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(54) Title: HIGH PRESSURE PUMP WITH PLUNGER SEAL PROTECTION

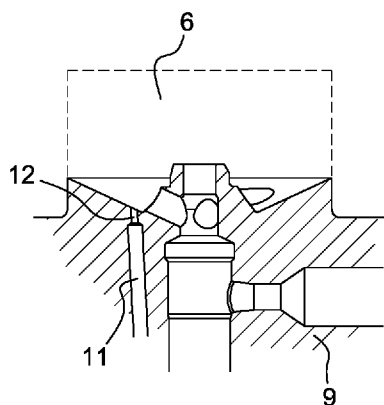


Fig. 2

(57) Abstract: A high pressure fuel pump including a low pressure fuel inlet adapted to allow fuel flow into a head cap volume, and a pumping chamber fluidly connected to said head cap volume via an inlet valve, arranged to allow fuel flow from said head cap volume into said pumping chamber, and a plunger adapted to reciprocate within said pumping chamber to pressurize fuel, said pumping chamber including an outlet valve; and further including a circumferentially arranged plunger seal adapted to prevent leakage flow of fuel between the plunger and the pump housing portion forming the pump- ing chamber, and out of the pumping chamber, and including a seal back- flow conduit arranged to provide a back flow of said fuel leakage from seal region to said head cap space, characterised where said seal backflow con- duit includes a damping restriction.

HIGH PRESSURE PUMP WITH PLUNGER SEAL PROTECTION

5 TECHNICAL FIELD

This invention relates to high pressure fuel pumps which include an e.g. cam driven plunger, adapted to reciprocate within a pumping chamber in order to pressurise fuel, and which include a plunger seal.

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BACKGROUND OF THE INVENTION

Fuel flow into a pressurizing chamber of a piston (plunger) type pump is typically controlled by an inlet metering valve (IMV). Typically an inlet valve is also located integral with the pump (on the head cap thereof) such that fuel can pass into the pumping chamber where there is a pressure differential between the outlet of the IMV (inlet to the pump) and the pressurization chamber, of about 1.5 bar. The fuel is subsequently pressurized by such a plunger or piston, (typically cam driven) before the pressurized fuel is outlet, e.g. via a common rail, to fuel injection equipment. The outlet of fuel from the chamber may take place via outlet valve.

There is leakage of fuel between around the plunger/piston during the pressurization stroke and to reduce this and to prevent contamination of this fuel leakage into the cambox and ultimately the engine oil, a plunger seal is provided. To provide back path of this leakage flow, a seal return line is e.g. provide by a bore of drilling thus this providing a conduit for leakage flow back to the head cap space. A problem identified by the inventors is pressure fluctuation in the paths between the IMV and the Inlet valve (e.g. in the head cap space) and in particular pressure spikes can lead to wear of the seal.

It is an object of the invention to overcome this problem.

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SUMMARY OF THE INVENTION

In one aspect is provided a high pressure fuel pump including a low pressure fuel inlet adapted to allow fuel flow into a head cap volume, and a pumping chamber fluidly connected to said head cap volume via an inlet valve, arranged to allow fuel flow from said head cap volume into said pumping chamber, and a plunger adapted to reciprocate within said pumping chamber to pressurize fuel, said pumping chamber including an outlet valve; and further including a circumferentially arranged plunger seal adapted to prevent leakage flow of fuel between the plunger and the pump housing portion forming the pumping chamber, and out of the pumping chamber, and including a seal backflow conduit arranged to provide a back flow of said fuel leakage from seal region to said head cap space, characterised where said seal backflow conduit includes a damping restriction.

Said damping restriction may comprise a portion of the back flow conduit having a reduced cross sectional area.

The back flow conduit may have an outlet to the head cap space and the damping restriction is formed at or adjacent to the outlet.

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The damping restriction may be provided as an insert.

The plunger seal may be located within the pump housing portion forming the pumping chamber, and surrounding a portion of said plunger.

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BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is now described by way of example with reference to the accompanying drawings in which:

- Figure 1 shows a partial sectional view of a prior art high pressure fuel pump;
- Figure 2 shows a partial sectional view of a high pressure fuel pump according to one example.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows a schematic view showing a cross section through the top portion of a high pressure fuel pump 1. Fuel is pressurised by way of a plunger (or piston) 2 which is driven by a cam (not shown), adapted to pressurise fuel which enters into a pressurisation chamber 3. The plunger is adapted to reciprocate up and down within the pressurisation chamber formed from the pump housing 4, so as to draw fuel in on the down stroke and pressurise the fuel on the upstroke.

- 10 Fuel is drawn into the pump via an inlet 7 to a head cap space/area 6. The inlet may be downstream of an inlet metering valve. The fuel flowing into the head cap area from the inlet 7 is shown by arrow A. An inlet valve 8 is arranged so as to provide a flow path of fuel from the head cap space to the pumping chamber when there is a pressure differential there between of about 1.5 bar. A higher pressure differential opens the inlet valve. When pressurising fuel on the upstroke, the plunger moves upwards. In the figure the plunger is shown at the top dead centre position. Pressurised fuel leaves the pressure chamber via outlet valve 9.

- As a result of the pressurisation there is a leakage of fuel between the surface of the plunger and the pumping chamber wall formed by the pump housing, shown by arrow B. To reduce this problem, a plunger leakage seal 10 is provided around the plunger and formed in the pumping chamber. This prevents fuel entering the cam box and without this, risks fuel leaking to the engine oil thus diluting the engine oil.

- 25 In order to provide a back path for fuel leakage as well as to prevent any danger of contamination of engine oil, it is known to provide a seal return line 11 which is effectively a conduit such as a bore to allow fuel flow back to the header cap volume/space.

- 30 The inventor has identified that in operation of the fuel pump the pressure in the head cap volume/area is subject to pressure fluctuations which includes pressure spikes. Such pressure spikes can lead to damage and wear of the seal.

In order to overcome this problem, in one aspect is provided a damping orifice into seal return line.

Figure 2 shows an example of the invention which is similar to figure 1 with
5 identical components having the same reference numerals. In the figure, the design is basically the same as in figure 2 except there is included a damping restriction/orifice 12 in the seal return line (conduit or bore). Thus conduit or bore includes a portion which has a substantially narrower cross section or diameter. This provides the requisite damping with regard to the pressure oscillations in the
10 head cap space affecting the seal.

The damping orifice/restriction in the example is adjacent the head space and open to it but the restrictor or damping orifice may be located anywhere in the seal return line. The damping restriction may be provided by an insert.
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CLAIMS

1. A high pressure fuel pump including a low pressure fuel inlet adapted to allow fuel flow into a head cap volume, and a pumping chamber fluidly connected to said head cap volume via an inlet valve, arranged to allow fuel flow from said head cap volume into said pumping chamber, and a plunger adapted to reciprocate within said pumping chamber to pressurize fuel, said pumping chamber including an outlet valve; and further including a circumferentially arranged plunger seal adapted to prevent leakage flow of fuel between the plunger and the pump housing portion forming the pumping chamber, and out of the pumping chamber, and including a seal backflow conduit arranged to provide a back flow of said fuel leakage from seal region to said head cap space, characterised where said seal backflow conduit includes a damping restriction.
2. A pump as claimed in claim 1 where said damping restriction comprises a portion of the back flow conduit having a reduced cross sectional area.
3. A pump as claimed in claims 1 to 2 where the back flow conduit has an outlet to the head cap space and the damping restriction is formed at or adjacent to the outlet.
4. A pump as claimed in claim 3 wherein the damping restriction is provided as an insert.
5. A pump as claimed in claims 1 to 4 wherein said plunger seal is located within the pump housing portion forming the pumping chamber, and surrounding a portion of said plunger.

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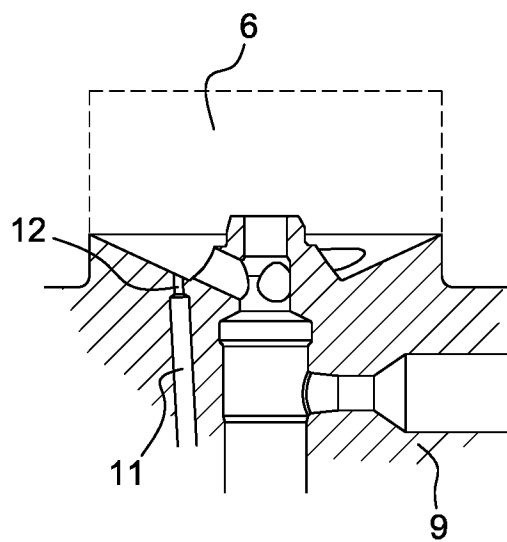
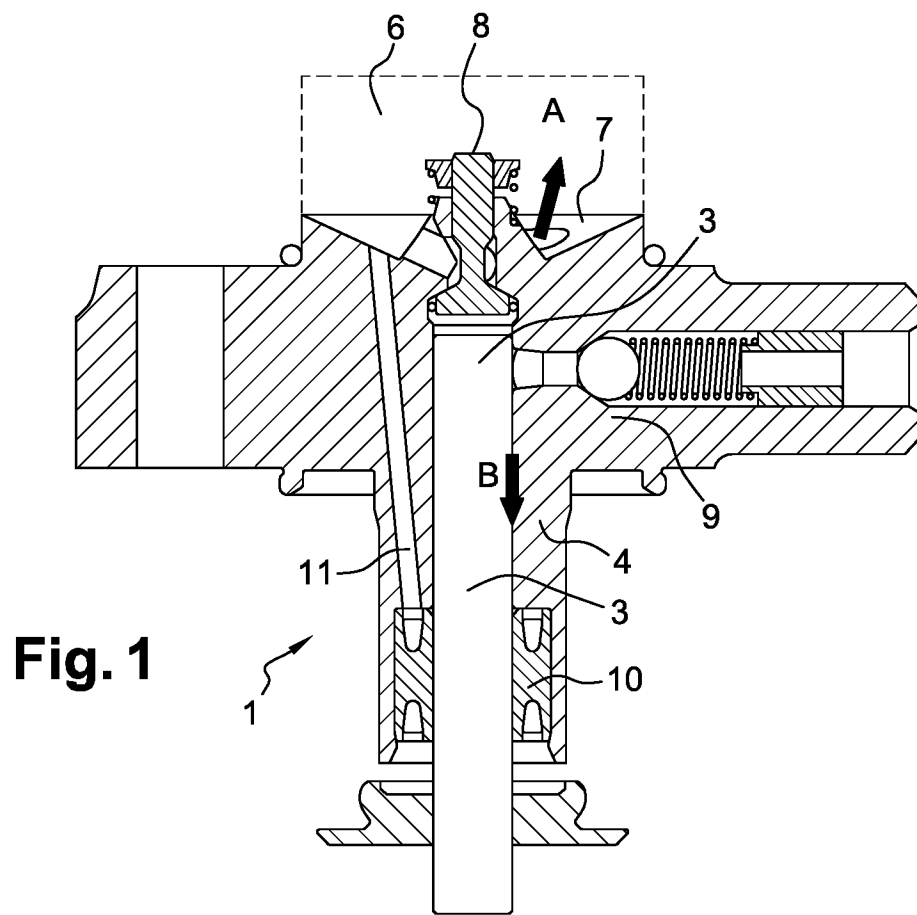


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER

INV. F02M55/00 F02M59/44
ADD.

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)
F02M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2011 007781 A1 (CONTINENTAL AUTOMOTIVE GMBH [DE]) 25 October 2012 (2012-10-25)	1-3,5
Y	figure 1	4
Y	----- WO 2015/055332 A1 (CONTINENTAL AUTOMOTIVE GMBH [DE]) 23 April 2015 (2015-04-23) figures 1a-4	4
X	----- EP 1 707 799 A1 (DENSO CORP [JP]) 4 October 2006 (2006-10-04) figures 12-15	1



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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