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(54) High pressure pump

(57) A high pressure fuel pump unit (10) comprises a pump head (12), a cam-follower (24), a plunger (18) extending along a longitudinal axis (A) from a first extremity slidably arranged in a pumping bore (14) of the pump head (12) to a second extremity (22) cooperating with the cam-follower (24) lubricated by oil and, a spring (30) compressed between the pump head (12) and the cam-follower (24). The pump unit (10) further comprises an annular seal (34) arranged around the plunger (18) and fixed to the pump head (12) in order to prevent mixing of fuel with oil.

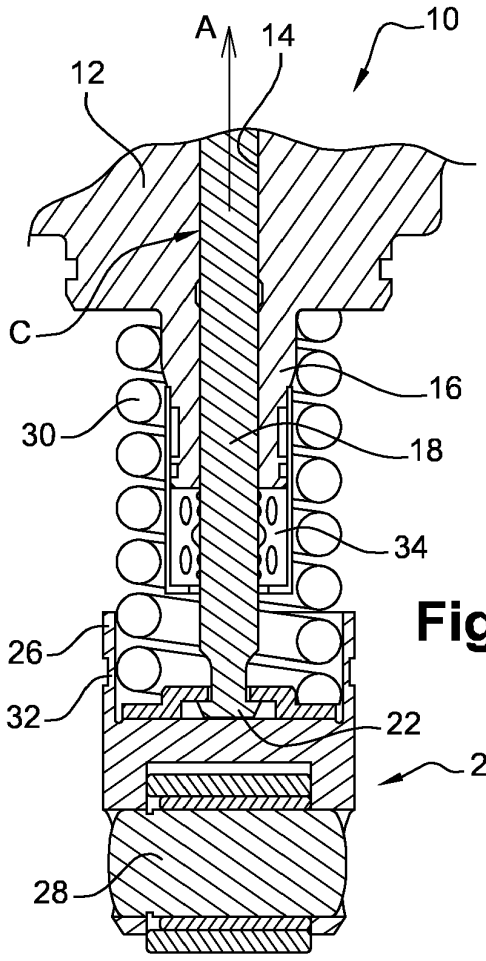

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a high pressure fuel pump actuated by an oil lubricated cam follower.

BACKGROUND OF THE INVENTION

[0002] In a high pressure fuel pump a plunger extends from an upper extremity forming a piston in a pump head to a lower extremity provided with a cam follower and a pin bush roller. The cam follower follows a cam which rotations actuate the plunger and consequently the piston is reciprocally moving inside the pump head. A coil spring compressed between the cam follower and the pump head maintains permanent contact between the roller and the cam.

[0003] The piston is wetted by fuel while the lower extremity and the cam follower are lubricated by engine oil and, as the plunger reciprocally slides within the pump head, some small quantities of oil and fuel mix and generate undesirable pollution.

[0004] Another issue is related to the assembly process. The plunger is not held in the pump before the pump unit is fixed on the engine, therefore it may happen that, on the assembly line, a plunger falls off the pump head.

SUMMARY OF THE INVENTION

[0005] Accordingly, it is an object of the present invention to provide ahigh pressure fuel pump unit comprising a pump head, a cam-follower for cooperating with a rotating cam, a plunger extending along a longitudinal axis from the pump head to a cam follower and a spring compressed between the pump head and the cam-follower for soliciting the cam-follower toward the cam. The plunger extends from a first extremity slidably arranged in a pumping bore of the pump head, where is pumped the fuel, to a second extremity cooperating with the cam-follower lubricated by oil. The pump unit further comprises an annular seal arranged around the plunger and fixed to the pump head in order to prevent mixing of fuel with oil.

[0006] The seal is a double lip seal, its two lips cooperating with the plunger.

[0007] Furthermore the seal may solicit the plunger with a surrounding radial force inwardly oriented sufficient to retain the plunger in the pump head and to prevent the plunger to accidently fall-off the pump head during the assembly of the pump unit.

[0008] The seal is arranged within a seal retaining sleeve attached to the pump head.

[0009] The pumping bore opens out of the pump head in a cylindrical recess, the seal being arranged in said cylindrical recess.

[0010] In another embodiment, a pump unit comprises a bell shape member fixed to the pump head in a location surrounding said cylindrical recess, and axially extending to a distal end having an aperture through which the plunger extends.

[0011] The plunger may be provided with an annular groove in a location that is permanently inside the bell shape member The groove receives an annular retaining clip which outer diameter is larger than the diameter of the aperture so to prevent the plunger to accidently fall-off the pumping bore during the assembly of the pump unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The present invention is now described by way of non-limiting examples with reference to the accompanying drawings in which:

Figure 1 is an axial section of a pump unit as per the invention.
Figure 2 is a detail of part of figure 1.
Figure 3 is another embodiment of a pump unit as per the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] For clarity and concision purposes and to ease the understanding of the description a bottom-up orientation as shown in figure 1 will be used. The terms top, bottom, upper, lower... as well as the orientations downward, downwardly, upward, upwardly may be utilized without any intention to limit the scope of the invention, especially in regards of the numerous possibilities of installation of the pump in a vehicle.

[0014] A high pressure fuel pump 10 extends along a longitudinal axis A and comprises a pump head 12 fixed directly to the engine (not represented). Alternatively it may be fixed on a separate housing. The head 12 is provided with an axial bore 14 which upper extremity is a compression chamber receiving fuel from an inlet controlled by a valve. The pressurized fuel leaves the compression chamber through an outlet controlled by another valve. The pump head 12 is further provided with a cylindrical member 16 that axially extends downwardly, the bore 14 centrally extending in said cylindrical member 16.

[0015] In the bore 14 is slidably arranged a plunger 18 which upper extremity is a piston. The diametral clearance C between the bore 14 and the plunger 18 is typically of few microns enabling on one end, the plunger 18 to slide in the bore 14 and, on the other end to compress the fuel in ensuring there is minimal leakage through the diametral clearance C. The plunger 18 downwardly extends to a lower extremity 22 that abuts against a cam follower 24 comprising a cup-like member 26 and a pin bush roller 28 rolling on the rotating cam. A coil spring 30 is arranged around the plunger 18 and is compressed between the pump head 12 and the cam follower 24. More particularly, as it can be seen on figure 1, the top part of the spring 30 is engaged around the cylindrical member 16, the final spiral abutting against a flat surface

of the head 12. The lower part of the spring 30 is received on a spring seat 32 arranged inside the cup-like member 26.

[0016] In a first embodiment shown on figure 1 and detailed on figure 2, the pump unit 10 further comprises a seal 34 arranged in a seal retaining sleeve 36. The seal retaining sleeve 36 has a cylindrical wall 38 engaged and fixed, by crimping, screwing, gluing or any other mean, over the lower end of the cylindrical member 16 and a disc-shape bottom wall 40 provided with a central aperture 42. In place, the plunger 18 extends out of the cylindrical member 16 through the aperture 42. The seal 34 is arranged in the internal tubular space defined between the cylindrical wall 38, the bottom wall 40 and the plunger 18.

[0017] As known in the art, once the unit pump 10 is in place, the plunger 18 reciprocally moves up-and-down actuated by the displacement of the cam follower 24 rolling on the rotating cam. The piston is wetted by fuel while the cam follower is lubricated by engine oil. A first function of the seal 34 is to ensure total separation between the two fluids by creating a barrier around the plunger 16. To ensure this, the seal 34 is a double lip seal 34 so to circumferentially contact the plunger 18 in two parallel zones.

[0018] A second function of the seal 34 is related to the assembly process particularly when assembling the pump unit directly to an engine. The pump unit 10 is assembled by inserting the plunger 18 into the bore 14. The integrity of the pump unit 10 is maintained when it is finally fixed on the engine. The pump head 12 is fixed to the engine and on the opposite side the cam follower 24 is against the rotating cam and, in between, the spring 30 is compressed ensuring zero free play. Prior to this assembly into the engine, the plunger 18 may accidentally fall off the pump head 12. The second function of the seal 34 is to retain the plunger 18 in place and avoid these accidents. The seal 34 is then further designed to generate on the plunger 18 circumferential forces radially inwardly oriented. The forces are sufficient to retain the plunger 18 in place after it is engaged in the bore 14.

[0019] During the assembly process the seal retaining sleeve 36 is fixed on the pump head 12 then the seal 34 is arranged inside the seal retaining sleeve 36. Afterward, the plunger 18 is inserted through the seal 34 and inside the bore 14. Alternatively, should the fixation process allow this, the seal 34 may be set in the seal retaining sleeve 36 before the seal retaining sleeve 36 is fixed on the pump head 12.

[0020] A second embodiment is now described in reference to figure 3. The cylindrical member is much shorter than in the first embodiment. This short cylindrical member 44 is provided with an internal axial recess 46 wherein opens the bore 14 and wherein is arranged the seal 34. Externally, the short cylindrical member 44 is provided with an attachment mean such as a thread, as represented on figure 3, or alternatively a crimping geometry, a gluing surface or even radial threaded holes for receiving radially oriented screws. The pump head 12 is further equipped with a bell-shape-member 48 attached via attachment mean complementary to the mean provided with the head 12. Internally, the bell-member 48 has a cylindrical hole 50 that diameter D1 is smaller than the external diameter D2 of the seal 34 so, when fixing the bell member 48, the inner part of its wall comes in contact with the pumping head 12 creating a stop preventing removal of the seal 34 during operation. As visible on figure 3, the bell member 48 is axially provided with an aperture 52 which diameter D3 is smaller than the diameter D1 of the cylindrical hole 50 and, when assembled the plunger 18 extends out of the bore 14, through the seal 34, through the cylindrical hale 50 and out through the aperture 52.

[0021] In this second alternative the seal 34 also ensures the two functions of sealing and retaining the plunger.

[0022] For increased robustness of the retaining function, the plunger 18 may be provided with a further retaining mean that is a retaining clip 54 with outer diameter D4 larger than the diameter D3 of the aperture 52. The clip 54 is set in a groove arranged in the plunger 18 in a location that is proximate the seal 34 when the plunger 18 is fully inserted inside the bore 14. Also the bell member 48 has to be sufficiently long so, when the plunger 18 travels downwardly the clip 54 remains inside the cylindrical hole 50 travelling from proximate the seal 34 to proximate the aperture 52. During the assembly process, should the seal 34 not retain sufficiently the plunger 18, the plunger 18 will slide until the clip 54 abuts against the bottom wall of the bell member 48 preventing a total disassembly of the plunger 18 and an undesirable fall off. Also, the outer face 56 of the bell member 48 is slightly conical with apex toward the cam so to ease the engagement and positioning of the spring 30.

Claims

1. A high pressure fuel pump unit (10) comprising a pump head (12), a cam-follower (24) for cooperating with a rotating cam, a plunger (18) extending along a longitudinal axis (A) from a first extremity slidably arranged in a pumping bore (14) of the pump head (12), where is pumped the fuel, to a second extremity (22) cooperating with the cam-follower (24) lubricated by oil and, a spring (30) compressed between the pump head (12) and the cam-follower (24) for soliciting the cam-follower (24) toward the cam, **characterized in that**
   the pump unit (10) further comprises an annular seal (34) arranged around the plunger (18) and fixed to the pump head (12) in order to prevent mixing of fuel with oil.

2. A pump unit (10) as set in the preceding claim wherein the seal (34) is a double lip seal (34), its two lips

cooperating with the plunger (18).

3. A pump unit (10) as set in any of the preceding claims wherein the seal (34) solicits the plunger (18) with a surrounding radial force inwardly oriented sufficient to prevent the plunger (18) to accidently fall-off the pump head (12) during the assembly of the pump unit (10).

4. A pump unit (10) as set in any of the preceding claims wherein the seal (34) is arranged within a seal retaining sleeve (36) attached to the pump head (12).

5. A pump unit (10) as set in any of the claims 1 to 3 wherein the pumping bore (14) opens out of the pump head (12) in a cylindrical recess (46), the seal (34) being arranged in said cylindrical recess (46).

6. A pump unit (10) as set in claim 5 further comprising a bell shape member (48) fixed to the pump head (12) in a location surrounding said cylindrical recess (46), and axially extending to a distal end having an aperture (52) through which the plunger (18) extends.

7. A pump unit (10) as set claim 6 wherein the plunger (18) is provided with an annular groove in a location that is permanently inside the bell shape member (48), said groove receiving an annular retaining clip (54) which outer diameter (D4) is larger than the diameter (D3) of the aperture (52) so to prevent the plunger (18) to accidently fall-off the pumping bore (14) during the assembly of the pump unit (10).

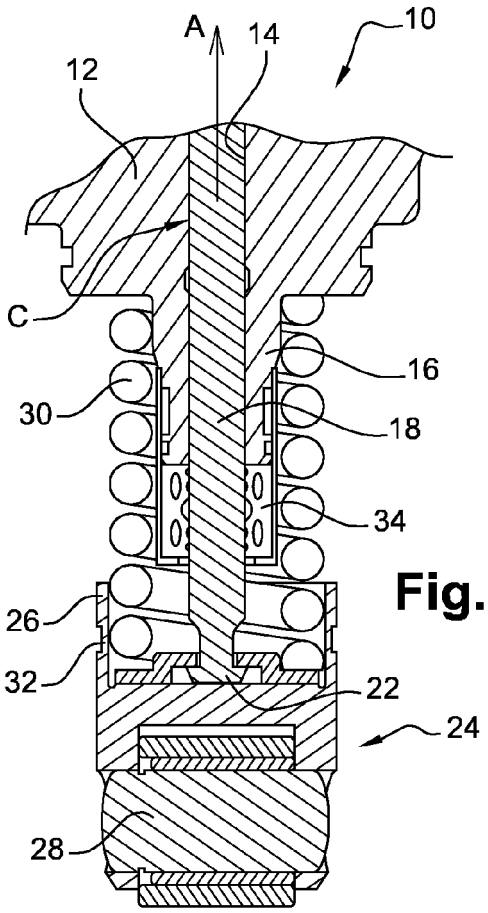

Fig. 1

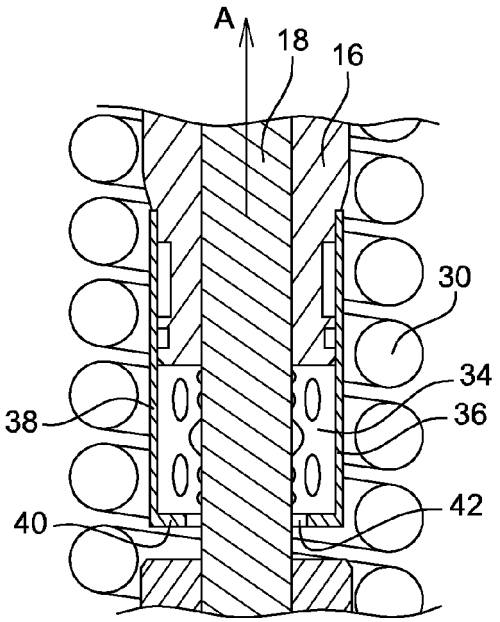

Fig. 2

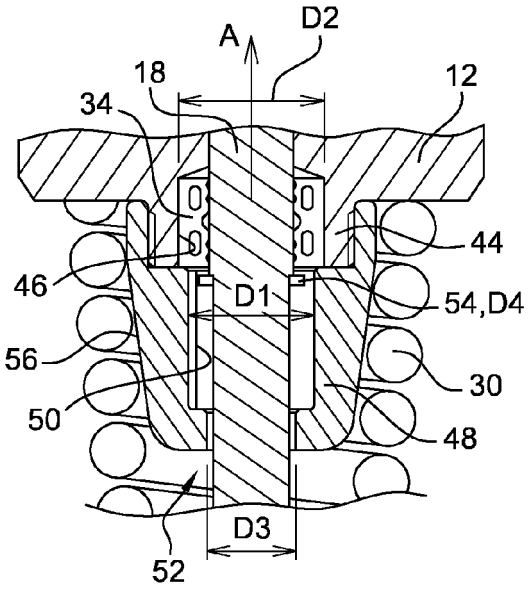

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 13 17 4546

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	EP 2 317 120 A1 (MAGNETI MARELLI SPA [IT]) 4 May 2011 (2011-05-04) * paragraph [0019] - paragraph [0021]; figures 2, 7 *	1-7	INV. F04B1/04 F04B53/14
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			TECHNICAL FIELDS SEARCHED (IPC) F04B F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 November 2013	Tortosa Masiá, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 17 4546

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82