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[54] **SYSTEM OF FUEL INJECTION AND PRECOMBUSTION-CHAMBER SPRAY IGNITION IN PISTON AND ROTARY-PISTON INTERNAL COMBUSTION ENGINES**

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[58] **Field of Search**.....F02b/3/00; 123/8.13, 32 SP, 123/32 ST, 139 AJ, 139 AW, 119 A; 60/39.48

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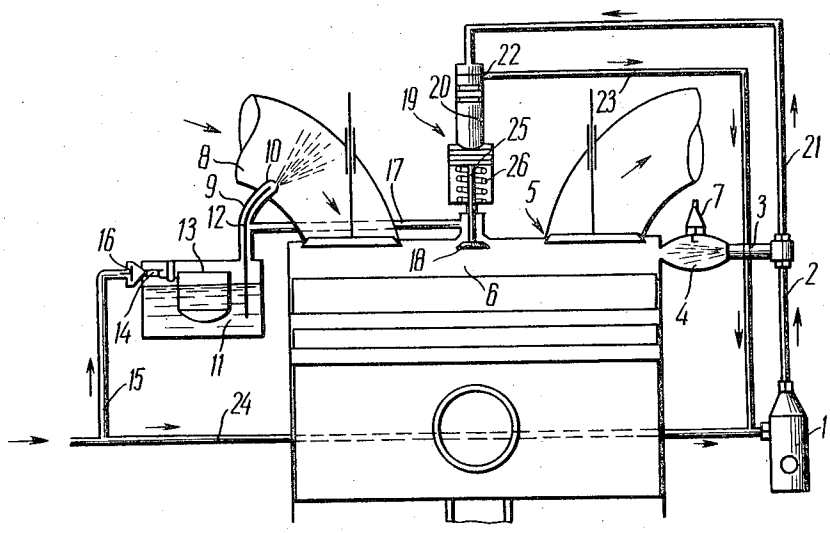
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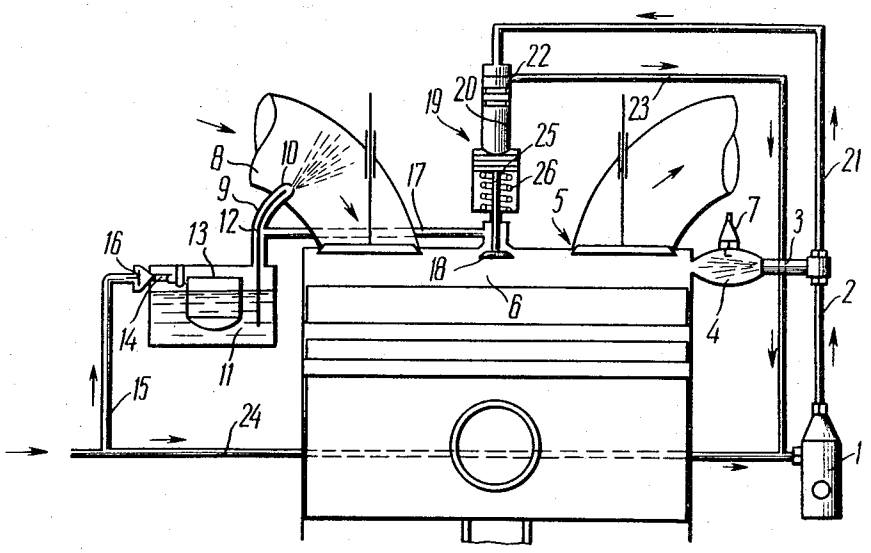
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[57] **ABSTRACT**

A system of fuel injection and precombustion-chamber spray ignition in piston and rotary-piston internal combustion engines is provided with a nozzle disposed in the precombustion chamber of the engine and connected to a fuel pump, and a jet pump connected to a tank filled with fuel that is provided with a device for maintaining a preset level in it. The tank and the jet pump are connected to the combustion chamber of the engine by a duct in which a shut-off valve is installed for tapping gas from the combustion chamber to the jet pump and tank, the valve having a drive functioning synchronously with the delivery of fuel by the fuel pump.

4 Claims, 1 Drawing Figure




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SYSTEM OF FUEL INJECTION AND PRECOMBUSTION-CHAMBER SPRAY IGNITION IN PISTON AND ROTARY-PISTON INTERNAL COMBUSTION ENGINES

The present invention relates to systems of fuel delivery and controlling engine duty used in piston and rotary-piston internal combustion engines.

Known in the art is a system of fuel injection and precombustion-chamber spray injection in piston and rotary-piston internal combustion engines comprising a nozzle disposed in the precombustion chamber of the engine and connected to a fuel pump, and a fuel atomizer arranged in the inlet pipe.

The known system of fuel injection does not make it possible to use increased compression ratios of the mixture in the combustion chamber, as such ratios could lead to detonation during combustion of the mixture, which limits the possibility of effective qualitative control of all the working duties of the engine.

No provision is made in the known systems for automatic reduction of the amount of fuel fed into the precombustion chamber as the load on the engine grows. This may lead to too great overenrichment of the mixture in the precombustion chamber and reduce to zero the effect of precombustion-chamber spray ignition.

In the known systems, economical operation of the engine is ensured when the load drops by using a rich mixture at the expense of quantitative control of the working duties, which leads to a poorer performance of the engine working cycle and a growth of the toxicity of the exhaust gases, and also to a more intricate system of controlling the engine working duties, namely, to the installation of an additional automatic device for controlling the quality of the mixture.

An object of the present invention is to provide such a system of fuel injection and precombustion-chamber spray ignition in piston and rotary-piston internal combustion engines that would ensure qualitative control of all the engine working duties with the use of a high compression ratio of the mixture, with its following automatic reduction as the load on the engine grows.

It is proposed a system of fuel injection and precombustion-chamber spray injection in piston and rotary-piston internal combustion engines comprising a nozzle disposed in the precombustion chamber of the engine and connected to a fuel pump, and a fuel atomizer disposed in the inlet pipe of the engine, wherein, according to the invention, the atomizer is a jet pump connected to a tank filled with fuel that is provided with a device for maintaining a preset level of the fuel in it, and the said tank is connected to the combustion chamber of the engine by means of a duct in which there is installed a shut-off valve equipped with a drive that operates synchronously with delivery of the fuel by the fuel pump, the valve being designed for tapping gas from the combustion chamber into the jet pump and tank and simultaneously for changing the compression ratio of the mixture depending on the engine duty.

The jet pump of the system is an atomizer whose inner fuel-feeding tube has one and end immersed in the fuel contained in the tank.

The device for maintaining the preset level of the fuel in the tank is a float closing the outlet orifice of the pipe feeding the fuel at a preset level of the latter, a non-return valve being installed in the pipe.

The shut-off valve is spring-loaded and is operated by a piston valve pusher that moves under the pressure of the fuel fed to it from the fuel pump, the excess fuel being discharged by the piston valve pusher along a pipe into the inlet system of the fuel pump.

The proposed system ensures qualitative control of all the working duties of the engine even when using low-octane fuels by providing the possibility of using a high compression ratio of the mixture with its following automatic reduction as the load on the engine grows.

The possibility of using effective qualitative control ensures high fuel economy in the engine, appreciably reduces the toxicity of the exhaust gases and simplifies the system of controlling the engine duties, eliminating the use of an automatic device for controlling the quality of the mixture.

As the engine load grows, the automatic reduction of the compression ratio of the mixture by partial removing of the gases from the combustion chamber while retaining a constant geometrical compression ratio of the engine excludes the possibility of detonation combustion at high load duties at which the composition of the mixture in the main combustion chamber is the most dangerous from the viewpoint of detonation.

In the proposed system, provision is made for automatic reduction of the supply of the precombustion chamber part of the fuel by bypassing part of it with the aid of the piston valve pusher into the inlet system of the fuel pump, thus ensuring an almost constant easily flammable enriched composition of the mixture in the precombustion chamber and retaining the precombustion-chamber and spray effect at any engine duties.

In addition, the change in the supply of the part of the fuel fed into the main combustion chamber depending on engine operation is automatically set by using the jet pump, which functions under the action of the gas delivered to the tank from the combustion chamber.

The nature of the present invention will become more fully apparent from a consideration of the following detailed description of an exemplary embodiment thereof, taken in conjunction with the accompanying drawing.

The system shown in the drawing comprises fuel pump **1** connected by means of pipe **2** to nozzle **3** installed in precombustion chamber **4** of combustion chamber **5** of the engine, chamber **5** consisting of precombustion chamber **4** and main chamber **6**.

Spark plug **7** is installed in precombustion chamber **4** for ignition of an enriched mixture.

At inlet pipe **8** of the engine there is installed jet pump **9** for atomization of the fuel that comprises an atomizer whose atomizing part **10** is disposed in inlet pipe **8**. Atomizer **9** is connected to tank **11** containing fuel by means of fuel delivery tube **12**, one end of which is immersed in the fuel contained in tank **11**. The preset level of fuel is maintained in tank **11** by means of a device comprising float **13** carrying closing needle **14** that shuts the outlet orifice of pipe **15** supplying the fuel.

Pipe **15** contains a non-return valve **16** for closing its outlet orifice when gas is being fed into tank **11**.

Tank **11** and jet pump **9** are connected to combustion chamber **5** by means of duct **17** in which shut-off valve **18** is installed. Valve **18** is actuated by drive **19** and is designed for tapping the gas from combustion

chamber 5 into jet pump 9 and tank 11. Drive 19 comprises piston valve pusher 20 that moves under the action of the pressure of the fuel supplied from fuel pump 1 along pipes 2 and 21. The excess fuel is discharged by piston valve pusher 20 through port 22 and along pipe 23 into pipe 24 delivering fuel to fuel pump 1. Piston valve pusher 20 actuates valve 18, whose rod 25 is loaded by spring 26.

The system functions as follows.

Fuel from the fuel tank (not shown in the drawing) is supplied by a fuel-feed pump (not shown in the drawing) after filtration along pipes 15 and 24 into tank 11 and fuel pump 1, respectively.

During the compression stroke, pump 1 delivers the fuel along pipe 2 into nozzle 3, and also along pipes 2 and 21 to drive 19 of shut-off valve 18.

During starting, idle running and low loads of the engine, the entire cycle portion of fuel supplied by pump 1 is injected by means of nozzle 3 into precombustion chamber 4, where in all duties there is formed an enriched mixture that is easily ignited by spark plug 7,

Upon an increase in the amount of fuel delivered by pump 1, the pressure in pipes 2 and 21 will grow owing to the limited capacity of nozzle 3. As a result piston valve pusher 20, overcoming the resistance of spring 26 and the pressure of the gases in combustion chamber 5, opens shut-off valve 18 and bypass port 22. Compressed gas from combustion chamber 5 through duct 17 flows into atomizer 9 and tank 11 and exerts pressure on the fuel in it. Non-return valve 16 closes pipe 15.

Under the pressure of the gas flowing into jet pump 9 and tank 11, the fuel rising along tube 12 into atomizer 9, sucked into it by the stream of gases, is injected by atomizing part 10 of the atomizer into inlet pipe 8 of the engine.

As the fuel is consumed from tank 11, needle 14 of float 13 opens the inlet orifice of tank 11 and fills it with fuel to the preset level. When the fuel reaches the given level, needle 14 again closes the inlet orifice, stopping the supply of fuel into tank 11.

As the amount of fuel supplied by pump 1 increases, the excess fuel through port 22 and pipe 23 is discharged into the pipe 24 feeding fuel to fuel pipe 1. With an increase in the duration of fuel delivery by pump 1 the "time-section" of shut-off valve 18 grows.

With a growth in the load on the engine, the amount of fuel passing through atomizer 9 increases, and through nozzle 3 decreases, retaining the optimal enriched composition of the mixture in precombustion chamber 4, and it is this that ensures the precombustion-chamber spray effect at all engine duties.

Owing to an increase in the amount of gas tapped from combustion chamber 5, the compression ratio of the mixture decreases. For this reason it is possible to use high compression ratios corresponding to partial loads on the engine at which a too lean mixture in main combustion chamber 6 prevents any possibility of detonation appearing during combustion of the mixture.

When pump 1 stops delivering fuel, the pressure of the fuel in pipes 2 and 21 decreases, nozzle 3 stops injecting fuel into precombustion chamber 4, and piston valve pusher 20 and shut-off valve 18 under the action of spring 26 and the pressure of the gases in combustion chamber 5 return to their initial position, closing the entrance to duct 17 and part 22. As a result operation of atomizer 9 stops.

Thus, by changing only the position of the control member (not shown in the drawing) of pump 1, the optimal compositions of the mixture in combustion chamber 5 are ensured, and also the required compression ratio of the mixture. The above underlies the achievement of qualitative control of all the engine working duties.

What we claim is:

1. A system of fuel injection and precombustion-chamber spray ignition in piston and rotary-piston internal combustion engines, comprising a fuel pump; a nozzle disposed in the precombustion chamber of the engine and connected to said fuel pump; a tank filled with fuel and connected by means of a duct to said engine combustion chamber; a device for maintaining a preset level of fuel in said tank; a jet pump installed in the inlet pipe of said engine and connected to said tank, designed for injecting fuel into said inlet pipe; a shut-off valve disposed in said duct connecting the tank to the combustion chamber and designed for tapping gas from the combustion chamber into the tank and simultaneously for changing the compression ratio of the mixture depending on the engine duty; the gas, flowing into said tank under pressure, facilitates the suction of fuel into said jet pump and its injection into the combustion chamber; means for actuating said shut-off valve functioning synchronously with the delivery of fuel by the said fuel pump.

2. A system as claimed in claim 1, wherein the jet pump comprises an atomizer whose inner fuel delivery tube has one end immersed in the fuel contained in the tank.

3. A system as claimed in claim 1, wherein the device for maintaining the preset level of the fuel in the tank comprises a float closing the outlet orifice of the pipe supplying fuel at its preset level, a non-return valve being installed in the pipe.

4. A system as claimed in claim 1, wherein the shut-off valve is spring-loaded and is actuated by a piston valve pusher moving under the action of the fuel delivered to it from the fuel pump, the excess fuel being discharged by the piston valve pusher along a pipe into the inlet system of the fuel pump.

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