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FUEL PUMP FOR INTERNAL COMBUSTION ENGINES

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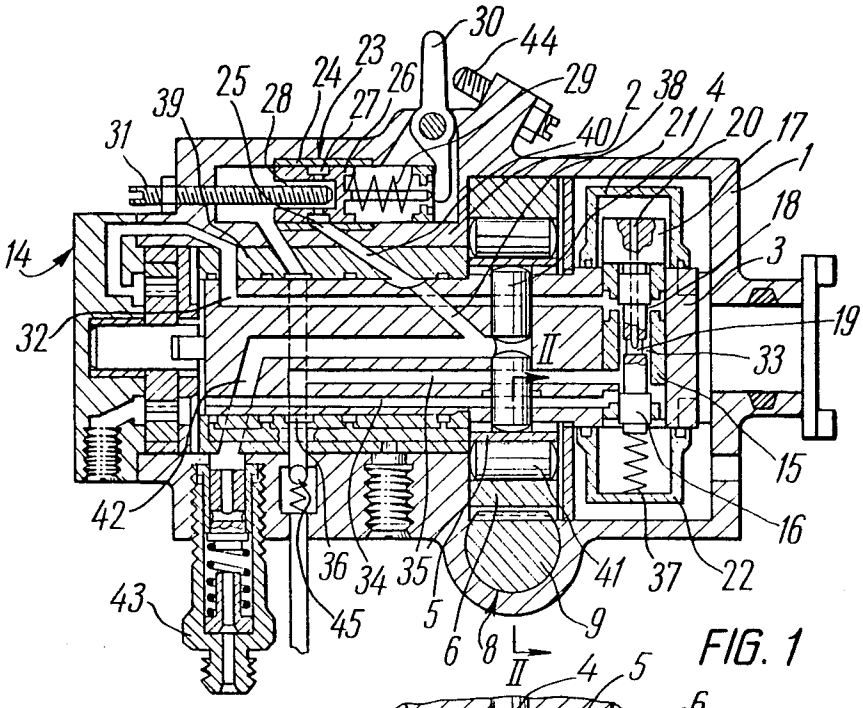


FIG. 1

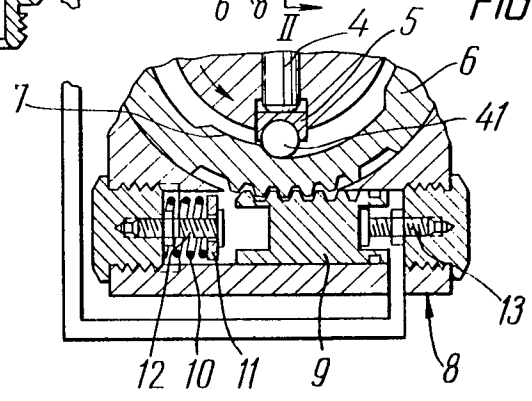


FIG. 2

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FUEL PUMP FOR INTERNAL COMBUSTION ENGINES

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U.S. Cl. 417—253 2 Claims

ABSTRACT OF THE DISCLOSURE

A fuel pump for internal combustion engines, comprises a housing accommodating a low pressure pump and a high pressure pump, the latter being connected to an automatic fuel injection advance device installed within the housing. A fuel feeder is installed in the housing for feeding fuel batchwise to the high pressure pump and a slide valve of a centrifugally sensitive element is also mounted in the housing and hydraulically connects the low pressure pump to the feeder and to the automatic fuel injection advance device.

The present invention relates to fuel pumps for internal combustion engines.

Known in the prior art is a fuel pump for internal combustion engines, where in a high-pressure pump with automatic fuel injection advance is connected to a low-pressure pump through a fuel feeder and a centrifugal sensitive element.

The centrifugal sensitive element is constituted as rotating weights which move under the action of the centrifugal force and act through a system of levers on the fuel feeder.

A disadvantage of the above fuel pump is that an insignificant wear of the parts of the sensitive element and the levers connecting it to the fuel feeder disturbs the stability of the fuel feed characteristic.

It is an object of the present invention to eliminate the above disadvantage.

The principal object of the present invention is to provide such a fuel pump which will ensure a stable fuel feed characteristic.

This object is achieved by the provision of a fuel pump for internal combustion engines, in which, according to the invention, the high-pressure pump, provided with automatic fuel injection advance, is connected to the low-pressure pump through a fuel feeder and a centrifugal sensitive element.

According to the present invention, the centrifugal sensitive element is constituted as a slide valve rotating about an axis perpendicular to the direction of its movement, and having its center of gravity displaced relative to this axis of rotation, said control valve hydraulically connecting the low-pressure pump to the fuel feeder and the automatic fuel injection advance device.

In a fuel pump of the rotary type it is expedient to install the slide valve in the rotor at right angles to its axis of rotation.

The details of the present invention will become more fully apparent from a consideration of the following description of an exemplary embodiment thereof, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a longitudinal section of the fuel pump for internal combustion engines according to the present invention; and

FIG. 2 is a cross section taken along line II—II of FIG. 1.

A housing **1** (FIG. 1) of the fuel pump accommodates a high-pressure pump **2** provided with a rotary distributor **3** having plungers **4** radially installed thereon, said plungers bearing against a cam ring **6** through pushers **5**.

The cam ring **6** has uniformly spaced cams **7** (FIG. 2) provided at the side of the plungers **4**, the cams **7** interacting via the pushers **5** with the plungers **4**.

An automatic fuel injection advance device **8** is connected with the cam ring **6**. The automatic device **8** comprises a piston **9** connected by meshing of rack teeth thereon with the cam ring **6**, a spring **10** on which a washer **11** rests with an adjusting screw **12** for limiting the movement of the piston **9** in one direction, and an adjusting screw **13** for limiting the movement of the piston **9** in the opposite direction.

The housing **1** also accommodates a low-pressure gear pump **14** connected to the rotary distributor **3**.

The rotary distributor is provided with an opening **15** arranged perpendicular to its axis of rotation. In this opening there is installed a sensitive element, fashioned as a slide valve **16** which at one side has an enlarged head **17**, due to which the center of gravity of the valve **16** is displaced relative to the axis of rotation of the rotary distributor **3**. The middle portion of the slide valve **16** is provided with an annular groove **18**, a radial duct **19** and an axial duct **20**. The valve **16** is closed at both sides with caps **21** and **22**.

The housing **1** accommodates a fuel feeder **23** comprising a sleeve **24** with a calibrated triangular opening **25**, and a piston **26**, on whose surface an annular groove **27** is formed which is provided with radial openings **28**. One side of the piston **26** is loaded by a spring **29** and is connected through the latter to a control lever **30**, whereas the other side is provided with an adjusting screw **31** which limits the stroke of the piston **26**.

The fuel pump operates as follows:

Upon rotation of the rotary distributor **3**, the low-pressure pump **14** communicating therewith delivers fuel from a tank (not shown) along a duct **32** into a space **33** defined by the annular groove **18** of the slide valve **16** and the surface of the opening **15**. A portion of the fuel flows along a duct **34** into the suction space of the low-pressure pump **14**. The remaining portion of the fuel flows from the space **33** along a duct **35** to the feeder **23** and the automatic fuel injection advance device **8**.

The pressure of the fuel in the space **33** and in the space under the cap **21** communicating with the latter via the ducts **19** and **20** depends on the ratio of the flow areas of the ducts **32** and **34**. This ratio is automatically set by slide valve **16** depending on the magnitude of the centrifugal force acting thereon and the force induced by the pressure of the fuel under the cap **21**, which prevents movement of the valve **16**. As a result of the interaction of these forces the valve **16** is set in a position wherein the pressure of the fuel under the cap **21** becomes equal to the centrifugal force acting on the valve **16** divided by its cross-sectional area.

The spring **37** serves for initial setting of the valve **16**.

Thus, the pressure of the fuel delivered along the duct **35** to the feeder **23** and the automatic fuel injection advance device **8** changes in proportion to the square of the speed of the rotary distributor **3**.

The plungers **4** of the rotary distributor **3** move apart under the action of the centrifugal force. By this movement a duct **38** will have communicated with the corresponding opening of a sleeve **39** connected via a duct **40** to feeder **23**. Thus injection of the fuel takes place.

Upon further rotation of the rotary distributor **3** the ducts **38** and **40** are disconnected. At this moment rollers **41** of the pusher **5** run onto the cams **7** of the cam ring **6**, and the plungers **4**, moving toward each other, compress the fuel and, when a delivery duct **42** coincides with a corresponding high-pressure pipe connection **43**, delivers it to the nozzle of the engine.

The amount of fuel delivered to the plungers **4** is determined by the flow area of the opening **25** in the sleeve **24** of the feeder **23**. The flow area of the opening **25** depends on the position of the edge of the annular groove **27** of the piston **26**. Depending on the required amount of fuel to be delivered, the position of the piston **26** is regulated by means of the adjusting screw **31**. The operational speed of the engine is determined by the degree of tightening of the spring **29**, which depends on the position of an adjusting screw **44**.

When the rated speed is reached, the pressure of the fuel delivered along the duct **35** acts on the piston **26** and, overcoming the resistance of the spring **29**, moves the piston. Then the edge of the groove **27** of the piston **26** begins to close the opening **25** in the sleeve **24** of the feeder **23**, reducing the flow area of this opening.

The automatic fuel injection advance device **8** ensures a change in the angle of fuel delivery advance by means of the piston **9** of the device, which, moving under the pressure of the fuel fed along the duct **35**, turns the cam ring **6**.

At low speeds of the engine, the pressure of the fuel cannot overcome the resistance of the spring of a valve **45** and the piston **9** will be in its extreme right-hand position, determined by the adjusting screw **13**, ensuring the maximum lag in the angle of fuel delivery commencement. Upon an increase in the speed, the fuel passing through the valve **45**, moves the piston **9** until it rests against the washer **11**, and compresses the spring **10**, turning at the same time the cam ring **6** in the direction increasing the angle of injection advance. The maximum angle of injection advance is determined by the position of the screw **12**.

What is claimed is:

1. A fuel-injection pump apparatus for an internal combustion engine, said apparatus comprising a high-pressure pump stage, a fuel-pressure regulator, a fuel feeder for said stage, a low-pressure feed pump including inlet and outlet chambers, inlet and outlet ducts coupled to said chambers, said low-pressure feed pump being connected via said fuel pressure regulator to said high-pressure pump stage, the fuel pressure regulator comprising a slide valve member and a spring associated with said valve member, said valve member being adapted to rotate about an axis perpendicular to the direction of its movement, the center of gravity of said valve member being eccentric relative to said axis, said valve member including a head at one end thereof, being provided with an annular groove in a portion thereof midway between its ends, a cap covering said head and a space being provided under the cap in communication with said annular groove, said groove having edges partially closing the inlet and outlet ducts connected to the outlet and inlet chambers of said low-pressure feed pump, said valve member controlling the fuel pressure in said groove and in the space under said cap by changing the ratio between the cross-sectional area of the inlet duct and that of the outlet duct, and automatically coming into an axial position which corresponds to a state of balance between said fuel pressure and the centrifugal force of said valve and the force of said spring, said annular groove communicating with said fuel feeder for the high-pressure pump stage to provide accurate metering of the fuel due to a high stability of the centrifugally controlled fuel pressure.

2. A fuel-injection pump as claimed in claim **1**, wherein said high-pressure pump stage includes an automatic fuel injection advance means including a piston and a spring with a gap between the same, said piston moving due to said gap into a position of the retard injection for starting of the engine.

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137—56; 417—462

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,676,023 Dated July 11, 1972

Inventor(s) Petr Ivanovich Andrusenko et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading to the printed specification, lines 19 and 20, "Alexandr Brokopievich Bakharev" should read -- Alexandr Prokopievich Bakharev --.

Signed and sealed this 27th day of February 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

[redacted]