May 3, 1938. J. J. BROEZE ET AL 2,116,337

PROCESS AND APPARATUS FOR THE COOLING OF FUEL ATOMIZERS

Filed June 15, 1937 2 Sheets-Sheet 1

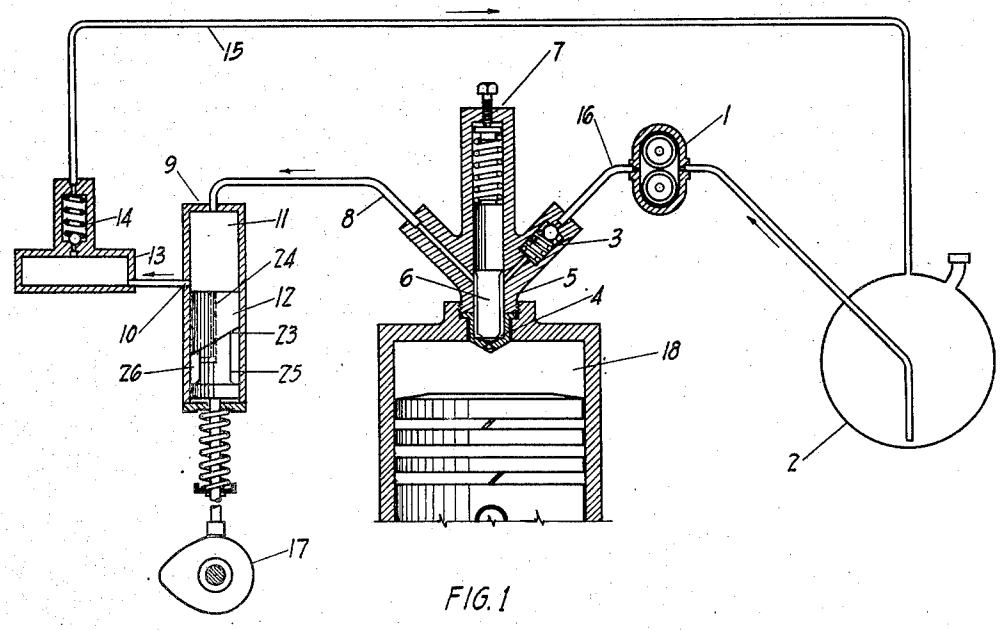

FIG. 1

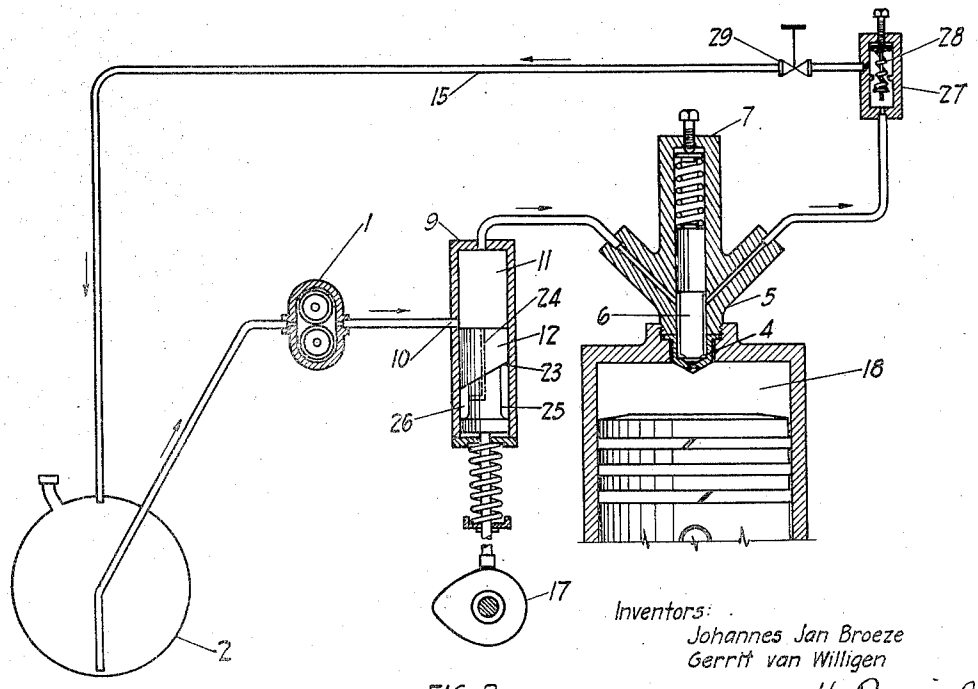

FIG. 2

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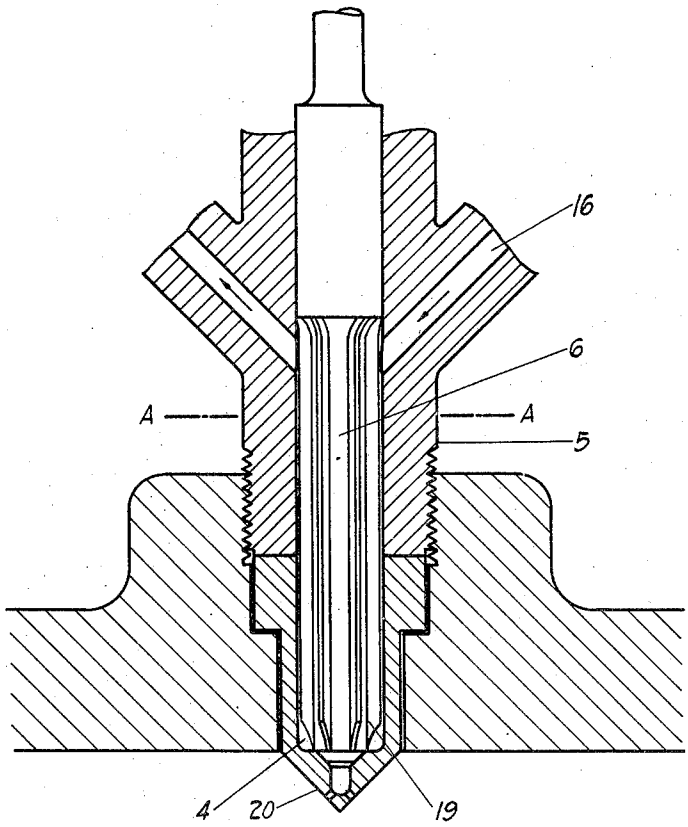

FIG. 3

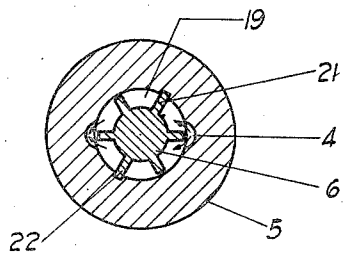

FIG. 4

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PROCESS AND APPARATUS FOR THE COOLING OF FUEL ATOMIZERS

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In the Netherlands June 22, 1936

3 Claims. (Cl. 123—139)

This invention relates to a method of and apparatus for cooling fuel atomizers or injectors of internal combustion engines employing solid injection of fuel.

In the past frequent clogging has been encountered with injectors of this type owing to the partial carbonization of the fuel in the injector body due in turn to the overheating of the fuel prior to injection.

Means have been suggested for eliminating this trouble but to our knowledge have only met with partial success.

It is therefore an object of this invention to provide a method and apparatus by which the overheating of the injector does not occur and the consequent carbonization of fuel in the injector body prevented.

It is a further object of this invention to provide a method and apparatus whereby the fuel for combustion acts as a carrier to remove heat from the injector body.

A further object is to devise a simpler cooling system than those now in use.

The other objects of our invention will be apparent to those skilled in the art.

In brief our invention comprises causing a flow of fuel through the injector body and effecting injections at desired intervals, by increasing the pressure on the fuel. The supply of fuel and of the cooling medium may be effected through a single duct so that only a separate discharge is required.

An advantage is that oil of high viscosity may be used as the oil by cooling the injector itself becomes warmed thereby reducing the viscosity.

According to one specific embodiment of our invention, the fuel space in the atomizer is connected with a liquid supply pump, with an outlet for the cooling liquid and with the injector opening. In order to allow easier control of the quantity and the pressure of the fuel to be injected, it is preferable to close the outlet for the cooling liquid and the pump for the cooling liquid during the injections by means of automatically operated valves so that during the injection period there is no outlet for the fuel to escape except through the injector orifice.

The further details of our invention will be seen from the following description of a specific embodiment of the invention, throughout which reference is made to the accompanying drawings of which:

Figure I is a schematic diagram showing the method of cooling the injection nozzle.

Figure II is a schematic diagram of an alternate cooling system.

Figure III is an elevation of parts of an injection nozzle showing details.

Figure IV is a cross section of the nozzle shown in Figure III.

Referring to Figure I, a pump 1 is connected by piping to a supply tank 2 and on its discharge side to a spring loaded check valve 3 communicating with fuel space 4 between the body 5 and needle 6 of the injector 7. A conduit 8 runs from the fuel space 4 to the discharge side of a fuel injection pump 9. This fuel injection pump is provided with a port 10 in the side of the pump cylinder 11 which is uncovered when the piston 12 is at the bottom of the cylinder. The port 10 is connected to a reservoir 13 which in turn is connected to a spring loaded check valve 14 opening away from said port. A line 15 then extends to the tank 2.

The method of operation is as follows: The pump 1 draws fuel from the tank 2 and forces it through line 16 and check valve 3 into the fuel space 4 in the injection nozzle 7. The fuel contacting the walls of the injection nozzle absorbs considerable heat therefrom and continues to flow through line 8 and by way of port 10, reservoir 13 and check valve 14 back to the fuel supply tank 2. The injection pump 9 is actuated by a cam 17 geared to the engine of which the injection system forms a part. When in the cycle of operation, fuel has to be injected into the combustion chamber 18 of the engine, the piston 12 of the injector pump 9 rises closing the port 10 and causing sufficient back pressure in the line 8 and fuel space 4 to close the check valve 3 and raise the atomizer needle 6 from its seat forcing fuel into the combustion chamber of the motor from the fuel space 4.

If desired, a cooler may be installed in the line 15 carrying the fuel back to the supply tank. However with the usual fuel supply tank there is sufficient radiation to remove the necessary amount of heat without resorting to this measure.

Referring to Figures III and IV which give details of a suitable injection nozzle, the fuel supply line 16 opens into one or more grooves 19 formed by ribs in the atomizer needle body.

In order to prevent the possibility of fuel bypassing to the line 8 without passing the fuel space 4 near the injector head 20 the ribs may be made to fit closely in the central bore. Moreover, two opposing ribs 21 and 22 may be made to extend into grooves provided in the wall of the central bore as shown.

The pressure on the system shown in Figure I may be maintained at any reasonable pressure by providing the check valve 14 with a sufficiently strong spring. The pressure at which injection into the cylinder of the engine takes place may be at any pressure above the normal pressure in the piping system. The quantity of fuel injected may be controlled in a usual manner by providing the piston with an inclined lower face 23 and an L-shaped passageway 24 from the upper face to the stem 25 below the lower face 23 and turning said piston assembly to bring the annular space 26 into communication with the port 10 at the desired point in the upward travel of the piston, thus relieving the pressure.

An alternate arrangement is shown in Figure II in which like parts are given like numerals. As will be seen from this figure, the check valve 14 is eliminated and the port 10 communicates with the discharge side of feed pump 1. The check valve 3 is replaced by a check valve 27 having a spring 28 normally keeping the valve open and a needle valve 29 so that a predetermined pressure may be kept on the system during the cooling period when the piston 12 uncovers port 10. The check valve 27 will upon an increase in pressure act against spring 28 closing the valve during the high pressure period of injection.

It should be understood that whereas we have, for the sake of simplicity, described our fuel injection system as related to one cylinder of an internal combustion motor, it is readily applied to multiple cylinder engines. In such cases the discharge side of feed pump 1 will be connected by a manifold to several identical systems of injectors and fuel injection pumps.

We claim as our invention:

1. In an injection system for internal combustion engines the combination comprising: a fuel nozzle for injecting fuel into an engine cylinder, a fuel feed pump for continuously pumping fuel through the body of said nozzle, a pressure operated valve for controlling the flow of fuel from said nozzle to the engine cylinder, a conduit connecting said fuel pump to said nozzle body and a fuel injection pump for controlling the operation of said pressure operated valve by forcing fuel toward said fuel injection nozzle connected to said nozzle body by a second conduit, said second conduit and pump normally forming a path for the fuel to flow during non-injection periods after it passes through the nozzle body.

2. In an injection system for internal combustion engines the combination comprising: a fuel reservoir, a fuel feed pump communicating therewith, a check valve for preventing fuel flowing back through said fuel pump, a pipe connecting said check valve to the fuel space of a spring-loaded atomizer, a second pipe connecting said fuel space with a fuel injection pump, said fuel injection pump being adapted to increase the pressure on said spring loaded atomizer to effect injection at definite periods, a third pipe connecting said fuel injection pump to said reservoir, said second pipe, said fuel injection pump and said third pipe normally forming a path for the fuel to flow to said reservoir during non-injection periods after it passes through the fuel space of the spring loaded atomizer.

3. Apparatus for cooling atomizers of internal combustion engines having solid injection of fuel comprising: a fuel supply tank, a fuel feed pump for continuously pumping fuel from said tank, a pressure actuated fuel atomizer connected at one side to said fuel feed pump, piping for conducting fuel from the body of said atomizer back to said supply tank and a plunger pump in said piping for increasing the pressure and reversing the flow of fuel in said piping whereby injection of fuel into the engine is effected.

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