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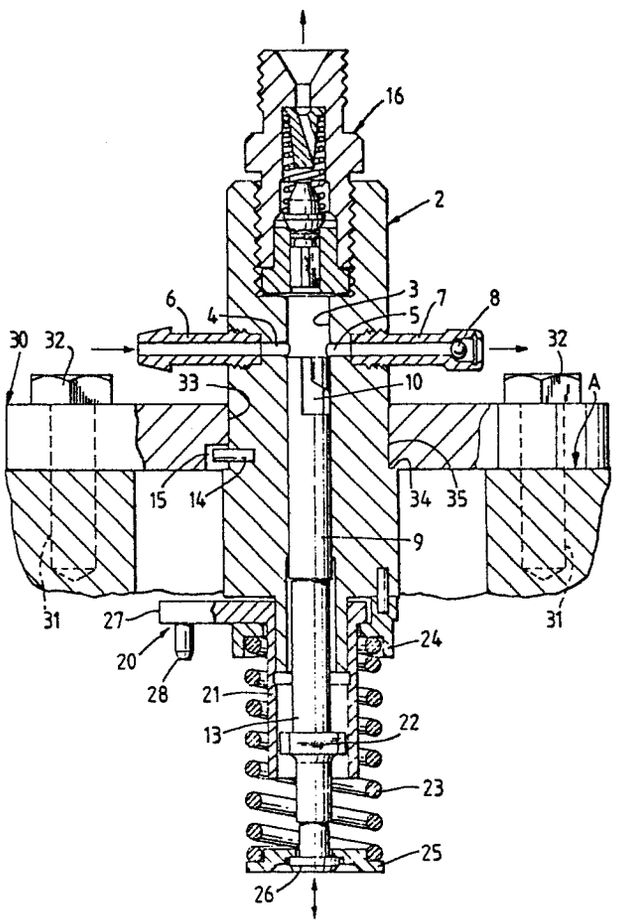
(54) Fuel injection pump for internal combustion engines.

(57) The pump comprises a body (2) provided with an axial inner chamber (3) communicating with a delivery pipe; a plunger (9) mobile within the chamber (3) and provided with a shaped-profile groove (10) to vary the pumped fuel delivery rate on varying the angular position of the plunger (9); an inlet bore (4) radially traverses said body (2) and opens into the inner chamber (3), said bore (4) communicating directly with the fuel feed pipe; a spill bore (5) which is distinct and separate from the inlet bore (4) radially traverses said body (2) to open into the inner chamber (3), said bore (5) communicating directly with the fuel spill pipe; a valve (8) is disposed in the spill bore (5) to allow fuel to leave but to prevent it returning to the chamber (3).



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FUEL INJECTION PUMP FOR INTERNAL COMBUSTION ENGINES

This invention relates to a fuel injection pump for internal combustion engines of the type comprising a cylindrical body provided with an axial inner chamber, a lateral port for fuel inlet to the inner chamber and a spill port for the fuel from said chamber; in the inner chamber there is mobile with reciprocating motion a plunger provided with a specially shaped groove arranged to vary the fuel pumping rate on varying the angular position of the plunger relative to the cylinder; in this respect by rotating said specially shaped groove the quantity of fuel positively fed to the engine explosion chamber for each delivery stroke varies because the quantity of fuel spilled from the inner chamber varies. Said pumps are generally known as "reciprocating Bosch type with variable spill".

For each engine cylinder there is generally provided one pump fixed in a housing provided in the engine structure and connected by a fuel delivery pipe to the engine explosion chamber.

The pumps are generally disposed mutually aligned and are all connected to suitable means, such as rack means, for simultaneously rotating the various plungers about their respective axes on command, so as to control the fuel delivery rate to the engine, and also to suitable means, such as a camshaft, for reciprocatingly driving the various plungers synchronously with the strokes of the engine.

The cylindrical body of known pumps consists of several elements assembled together, and normally comprises an inner tubular element containing the inner chamber, enclosed by an outer casing. Between the outer casing and tubular element there is an annular space communicating both with the fuel feed pipe and with the inner chamber by way of said lateral inlet port. This annular space is kept constantly filled with fuel, which enters the inner chamber therefrom. In some cases the same port acts both as the fuel inlet and as the fuel spill port. In other cases a spill port separate from the inlet port is provided. In still further cases, two annular ducts are provided, one for the inlet port and the other for the spill port, but these are not isolated from each other. In all cases the fuel which enters the inner chamber is mixed, in greater or lesser proportion, with fuel which has previously been spilled from the inner chamber.

During the plunger delivery stroke, when the spill port opens, the fuel leaves at high speed from this port, particularly when the port has opened to only a small extent, and this creates some fuel vaporisation with consequent formation of gas bubbles within the fuel. When these bubbles converge in the fuel pumped to the engine, they result in defective engine fuel feed mainly because as they are compressible they reduce the fluid delivery pressure to the engine to below the optimum value. This drawback is greater the smaller the pump throughput.

The object of the present invention is precisely to obviate the aforesaid drawback.

The invention as characterised in the claims also has the advantage of allowing the engine to be stopped rapidly and uniformly.

The invention is described in detail hereinafter with reference to the accompanying figure, which represents a section on an axial plane through one embodiment thereof.

The illustrated pump comprises a body 2 particularly of substantially cylindrical form, provided with a perfectly cylindrical axial inner chamber 3. The upper end of the chamber 3 communicates by way of a delivery valve, indicated overall by 16, with a pipe (not shown on the figure) for feeding fuel to the engine explosion chamber. A fuel inlet bore 4 radially traverses the body 2 and opens into the inner chamber 3. The bore 4 is directly connected to the fuel feed pipe (not shown on the figure) by a nipple 6 inserted into the bore 4 and partly projecting outwards.

A fuel spill bore 5 radially traverses the cylindrical body 2 and opens into the inner chamber 3. Said bore 5 is distinct and separate from the bore 4, and specifically is positioned on the opposite side of the body 2 to the bore 4. The bore 5 is connected directly to the fuel spill pipe (not shown on the figure), which leads to the fuel tank, by a nipple 7 inserted into the bore 5 and partly projecting outwards from the body 2. Within the chamber 3 there is disposed a plunger 9 which is mobile with reciprocating motion within said chamber and is arranged to pump the fuel arriving through the bore 4. Said plunger 9 is provided with an appropriate shaped-profile groove 10 of known type able to vary the amount of fuel pumped for each delivery stroke on varying the angular position of the plunger 9 relative to the cylindrical body 2. In this respect, on rotating the plunger 9 the position of the shaped profile varies relative to the spill bore 5, thus varying the length of the useful delivery stroke of the plunger 9. On the nipple 7 there is disposed a valve 8 of the type which allows the fuel to leave the chamber 3 but prevents its return to the chamber 3. Specifically, said valve 8 consists of a small ball free to move along the bore in the nipple 7 and able to close said bore if the fuel tends to be drawn back into the chamber 3.

The lower end of the plunger 9 defines a stem 13 which emerges from the body 2 and on which

there are disposed means 20 which rotate the plunger 9 on command.

Specifically, the means 20 comprise a sleeve 21 which forms a prismatic fit with the stem 13, the stem 13 sliding freely in an axial direction within the sleeve 21 without being able to rotate relative to it. For this purpose the stem 13 comprises a pair of flat surfaces 22 arranged to slide in corresponding flat grooves provided in the axial bore of the sleeve 21.

The sleeve 21 is held in position at the lower end of the body 2 by a ring 24. The helical return spring 23 for the plunger 9 is compressed between the ring 24 and a ring 25 retained by the enlarged end 26 of the stem 13. From the top of the sleeve 21 there projects a lever arm 27 to be connected by a pin 28 to a rod (not shown on the figure) which when connected to the various pumps of the engine simultaneously rotates the plungers 9 of these pumps.

For fixing the pump to the appropriate housing in the engine structure (indicated by A) there is provided a plate 30 with holes 31 which mate with the holes provided in the housing A, to allow fixing by screws 32. Said plate 30 generally differs as the characteristics of the housing A vary.

The plate 30 comprises a through hole 33 generally in a central position, through which the cylindrical body 2 is inserted as a exact fit. The outer surface of the body 2 comprises an intermediate shoulder 34 against which the plate 30 rests. Mutual locator means are provided on the portion 35 and on the plate 30 in a predetermined relative angular position. In this manner when the plate 30 is fitted to the body 2, said locator means ensure that the body 2 is orientated in a constant manner relative to the plate 30. Said locator means comprise a pin 14 fixed, in proximity to the shoulder 34, on the outer surface of the portion 35 so that it projects radially therefrom, and a corresponding groove 15 provided in the plate 30 in a position corresponding with the hole 33 and arranged to contain the pin as an exact fit.

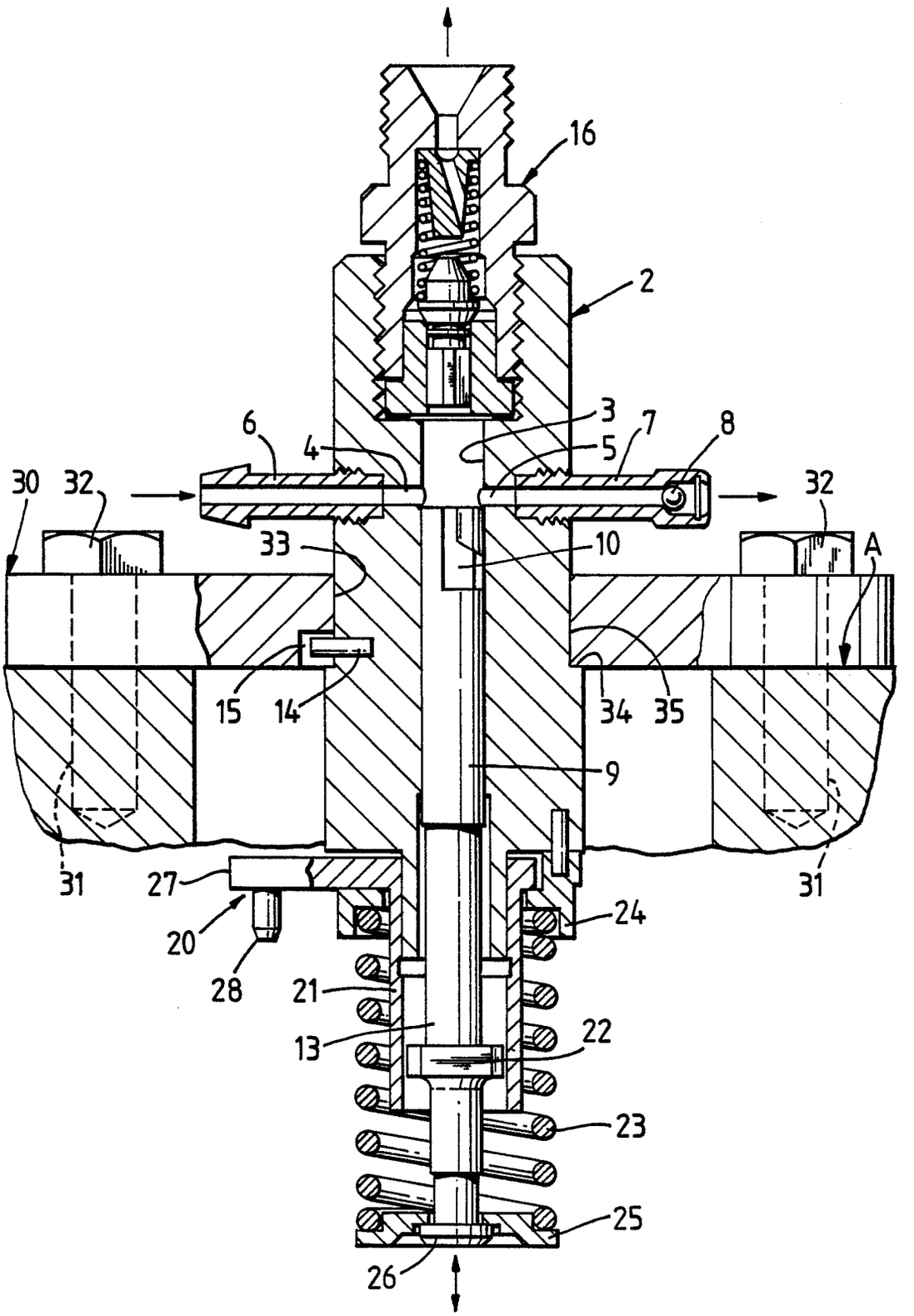
When the plunger 9 undergoes its delivery stroke (upwards in the figure), all the excess fuel spills through the bore 5 and into the spill pipe. During this, the bore 4 remains closed by the plunger 9 itself. When the plunger 9 undergoes its return stroke, the fuel present in the spill pipe is unable to return to the inner chamber 3 as the valve 8 closes the bore 5 in this direction. Thus only fuel originating from the feed pipe can enter the inner chamber 3 through the bore 4, this fuel being totally separate from the spill fuel. The pump is therefore fed with fuel which has not undergone the spill action and therefore does not comprise the small gas bubbles caused precisely by this spill action. Instead, these gas bubbles are discharged immediately through the bore 5 and fed to the tank. The pump therefore operates correctly.

Furthermore, by positioning upstream of the bore 4 a valve able on command to shut off the fuel feed pipe, the pump is unable to redraw fuel from the spill pipe because of the action of the valve 8, and thus as there is no fuel in the pump the engine stops rapidly and uniformly, without jumping.

Numerous modifications of a practical and applicational nature can obviously be made to the invention, but without leaving the scope of the inventive idea as claimed hereinafter.

Claims

1. A fuel injection pump for internal combustion engines, of the type comprising:
- a body (2) provided with an axial inner chamber (3) communicating with a delivery pipe;
- a plunger (9) mobile with reciprocating motion within said inner chamber (3) and provided with a shaped-profile groove (10) able to vary the pumped fuel delivery rate on varying the angular position of the plunger (9) relative to the cylindrical body (2);
- means (20) arranged to rotate the plunger (9) on command; characterised by comprising:
- an inlet bore (4) which substantially and radially traverses said body (2) and opens into the inner chamber (3), said bore communicating directly with the fuel feed pipe;
- a spill bore (5) which is distinct and separate from the inlet bore (4) and substantially and radially traverses said body (2) to open into the inner chamber (3), said bore (5) communicating directly with the fuel spill pipe;
- a valve (8) disposed in the spill bore (5) to allow fuel to leave the inner chamber (3) but to prevent it returning to said chamber (3).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European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 20 0365

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-C- 822 453 (VOIT) * Page 2, lines 16-103; figure 4 * ---	1	F 02 M 59/44 F 02 M 55/00
X	FR-A-2 482 203 (BOSCH) * Page 1, line 31 - page 14, line 40; figure 3 * -----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

F 02 M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28-06-1988	HAKHVERDI M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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