

(19)



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



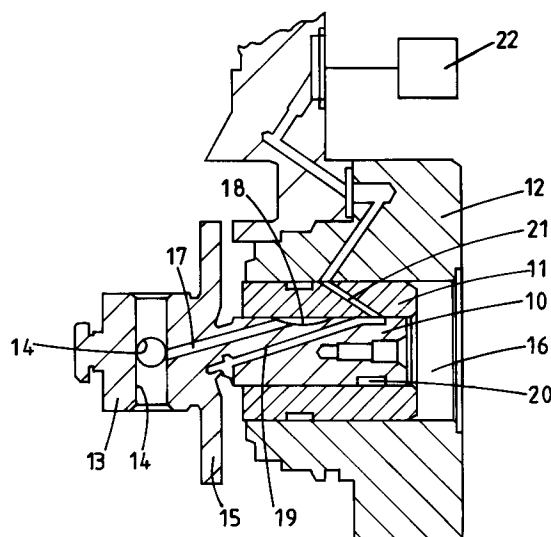
(11) Publication number:

**0 604 084 A1**

(12)

**EUROPEAN PATENT APPLICATION**(21) Application number: **93310016.6**(51) Int. Cl.<sup>5</sup>: **F02M 41/14, F02M 53/00**(22) Date of filing: **13.12.93**(30) Priority: **22.12.92 GB 9226671**(43) Date of publication of application:  
**29.06.94 Bulletin 94/26**(84) Designated Contracting States:  
**DE ES FR GB IT**(71) Applicant: **LUCAS INDUSTRIES PUBLIC  
LIMITED COMPANY**  
**Brueton House, New Road**  
**Solihull, West Midlands B91 3TX(GB)**(72) Inventor: **Felton, George Nicholas**  
**31 Brockenhurst Close**  
**Gillingham, Kent, ME8 0HD(GB)**(74) Representative: **Thompson, George Michael et  
al**  
**MARKS & CLERK,**  
**Alpha Tower,**  
**Suffolk Street Queensway**  
**Birmingham B1 1TT (GB)**(54) **Fuel pumping apparatus.**

(57) A rotary distributor type fuel pumping apparatus includes a distributor member (10) rotatable in a surrounding body (11) and has a first passage (17) through which in use flows hot fuel the temperature of which fluctuates depending on the quantity of fuel supplied by the apparatus. In order to minimise the risk of seizure when the temperature of the fuel in the first passage increases, the distributor member is provided with a second passage (19) through which in the use of the apparatus relatively cool fuel is circulated.

**EP 0 604 084 A1**

This invention relates to a fuel pumping apparatus for supplying fuel to an internal combustion engine and of the kind comprising a distributor member mounted for rotation in a surrounding body, and a passage formed in the distributor member and through which in the use of the apparatus fuel flows from a pumping chamber.

In one example of the apparatus the distributor member is provided with a bore in which is mounted a pair of pumping plungers, the bore and the inner ends of the plungers defining the pumping chamber. The plungers are moved inwardly by the action of cam lobes and the aforesaid passage conveys the fuel expelled from the pumping chamber to a plurality of outlet ports in turn.

In another example of the apparatus the distributor member in addition to being rotatable is also axially movable under the action of a cam. The end of the distributor member which lies within the surrounding body forms the movable wall of the pumping chamber and the aforesaid passage whilst it may convey fuel to the outlet ports in turn also serves to convey fuel spilled from the pumping chamber.

In order to minimise leakage of fuel, the working clearance between the surface of the distributor member and the wall of the body in which it is mounted, is very small. During the inward movement of the plungers or distributor member a high fuel pressure is generated within the pumping chamber and the fuel is heated. In steady conditions when the quantity of fuel pumped is more or less constant, the temperatures of the distributor member and the surrounding body are more or less the same and the working clearance is preserved. If however the quantity of fuel pumped is suddenly increased, the temperature of the distributor member increases but the temperature of the surrounding body increases at a lower rate so that the working clearance is diminished and as a result seizure can occur. If the quantity of fuel pumped is decreased the temperature of the distributor member decreases and even if the temperature of the surrounding body does not decrease at the same rate, this only leads to an increase in the working clearance so that although the leakage may increase there is no risk of seizure.

It has been proposed to increase the working clearance between the distributor member and the wall of the body but as stated this results in an increase in the leakage of fuel over the operating range of the apparatus which therefore has to be designed to take the increased leakage into account.

The object of the invention is to provide an apparatus of the kind specified in a simple and convenient form.

According to the invention in an apparatus of the kind specified there is formed in the distributor member an additional passage through which relatively cool fuel can be circulated.

An example of an apparatus in accordance with the invention will now be described with reference to the accompanying drawing which is a sectional side elevation of part of the apparatus.

Referring to the drawing the apparatus comprises a rotary distributor member 10 which is housed within a bore formed in a sleeve 11 which is secured within a housing 12. The distributor member is provided with an integral extension 13 which is located in a space defined in the pump housing and formed in the extension is a pair of diametrically disposed bores 14 which extend in the particular example, at right angles to each other.

Slidable within each bore 14 is a pair of pumping plungers (not shown) which at their outer ends in known manner, are engaged by cam followers respectively which include rollers bearing against the internal peripheral surface of an annular cam ring which surrounds the extension. The cam ring has in the particular example, four inwardly extending cam lobes which are equi-angularly spaced so that as the distributor member rotates the plungers will be driven inwardly at the same time.

The distributor member is driven in timed relationship with the associated engine by means of a drive shaft (not shown) which is journaled in the housing of the apparatus and the drive shaft includes an axially extending portion which surrounds the extension 13 and in which is formed slots to accommodate the aforesaid cam followers. The inner edges of the slots and also the cooperating surfaces of the cam followers, are inclined relative to the axis of rotation of the distributor member so that as the distributor member is moved axially the permissible outward extent of movement of the plungers is varied. In addition, the extension is provided with an integral plate 15 which has tongue portions which engage in the aforesaid slots so that rotary motion is transmitted to the distributor member. The axial position of the distributor member is determined by the pressure of fuel in a chamber 16 which positions the distributor member against the action of a spring (not shown). This pressure can be determined by an electromagnetic valve. A description of this form of apparatus is to be seen in GB-B-2037365.

Fuel is conveyed to and from the pumping chamber defined at the inner ends of the plungers, by means of a passage 17 which extends to the periphery of the portion of the distributor member lying within the sleeve 11. The passage does in fact terminate in a groove 18 which can register alternately with inlet and outlet ports formed in the

sleeve 11, the inlet and outlet ports in the particular example each being four in number and alternately arranged. The outlet ports communicate with outlets formed in the housing of the apparatus and these are connected in use, to the injection nozzles respectively of the associated engine. The inlet ports are connected together and to the outlet of a low pressure fuel supply pump. When the groove 18 is in register with an inlet port, fuel can flow through the passage 17 to urge the plungers outwardly by an amount determined by the axial position of the distributor member. As the distributor member rotates the groove 18 moves out of register with an inlet port and into register with the following outlet port. Once this communication has been established the plungers can be moved inwardly by the action of the cam lobes and fuel will be displaced through the passage 17 to an injection nozzle. This process is repeated and fuel is supplied to the combustion chambers of the engine in turn, the quantity of fuel being determined by the axial position of the distributor member.

In order to minimise leakage the diametral clearance between the distributor member 10 and the wall of the bore in the sleeve 11 is kept to a low value. During the operation of the apparatus the fuel in the pumping chamber is pressurised to a high value and as a result becomes heated. In steady conditions the temperatures of the distributor member and the sleeve will be substantially the same however, if the rate at which fuel is pumped is increased for example if the speed and/or the quantity of fuel supplied per delivery stroke is increased, the temperature of the distributor member will initially increase at a greater rate than that of the sleeve. As a result the clearance is reduced and breakdown of the fuel film which provides for lubrication of the distributor member can occur leading to seizure. This is a well known problem and it is the practice as shown in the drawing, to provide a locally weakened section at the junction of the distributor member 10 and the extension 13 which can shear in the event of seizure, to protect the components of the engine which drive the drive shaft of the apparatus.

In order to minimise the risk of seizure it is proposed to provide an additional passage in the distributor member 10 through which relatively cool fuel can be circulated. The additional passage is seen at 19 and it extends from a circumferential groove 20 formed in the distributor member which can communicate with a passage 21 in the sleeve. The passage 21 communicates by way of further passages in the housing with the outlet of a low pressure fuel supply pump 22. Conveniently this pump also supplies fuel at low pressure to the aforesaid inlet ports and it draws fuel from the supply tank. The temperature of the fuel is there-

fore relatively low and over the short term, constant. The groove 20 is positioned towards the end of the distributor member remote from the extension 13 and the passage 19 extends conveniently substantially parallel to the passage 17. The passage 19 opens to the periphery of the distributor adjacent the extension 13 and the fuel which flows through the passage flows into the space within the housing and is returned along with any leakage fuel, to the supply tank. It is preferable for the groove 20 to be in constant communication with the passage 21 but if space is a problem the communication can be established at high engine loads that is when the apparatus is delivering a substantial quantity of fuel and the distributor member is located axially to provide high fuel delivery.

The flow of fuel through the passage 19 acts to cool the distributor member and thereby by reducing the temperature variations experienced by the distributor member, minimises the risk of seizure. The flow of fuel through the passage 19 can be controlled by a suitably positioned control orifice.

By the use of the passage 19 it has been found possible to reduce the diametral clearance.

It will be understood that the invention can also be applied to distributor type pumping apparatus of the kind in which the axial position of the distributor member is fixed and in which the extent of outward movement of the plungers is determined not by an adjustable stop but by a throttle which controls the amount of fuel admitted to the pumping chamber. The invention may also be applied to the type of pump described in the opening of the specification in which the distributor member is axially movable by cam action to generate the high fuel pressure in the pumping chamber.

The invention can also be applied to the type of apparatus in which the axial position of the distributor member is fixed and the quantity of fuel spilled by the apparatus is determined by spilling fuel at the start or the end or both, of the delivery period.

An on/off valve may be provided to control the flow of fuel through the additional passage so as to avoid under certain conditions an operation for example engine starting, loss of fuel from the low pressure pump.

## Claims

1. A fuel pumping apparatus for supplying fuel to an internal combustion engine comprising a distributor member (10) mounted for rotation in a surrounding body (11), a passage (17) formed in the distributor member and through which in the use of the apparatus fuel flows from a pumping chamber (14), characterised by an additional passage (19) in the distributor

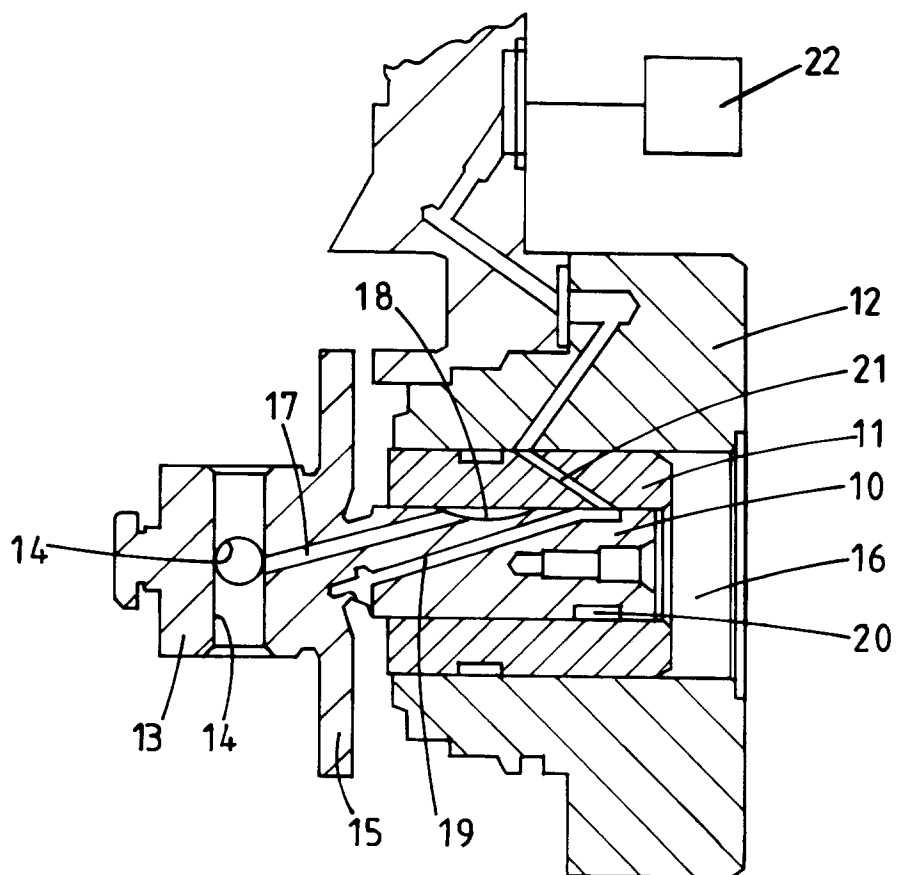
member through which relatively cool fuel can be circulated.

2. An apparatus according to Claim 1, characterised in that the additional passage (19) extends substantially parallel to the first mentioned passage (17). 5
3. An apparatus according to Claim 1, characterised in that the additional passage (19) is supplied with fuel by a low pressure pump (22), the pump drawing fuel from a supply tank. 10
4. A fuel pumping apparatus according to Claim 3, characterised by a control orifice for controlling the fuel flow through the additional passage. 15
5. A fuel pumping apparatus according to Claim 1, in which the distributor member (10) extends from the surrounding body (11), the extending portion of the distributor member having a transverse bore (14) in which is located a pair of cam actuated pumping plungers, said first mentioned passage (17) extending from the bore and opening onto the periphery of the portion of the distributor member which lies within the body (11), characterised in that said additional passage (19) at one end opens onto the periphery of the distributor member adjacent the extending portion thereof and at its other end opens into a circumferential groove (20) defined between the distributor member and the body (11), said groove being positioned to connect with a passage (21) in the body (11). 20  
25  
30  
35
6. A fuel pumping apparatus according to Claim 5, characterised in that said passage (21) can be connected to a source (22) of relatively cool fuel. 40

45

50

55





European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 93 31 0016

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.5)
X	GB-A-2 190 711 (LUCAS INDUSTRIES PUBLIC LTD. CO.) * page 1, line 86 - page 2, line 129; figures 1,2,3,5 * ---	1-6	F02M41/14 F02M53/00
X A	US-A-3 676 023 (P.I. ANDRUSENKO ET AL.) * column 2, line 31 - line 71; figure 1 * ---	1-4 5,6	
X A	GB-A-1 154 203 (C.A.V. LTD.) * page 1, line 31 - line 86; figure 1 * ---	1-4 5,6	
X	GB-A-845 212 (E. SATZGER) * page 3, line 7 - line 80; figures 1,5 * -----	1,2,4	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			F02M
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 31 March 1994	Examiner Hakhverdi, M
<b>CATEGORY OF CITED DOCUMENTS</b>			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	