



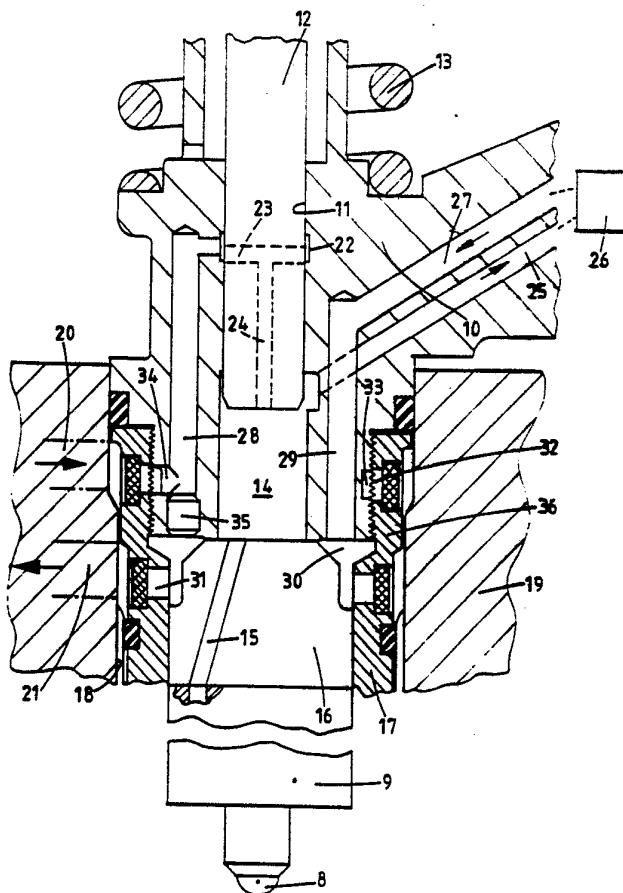
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/GB91/02025 (22) International Filing Date: 18 November 1991 (18.11.91) (30) Priority data: 9026838.4 11 December 1990 (11.12.90) GB (71) Applicant (for all designated States except US): LUCAS INDUSTRIES PUBLIC LIMITED COMPANY [GB/GB]; Brueton House, New Road, Solihull, West Midlands B91 3TX (GB). (72) Inventor; and (75) Inventor/Applicant (for US only) : LINTOTT, Edward, Robert [GB/GB]; 83 Clarence Road, Walthamstow, London E17 6AG (GB). (74) Agents: THOMPSON, George, Michael et al.; Marks & Clerk, Alpha Tower, Suffolk Street Queensway, Birmingham B1 1TT (GB).</p>		<p>(81) Designated States: AT (European patent), BE (European patent), CH (European patent), CS, DE, DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB, GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.</p> <p>Published <i>With international search report.</i></p>

(54) Title: FUEL PUMP

(57) Abstract

A unit injector has a pump body (10) against an end wall of which is located a member (16). Opening onto the end wall of the pump body is a pair of passages (28, 29) one of which communicates directly with the pumping chamber (14) and the other of which communicates with the chamber through a spill valve (26). A cap nut (17) is engaged with the pump body and defines a pair of axially spaced ports (31, 32) and the one port (31) communicates through a chamber (30) with the ends of said pair of passages (28, 29). The choice as to which of said passages shall communicate with the other port (32) is made by inserting a plug (35) into the end of the selected passage and forming a drilling (34) between the selected passage and the other port.



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FUEL PUMP

This invention relates to a unit injector for supplying fuel to an internal combustion engine, the injector comprising a pump body, a fuel injection nozzle secured to the body and having a fuel inlet connected to a pumping chamber defined in the body, a spill valve mounted on the pump body for controlling the amount of fuel supplied through the outlet of the nozzle, the unit injector being mounted in use within a bore defined in the cylinder head of an engine, the cylinder head also defining a fuel supply passage and a fuel drain passage opening into said bore at different axial positions, a fuel inlet port and a fuel outlet port defined by the injector for communication when the injector is located in the bore with said fuel supply passage and said fuel drain passage respectively.

Within the injector body the fuel inlet port communicates with a first passage through which fuel can flow to the pumping chamber and the fuel outlet port communicates with a second passage communicating with said spill valve. The fuel supply passage and the fuel drain passage in the cylinder head have to be located in the cylinder head with due regard to other passages and drillings in the cylinder head and also with due regard to the venting particularly of the fuel supply passage, of air. In some applications therefore it may be more convenient to have the fuel supply passage at a position closer to the nozzle than the fuel drain passage whilst in other applications it is more convenient to have the position of these passages reversed. Each pump has to be suitable for the particular application but it is desirable that the modification to the construction of the pump to enable it to function in both situations, should be kept to a minimum.

According to the invention a unit injector of the kind specified includes first and second passages opening onto an end face of the pump body, fuel flowing through the first passage to the pumping chamber and the second passage communicating with the spill valve, said passages opening into a chamber communicating with one of said ports, a drilling extending between the other of said ports and one of said passages and a plug which can be located in the end of said one passage to block communication between said one passage and the chamber.

An example of a unit injector in accordance with the invention will now be described with reference to the accompanying drawing which shows a part sectional side elevation of part of the injector.

Referring to the drawing the unit injector includes a body 10 in which is defined a bore 11 which accommodates a pumping plunger 12. The plunger is movable inwardly by an engine driven cam and is moved outwardly by means of a coiled compression spring part of which is seen at 13 and which is interposed between the body and a spring abutment carried by the plunger. The bore 11 at its inner end defines with the plunger 12, a pumping chamber 14 from which extends an outlet passage 15 formed in a distance piece 16 which is interposed between the body 10 and the body of a fuel injection nozzle 9. The nozzle and the distance piece are held in assembled relationship with the body 10 by means of a cap nut 17 which is in screw thread engagement with the body.

In the use of the injector it is mounted within a bore 18 formed in the cylinder head 19 of an engine with the outlet 8 of the injection nozzle 9 being exposed within a combustion chamber of the engine. The cylinder head defines a fuel supply passage 20 which is connected to a source of fuel under pressure and a passage 21 which

communicates with a drain. The source of fuel may be a pump having its outlet connected to the passage 20 and its inlet connected to the passage 21.

Formed in the wall of the bore is a circumferential groove 22 which is connected as will be explained, to the fuel supply passage 20. The groove 22 near the outermost position of the plunger as shown, communicates with a transverse drilling 23 formed in the plunger this in turn by way of an axial drilling 24 communicating with the pumping chamber 14. The pumping chamber 14 also communicates with a spill passage 25 leading to an electromagnetically operable spill control valve 26 to which is connected a return passage 27.

In operation, when the plunger moves outwardly to the extent that the drilling 23 is placed in communication with the groove 22, fuel can flow into the pumping chamber 14 and during the inward movement of the plunger as soon as the communication between the drilling 23 and the groove 22 has been broken, fuel is displaced assuming the spill control valve 26 is closed, through the passage 15 to the fuel injection nozzle 9 and the associated combustion space. If the spill valve 26 is opened whilst the plunger is moving inwardly the fuel displaced by the plunger will flow by way of the passage 25 through the spill valve to the passage 27 and the flow of fuel through the passage 15 will cease. The spill valve 26 therefore serves to control the quantity of fuel which is supplied to the associated engine.

The circumferential groove 22 and also the passage 27 communicate respectively with a pair of passages 28, 29 which extend axially within the pump body 10 and open onto an end face of the pump body at a position to communicate with an annular recess 30 which is in part defined by the distance piece 16 and the cap nut 17. In

addition, there is formed in the cap nut a plurality of fuel outlet ports 31 which place the recess 30 in communication with the fuel drain passage 21. Moreover, at a position axially removed from the ports 31 there is also formed in the cap nut a plurality of fuel inlet ports 32 which connect the fuel supply passage 20 with an annular groove 33 formed on the periphery of the body 10. The groove 33 in the example shown in Figure 1, communicates with the passage 28 by way of a drilling 34 and the communication of the end of the passage 28 with the recess 30 is prevented by means of a plug 35. In the arrangement shown therefore the passage 28 conveys fuel from the fuel supply passage 20 to the circumferential groove 22 whilst the passage 29 conveys the fuel which flows through the spill control valve, to the recess 30. If for some reason or other the engine manufacturer decides that the roles of the passages 20 and 21 should be reversed, it is a simple matter to place the plug 35 in the end of the passage 29 not to form the drilling 34 but to form the drilling between the groove 33 and the passage 29.

As will be observed the cap nut 17 defines an annular land 36 the external surface of which is disposed in close relationship with the wall of the bore 18 and it serves to restrict communication between the fuel supply and fuel drain passages 20, 21 moreover, the cap nut carries a pair of annular filter elements surrounding the ports 31 and the ports 32 respectively.

CLAIMS

1. A unit injector for supplying fuel to an internal combustion engine, comprising a pump body (10), a fuel injection nozzle (9) secured to the body and having a fuel inlet connected to a pumping chamber (14) defined in the body, a spill valve (26) mounted on the pump body for controlling the amount of fuel supplied through the outlet (8) of the nozzle, the unit injector in use being mounted in a bore (18) defined in the cylinder head (19) of an engine, the cylinder head (19) also defining a fuel supply passage (20) and a fuel drain passage (21) which open into the bore (18) at axially spaced positions, a fuel inlet port (32) and a fuel outlet port (31) defined by the injector for communication when the injector is located in the bore (18) with said fuel supply passage (20) and said fuel drain passage (21) respectively characterised by first and second passages (28, 29) opening onto an end face of the pump body (10) fuel flowing through the first passage (28) to the pumping chamber (14) and the second passage (29) communicating with the spill valve (26) said first and second passages (28, 29) opening into a chamber (30) communicating with one of said ports (31, 32), a drilling (34) extending between the other of said ports (31, 32) and one of said first and second passages (28, 29) and a plug (35) which can be located in the end of said one of said first and second passages (28, 29) and the chamber (30).

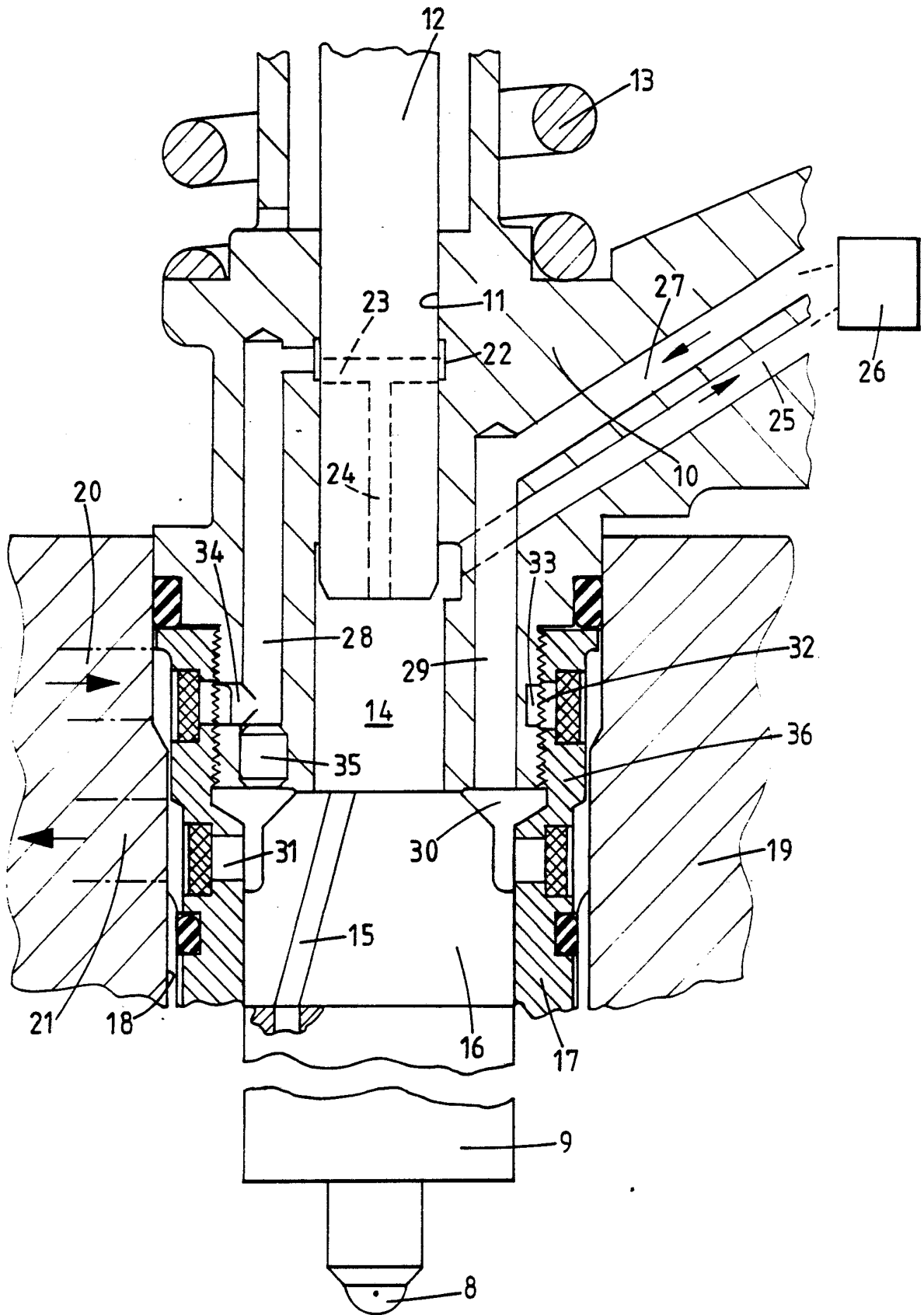
2. A unit injector according to Claim 1, characterised in that said chamber (30) is part defined in a member (16) which is held against said one end face of the pump body.

3. A unit injector according to Claim 2, characterised in that said chamber (30) is in part

defined by a cap nut (17) engaged with the pump body and serving to retain said member (16) in sealing engagement with said end face, said one part (31) being formed in the skirt portion of the cap nut.

4. A unit injector according to Claim 3, characterised in that the other port (32) is formed in the skirt portion of the cap nut (17).

5. A unit injector according to Claim 4, characterised in that said cap nut (17) intermediate said ports (31, 32) defines an annular land (36) the external surface of which is disposed in close relationship with the wall of the bore (18) intermediate said fuel supply and fuel drain passage (20, 21).



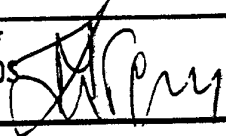
INTERNATIONAL SEARCH REPORT

PCT/GB 91/02025

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 F02M57/02		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	F02M	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	US,A,4 618 095 (SPOOLSTRA) 21 October 1986 see column 3, line 55 - column 11, line 10; figures	1

A	EP,A,0 178 428 (BOSCH) 23 April 1986 see page 9, paragraph 3 - page 10, paragraph 2; figures	1

<p>¹⁰ Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
10 MARCH 1992	20 MAR 1992	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	SIDERIS MARIOS 	

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. GB 9102025
SA 53310**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		EP-A, B 0207652	07-01-87
		JP-A- 62007970	14-01-87

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