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(54) Fuel pump

(57) A fuel pump comprises a distributor member (2) rotatable within a sleeve (1), the distributor member (2) including a through bore (4) within which a pair of plungers (9) are reciprocable under the influence of the cam surface of a cam ring (15). The cam ring is angularly adjustable to permit control of the timing of fuel delivery, the angular position of the cam ring (15) being controlled by an advance piston arrangement (19, 20) arranged to be supplied with fuel from a transfer pump (5) through at least one passage (7) provided in the distributor member (2). The supply of fuel through the passage(s) (7) has a cooling effect on the distributor member (2), in use.

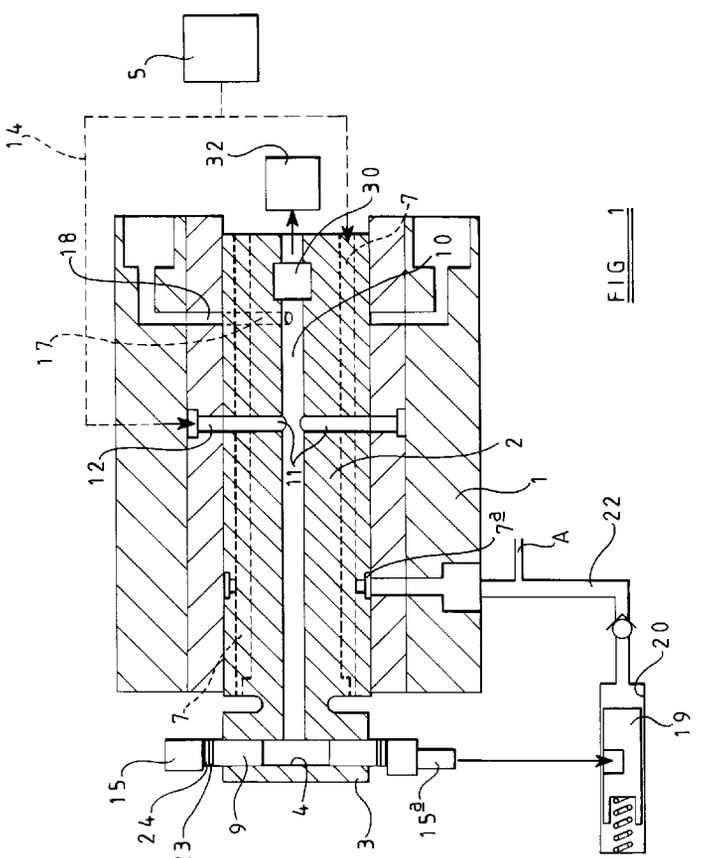

FIG 1

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Description

This invention relates to a fuel pump, in particular to a distributor pump for use in supplying fuel under pressure to the cylinders of a diesel internal combustion engine.

One common type of fuel pump comprises a distributor member rotatable within a sleeve. The distributor member includes an end region provided with radially extending bores within which respective plungers are reciprocable. Each plunger includes a shoe carrying a roller arranged to engage the inner surface of a cam ring, moving the plunger under the influence of the cam ring.

In use, fuel is supplied to the bores, pushing the plungers radially outwards. Rotation of the distributor member results in the termination of fuel supply to the bores, further rotation resulting in the rollers engaging cam lobes provided on the cam ring, pushing the plungers inwardly to pump the fuel from the bores through a series of passages to one of the cylinders of an associated engine.

In order to adjust the timing of fuel delivery to the engine, the angular position of the cam ring, and hence the cam lobes, is adjusted, movement in one direction resulting in relatively early fuel delivery, movement in the other direction retarding fuel delivery. The cam ring is moved under the action of an advance piston which is supplied with fuel at a pressure related to engine speed by a transfer pump, the rotor of which is commonly provided at an end of the distributor member.

In fuel pumps of the type in which, after delivery of the desired amount of fuel a spill valve is opened to permit fuel to enter a suitable reservoir from where the fuel is returned to the pump bores during a later filling part of the pump cycle, there is the problem that the fuel tends to heat up, getting hotter the more often it is passed between the pump bores and the reservoir. The heat from the fuel tends to be transmitted to the distributor member which will then be subject to thermal expansion.

Since the distributor member is a good fit within the sleeve in order to minimise fuel leakage therebetween, it will be recognised that it is desirable to avoid increasing the temperature of the distributor member in order to avoid expansion thereof which could result in seizure. One technique for maintaining the temperature of the distributor member is to supply relatively cool fuel from the transfer pump to elongate passages extending through the distributor member. This technique has the disadvantage that an additional fuel demand is placed on the transfer pump. Further, since the distributor member is cooled, there is a tendency to run the engine and pump at a higher temperature and pumping pressure which tends to increase the level of fuel leakage from the advance box which houses the advance piston. Such leakage further increases the demand on the transfer pump.

It is an object of the invention to provide a fuel pump in which the above described disadvantages are reduced.

According to the present invention there is provided a fuel pump comprising a distributor member arranged to deliver fuel to a cylinder of an associated engine, and a transfer pump arranged to supply fuel to an advance piston for adjusting the timing of fuel delivery to the cylinder, the transfer pump communicating with the advance piston through at least one passage extending within the distributor member.

It will be recognised that by supplying fuel to the advance piston through the distributor member, cooling of the distributor member can be achieved without significantly increasing the demand placed upon the transfer pump.

The invention will further be described, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a spill pump in accordance with an embodiment of the invention;

Figure 2 is a view illustrating the positions of parts of the spill pump of Figure 1; and

Figure 3 is a diagram illustrating the relative positions of the passages of the distributor member illustrated in Figure 1.

The fuel pump illustrated in diagrammatic form in the accompanying drawings comprises a generally cylindrical sleeve within which an elongate cylindrical distributor member 2 is rotatable. An end 3 of the distributor member 2 is provided with a diametrically extending through bore 4 within which a pair of plungers 9 are reciprocable. The outer end of each plunger 9 is provided with a shoe 23 which in turn carries a roller 24 which is engageable with the cam surface of a cam ring 15.

The distributor member 2 includes an axially extending passage 10 which communicates with the through bore 4, a radially extending delivery passage 17 and four radially extending inlet passages 11 each communicating with the axially extending passage 10. As shown in Figure 3, the four inlet passages 11 are equiangularly spaced from one another, and the delivery passage 17 is offset from the inlet passages 11.

The sleeve 1 is provided with inlet ports 12 which are arranged such that on rotation of the distributor member 2, the inlet passages 11 register with the inlet ports 12, in turn. The sleeve 1 further includes four equiangularly spaced delivery ports 18 which communicate with respective cylinders of an associated engine.

A rotary transfer pump 5 which may be provided at an end of the distributor member 2 such that the vanes thereof rotate with the distributor member 2 is arranged to deliver fuel to a pair of passages 7 which extend parallel to the axially extending passage 10. The transfer pump 5 is provided with a pressure control valve which

is arranged to control fuel flow between the outlet and inlet of the transfer pump 5 so that the outlet pressure varies in accordance with the speed at which the pump is driven. The transfer pump 5 is also arranged to deliver fuel to the inlet ports 12 through a suitable fuel line 14.

The passages 7 each communicate with an annular groove 7a provided in the surface of the distributor member 2, the annular groove 7a communicating with a passage 22 which carries fuel from the transfer pump 5 to an advance piston 19 which is slidable within a bore 20. The advance piston 19 includes a recess within which a peg 15a connected to the cam ring 15 is received so as to transmit movement of the advance piston to the cam ring 15 in a conventional manner. The advance piston 19 is spring biased in a direction which retards the timing of delivery of fuel to a cylinder of the associated engine, fuel supplied by the transfer pump 5 moving the piston 19 against the action of the spring to advance the timing of delivery of fuel.

In use, the distributor member 2 is driven in timed relation with the associated engine by a drive shaft (not shown). Starting from the position illustrated in Figure 1, fuel is supplied by the transfer pump 5 through the fuel line 14 from where it is supplied through the inlet ports 12 to the inlet passages 11. From the inlet passages 11, the fuel flows through the axially extending passage 10 to the bore 4 where the plungers 9 are pushed in an outward direction. As shown in Figure 2, at this point the rollers 24 are not aligned with the cam lobes of the cam ring 15. Rotation of the distributor member 2 results in the communication between the inlet port 12 and the inlet passage 11 being broken, further rotation resulting in the delivery passage 17 aligning with one of the delivery ports 18. Shortly thereafter, the rollers 24 engage against the leading flanks of respective cam lobes, the engagement resulting in the plungers 9 being pushed inwardly resulting in fuel being pumped through the axially extending passage 10, the delivery passage 17 and one of the delivery ports 18 to be delivered to the respective cylinder of the associated engine.

After delivery of the desired amount of fuel, a spill valve 30 is opened to permit fuel to escape from the axially extending passage 10 to a suitable reservoir from where, during the next filling stage of the pumping cycle, the fuel may be returned to the axially extending passage 10 and the bore 4.

Since the transfer pump 5 operates at the speed of rotation of the distributor member 2, and hence at a speed associated with engine speed, the pressure of fuel supplied to the passages 7 and hence to the advance piston 19 is related to engine speed. At relatively low engine speeds, the advance piston 19 is pushed by the spring to a relatively retarded position, increases in the speed of the engine resulting in the pressure of fuel applied to the advance piston 19 increasing, and hence the position of the cam ring 15 being adjusted to advance the timing of delivery of fuel to the engine.

It will be recognised that since the relatively cool fuel from the transfer pump 5 is supplied to the advance piston 19 through the passages 7 in the distributor member 2, the relatively cool fuel maintains the distributor member 2 at a relatively cool temperature. The cooling of the distributor member 2 results in thermal expansion of the distributor member 2 being minimised, thus reducing the risk of seizure.

Since fuel is fed to the passages 22 through passages 7, there is no need to provide a passage in the sleeve 1 extending parallel to the axially extending passage 10 of the distributor member 2 in order to supply fuel to the advance piston 19. The cooling effect which occurs when such a passage is provided is therefore avoided in the device illustrated in Figure 1. The removal of this cooling effect further reduces the risk of seizure of the distributor member 2 within the sleeve 1.

One or more of the passages 7 may be extended so as to communicate with the interior of the housing 31 which houses the cam ring 15 to supply relatively cool fuel thereto in order to increase the flow of fuel through the passages 7 (as shown in Figure 1). The extension to the passage(s) 7 is preferably of reduced diameter in order to reduce the flow of fuel to the housing 31 and to reduce the risk of fuel from the housing 31 returning along the passages 7.

Where the transfer pump 5 is arranged to supply fuel to other auxiliary devices, the supply to such devices is preferably taken from the port marked A in the passage 22 shown in Figure 1. It will be recognised that the fuel fed to such auxiliary devices passes through the passages 7 in the distributor member 2, the fuel having a cooling effect on the distributor member 2.

Although the illustrated embodiment uses an annular groove 7a to provide communication between the passages 7 and the passage 22, such communication could be achieved by means of suitable ports.

For a description and drawings of a spill pump to which the invention could be applied, the readers attention is directed towards GB-A-2253445. Although the description and drawings forming part of this application relate only to spill-type fuel pumps, it will be recognised that the invention would be applied to other types of rotary pump in which it is desired to cool the distributor member.

Claims

1. A fuel pump comprising a distributor member (2) arranged to deliver fuel to a cylinder of an associated engine, and a transfer pump (5) arranged to supply fuel to an advance piston arrangement (19, 20) for adjusting the timing of fuel delivery to the cylinder, the transfer pump (5) communicating with the advance piston arrangement (19, 20) through at least one passage (7) extending within the distributor member (2).

2. A fuel pump as claimed in Claim 1, further comprising a spill arrangement (30) whereby after delivery of a desired quantity of fuel, excess fuel delivered by the fuel pump is delivered to a high pressure reservoir (32), the spill arrangement (30) being arranged to return the excess fuel for subsequent delivery to a cylinder of the engine.

3. A fuel pump as claimed in Claim 1 or Claim 2, wherein the passage (7) or at least one of the passages (7) is arranged to supply fuel to the interior of the housing (31).

4. A fuel pump as claimed in Claim 3, further comprising means for controlling the supply of fuel to the interior of the housing (31).

5. A fuel pump as claimed in Claim 4, wherein the means for controlling comprises at least one extension to the passage (7) or at least one of the passages (7), the extension being of reduced diameter.

6. A fuel pump as claimed in any one of the preceding claims, wherein the at least one passage (7) comprises a pair of passages (7) arranged to communicate with one another, and through which the transfer pump (5) communicates with the advance piston arrangement (19, 20).

7. A fuel pump as claimed in any one of the preceding claims, wherein the advance piston arrangement (19, 20) communicates with the or each passage (7) through a line (22) provided with a port (A) arranged to permit fuel supply to an auxiliary device.

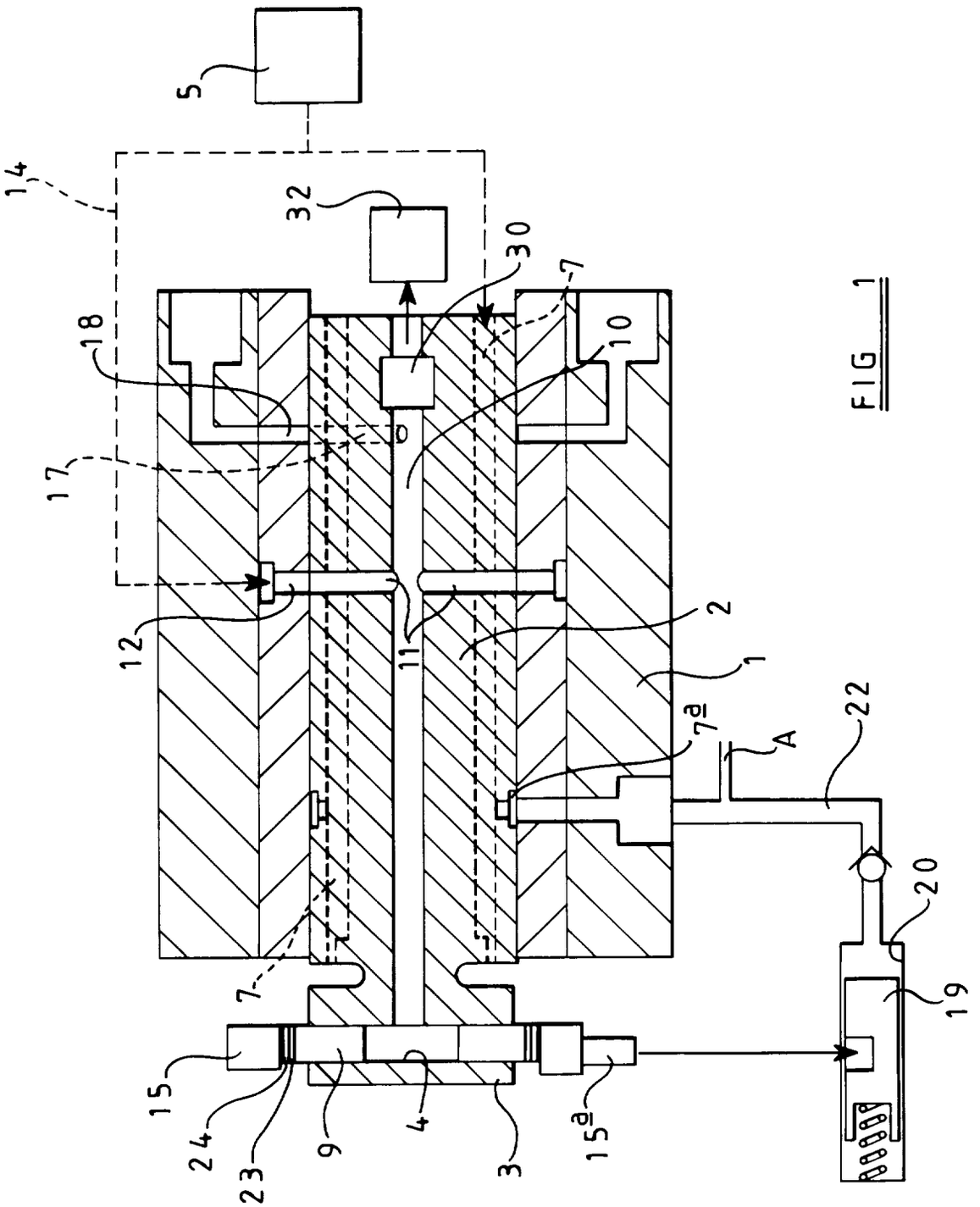

FIG 1

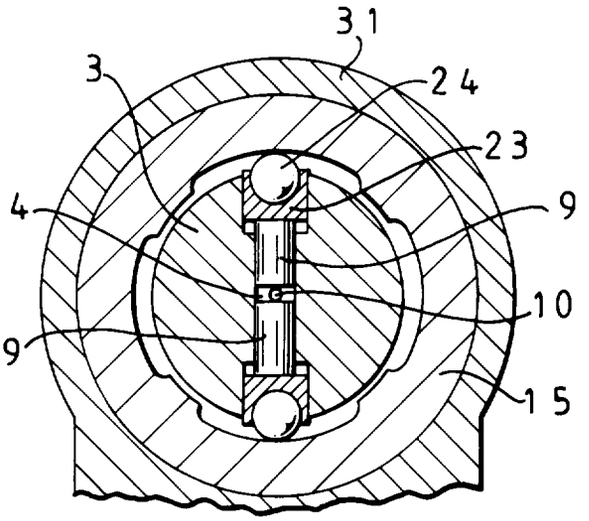

FIG 2

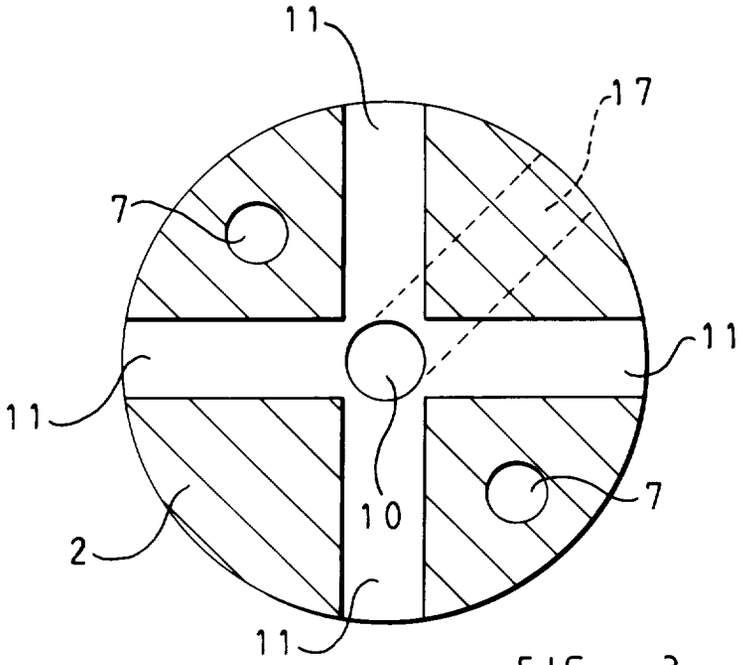

FIG 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 30 8194

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.6)
X Y	GB-A-1 254 476 (NOGINSKY ZAVOD TOPLIVNOI APPARATURI IMENI 50-LETIA OKTYABRYA) * page 2, line 8 - page 3, line 35; figures 1,2 *	1,3,4,6,7 2	F02M41/14
D,Y	GB-A-2 253 445 (LUCAS INDUSTRIES PUBLIC LTD. CO.) * page 4, line 1 - page 7, line 17; figure *	2	
A	PATENT ABSTRACTS OF JAPAN vol. 14 no. 315 (M-0995) ,6 July 1990 & JP-A-02 104964 (NIPPON DENSO CO. LTD.) 17 April 1990, * abstract *	1,2,6	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 March 1996	Hakhverdi, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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