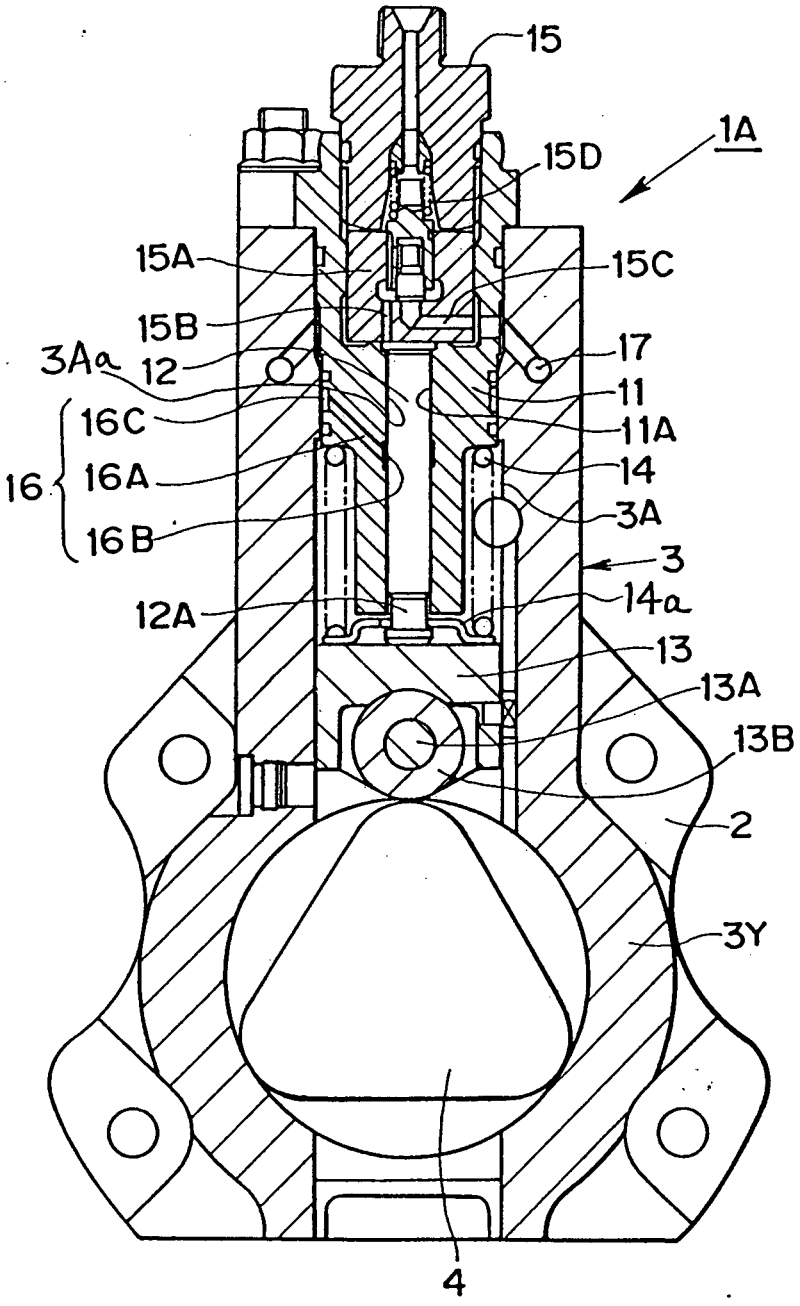

15
1A
15D
15A
15C
15B
17
3Aa
12
11
16C
11A
16
16A
14
16B
3A
3
12A
14a
13
13A
13B
2
3Y
4

FIG.3

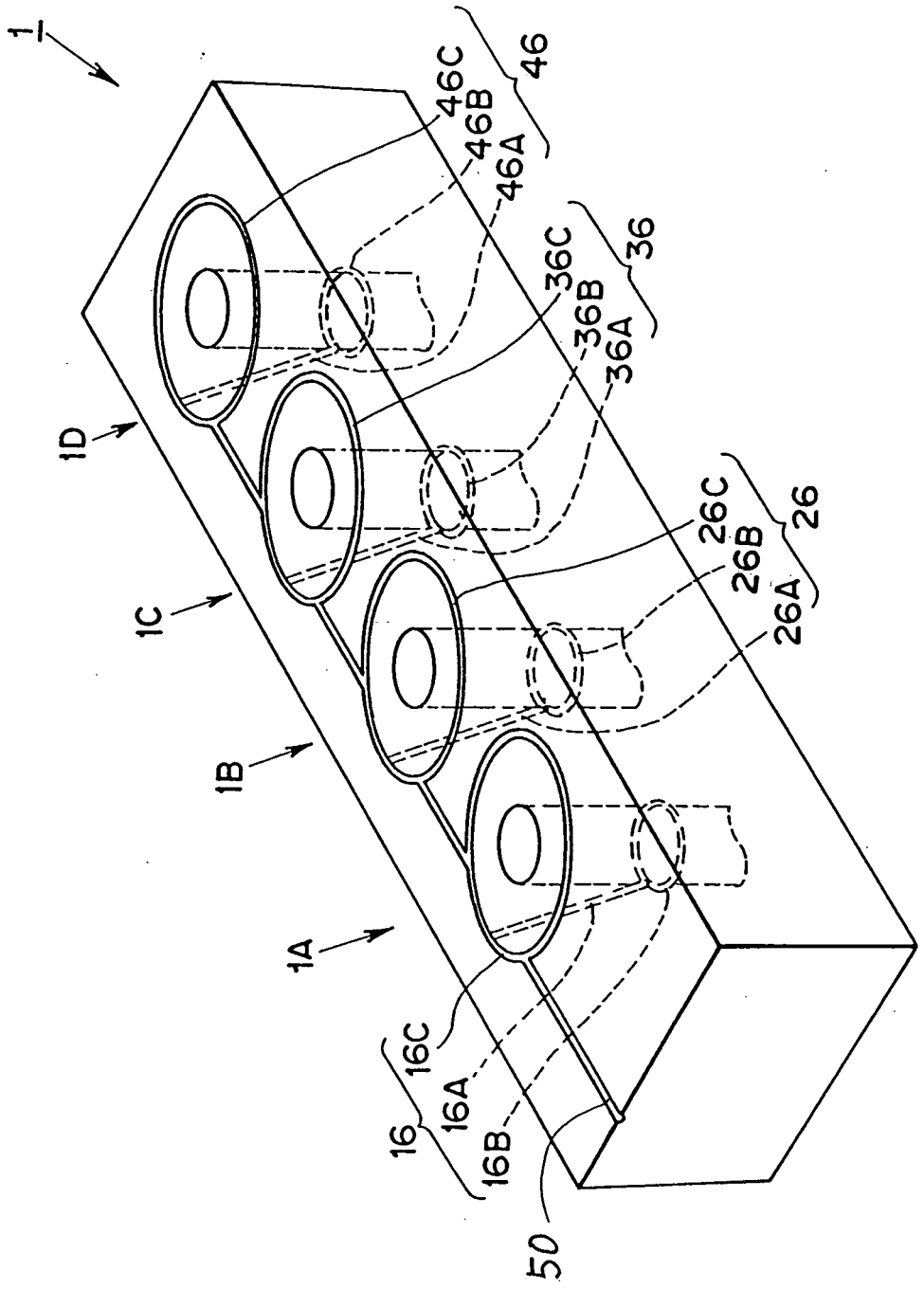

1
46C
46B
46A
46
36C
36B
36A
36
1D
1C
26C
26B
26A
26
1B
1A
16C
16A
16B
16
50

FIG.4

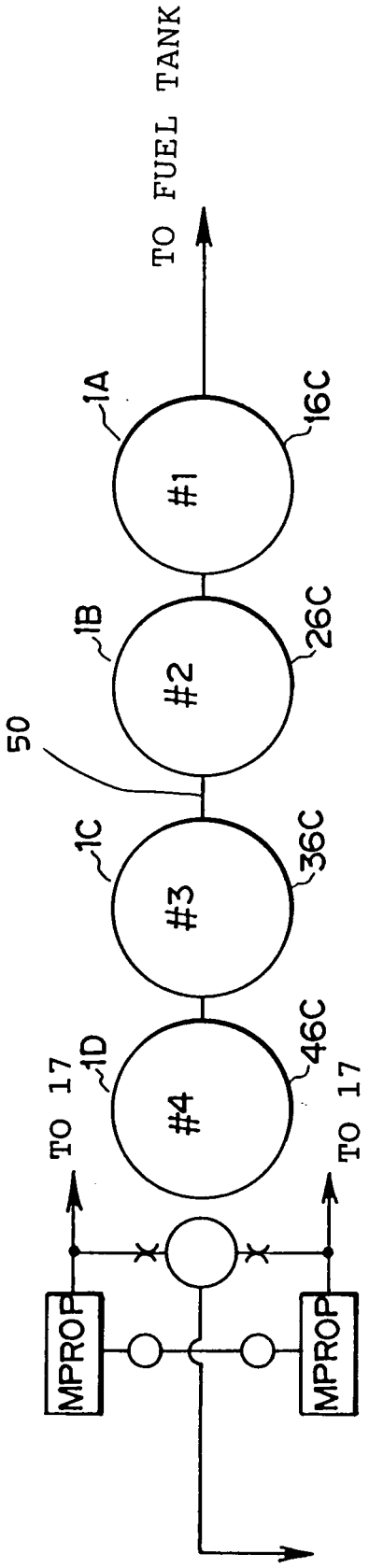

TO FUEL TANK
1A
#1
16C
1B
#2
26C
50
1C
#3
36C
1D
#4
46C
TO 17
TO 17
MPROP
MPROP

FIG.5

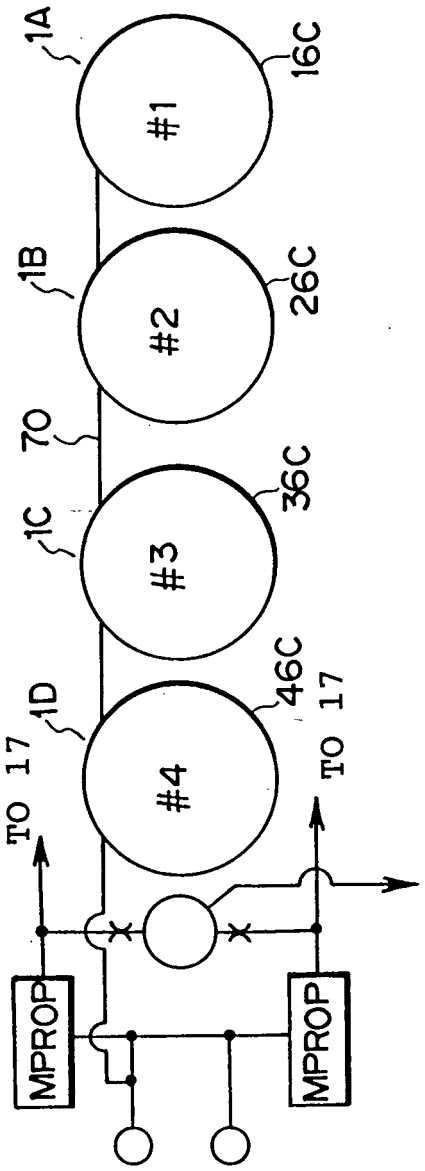
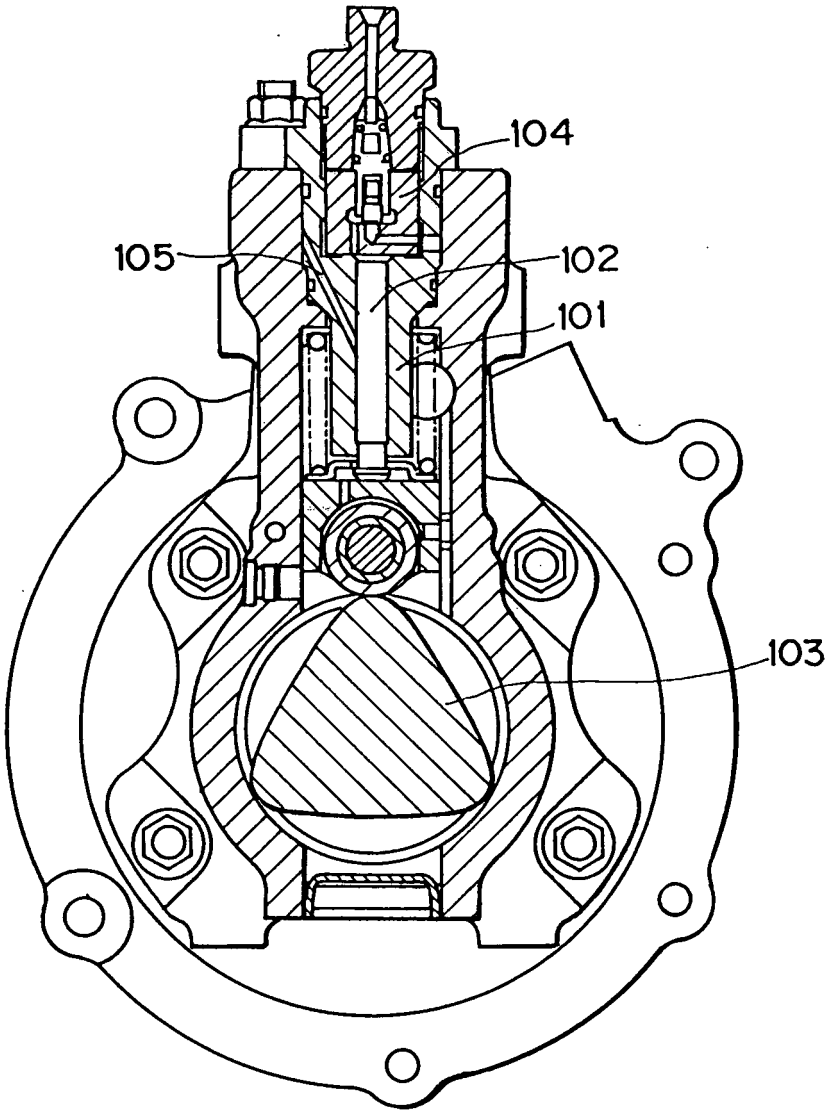


FIG.6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/066078

A. CLASSIFICATION OF SUBJECT MATTER
F02M59/44(2006.01)i

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)
F02M59/44

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 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

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.
X Y	JP 63-3418 Y2 (Yanmar Diesel Engine Co., Ltd.), 27 January, 1988 (27.01.88), Column 7, lines 18 to 28; Figs. 2, 3 (Family: none)	1,2 3,4
Y	JP 2002-276507 A (Isuzu Motors Ltd.), 25 September, 2002 (25.09.02), Par. Nos. [0034], [0035]; Fig. 1 (Family: none)	3
Y	JP 3522782 B2 (Robert Bosch GmbH), 20 February, 2004 (20.02.04), Par. Nos. [0014], [0015]; Fig. 1 (Family: none)	4

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 November, 2007 (05.11.07)	20 November, 2007 (20.11.07)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 8068370 A **[0002] [0003]**