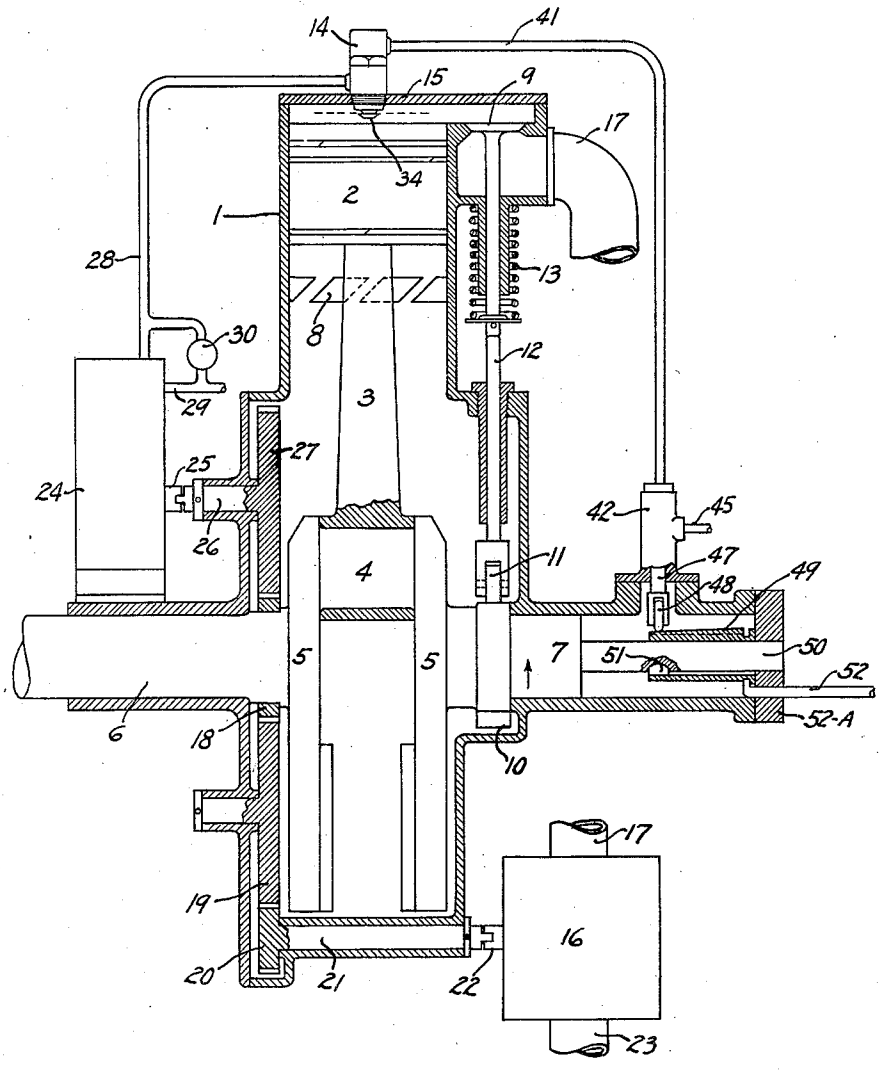
April 12, 1932. L. L. SCOTT 1,853,235

FUEL INJECTION ENGINE

Filed Feb. 7, 1930 2 Sheets-Sheet 1

FIG. 1



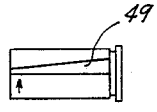


FIG. 5

INVENTOR.

Lewis L. Scott

April 12, 1932. L. L. SCOTT 1,853,235

FUEL INJECTION ENGINE

Filed Feb. 7, 1930 2 Sheets-Sheet 2

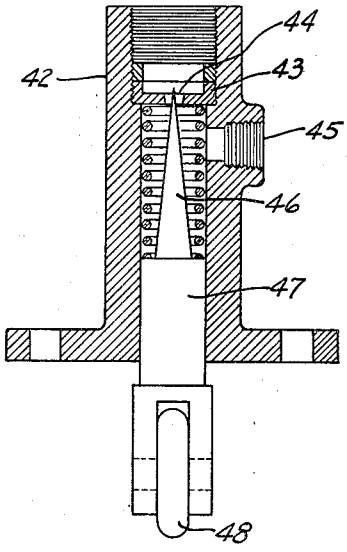


FIG. 4

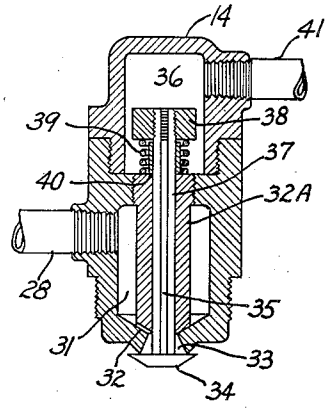


FIG. 2

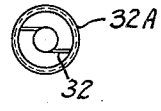


FIG. 3

INVENTOR.

Lewis L. Scott

Patented Apr. 12, 1932 1,853,235

UNITED STATES PATENT OFFICE

LEWIS L. SCOTT, OF ST. LOUIS, MISSOURI

FUEL INJECTION ENGINE

Application filed February 7, 1930. Serial No. 426,548.

This invention relates to fuel injection engines and is particularly useful in engines running at high speeds, such as used for propelling aeroplanes, and has for its object the provision of means for properly controlling the injection of fuel so as to avoid excessive high working pressures in the engine and a smoky exhaust when running at high speed.

The invention is illustrated in the accompanying drawings, in which:

Figure 1 is a sectional view of a single cylinder, two cycle engine embodying my invention, but shown more or less in a diagrammatic way.

Figure 2 is a sectional view of the fuel atomizing nozzle.

Figure 3 is a front end view of the nozzle whirler.

Figure 4 is a sectional view of the fuel control valve.

Figure 5 is a plan view of the fuel control valve cam.

Referring now to the drawings, the numeral 1 indicates the cylinder of an engine, which may be either air or water cooled. 2 is a piston adapted to reciprocate in the cylinder. 3 is a connecting rod attached to the piston 2 and connected to the crankpin 4, which crankpin is attached to the crankarms 5, said crankarms being joined to the shafts 6 and 7. The numeral 8 indicates exhaust ports commonly used in two cycle engines. The numeral 9 is an intake valve for admitting air to the engine cylinder. The valve 9 is operated by the cam 10, attached to the crankshaft 7, through the roller 11 and push rod 12. The numeral 13 indicates a spring which is adapted to close the valve 9. The numeral 14 indicates a spray nozzle which is secured to the cylinder head 15. The numeral 16 indicates an air blower which furnishes air through pipe 17, (shown partly broken away), which air is admitted to the engine cylinder through the valve 9. This air blower may be of any well known type. The numeral 18 indicates a gear secured to the engine shaft 6, which gear is adapted to drive the gear 19, which gear 19 drives gear 20. The numeral 21 indicates a shaft secured to the gear 20 and adapted to drive the rotor shaft 22 of the blower 16. The numeral 23 indicates the intake pipe of the blower 16. The numeral 24 indicates a pump for pumping fuel oil under high pressure to the nozzle 14. The pump 24 may be of any well known construction, and may have any number of plungers necessary, and is adapted to pump oil at fuel pressures up to 10,000 pounds. 25 indicates the pump drive shaft, which is driven by the shaft 26, which shaft 26 is secured to the gear 27, which gear meshes with the gear 18 secured to the drive shaft 6. The numeral 28 indicates the high pressure discharge pipe from the pump 24, which pipe connects to the nozzle 14. The numeral 29 indicates the suction pipe from the pump 24, which runs to a fuel tank, not shown. The numeral 30 indicates any well known type of pressure relief valve, which is connected to the pipe 28 and to the pipe 29, said valve being adapted to maintain a uniform pressure of, say, 10,000 pounds in the discharge pipe 28.

I will now describe the fuel nozzle, (see Figure 2). Fuel enters into the chamber 31 from the pipe 28, and passes through the tangential slots 32 of the nozzle whirler 32—A, into the whirling chamber 33, where said fuel is rotated rapidly. The numeral 34 indicates the head of the fuel valve, which is seated against a sharp edge projection of the nozzle body. The head 34 is attached to the stem 35, and said stem passes through the nozzle whirler 32—A into the chamber 36. A by-pass from the whirling chamber 33 to the chamber 36 may be provided in any convenient manner, such as by grooves 37 in the stem 35. The upper part of the valve stem 35 is threaded, and carries the nut 38. The spring 39 is interposed between the nut 38 and the top of the nozzle whirler 32—A, and is adapted to close the valve 34 under certain conditions. The numeral 40 indicates a spacer which limits the opening of the valve 34. This opening is usually quite small, and may run from ".001" to ".005." The number 41 indicates a fuel return pipe which connects to the upper chamber 36 of the nozzle 14 and runs to the fuel control valve 42. The member 43 is seated in the upper part

of the fuel control valve casting 42, and is provided with a central orifice 44, through which fuel may pass and return to the fuel tank, (not shown), through the opening 45. The valve 46 is adapted to cooperate with the orifice 44 and thereby control the fuel pressure in the pipe 41 and in the whirling chamber 33 of the nozzle. The valve 46 is secured to the plunger 47, which plunger carries the roller 48, which roller is adapted to cooperate with the cam 49, which cam is driven by the extension shaft 50 of the engine crankshaft 7. The cam 49 is slidably mounted on the shaft 50, and is driven by the key 51. The member 52, carried by the head 52—A, is adapted to engage a groove at the end of the cam so that said cam may be slided on the shaft 50. By referring to Figure 5, which shows a plan view of the cam 49, it will be seen that the left end of the cam is narrow, compared with the right hand end, and by referring to Figure 1, it will be seen that the top surface of the cam tapers upward from left to right. In the position shown in Figure 1, the cam 49 will engage the roller 48 and move the valve 46 into the orifice 44 so as to restrict said orifice a small amount, whereby, if the cam were moved so that its extreme right hand end would contact with the roller 48, the valve 46 would project into the orifice 44 so as to practically close said orifice, and in this position, the valve would not only remain closed for a greater length of time, but, (due to the taper of the front side of the cam), would start to close earlier so as to change the time of injection of the fuel with relation to the position of the piston 2.

It is obvious that this fuel injection system may be applied to an engine of the four cycle type as well as the two cycle, and that any number or arrangement of cylinders may be used. For example, if it was desired to build a radial type of engine with, say, nine cylinders, only one fuel pump would be required, and one cam 10 could operate all of the intake valves, which would be arranged radially, and one cam 49 could operate all of the fuel control valves, which would be arranged radially, and one blower 16 could supply air necessary for all of the cylinders.

Assuming that the engine is running and the parts are in the positions as shown in Figure 1, the piston 2 is at the top of its stroke and fuel is being injected, (as indicated by the dotted lines around the top part of the valve 34), into the engine cylinder. The fuel pump 24 will create a high fuel pressure in the line 28, which pressure is controlled by the automatic valve 30, and the fuel enters the whirling chamber of the nozzle 33, through the slots 32, under very high pressure which pressure is caused by the restricted area of the whirler slots 32. The spring 39 is usually set to permit the valve 34 to open at say 1,000 pounds pressure. The cam 49, in the position shown in Figure 1, will operate the valve 46 so as to cause a pressure in the line 41 and in whirling chamber 33 of, say, 2,000 pounds for a short period of time. This cam 49 is set, with relation to the crankpin 4, so that the valve 46 will be operated a few degrees before top dead center of the piston 2. In this position, only a very small amount of fuel will be injected into the engine under a relatively low fuel pressure, say, 2,000 pounds. The fuel injected into the engine cylinder will be ignited by the heat of compression and will expand and move the piston 2 downward, uncovering the exhaust ports 8, permitting the burned gases to pass outward. At this time, the valve 9 will be operated by the cam 10 and fresh air will be forced into the cylinder, forcing the burned gases out through the exhaust ports 8 and filling the cylinder with a charge of fresh air, and the next upstroke of the piston will compress said air and fuel will be injected as before described. In order to inject greater quantities of fuel into the cylinder, the cam 49 can be moved to the left on the shaft 50, and by so doing, the valve 46 will move upward into the orifice 44, so as to create a higher pressure in the fuel line 41 and whirling chamber 33, so that by this movement of the cam, a range of pressures can be had in the whirling chamber from, say, 2,000 to 10,000 pounds, and it will be seen that the length of time that the fuel is being injected will be increased as the cam 49 is moved to the left, and that the time of injection, with relation to the stroke of the piston, will be earlier as said cam is moved to the left. The pump 24 is adapted to pump fuel continuously through the whirling chamber 33 of the nozzle and to maintain a continuous high pressure on the line 28. When fuel is not being injected into the engine cylinder, it will pass from the whirling chamber 33, through the slots 37 to the pipe 41, through orifice 44 and pipe 45, back to the fuel tank under substantially no pressure, although said fuel is uunder a high pressure in line 28 at this time. When the valve 46 is moved into the orifice 44, by action of the cam 49, there will be a pressure created in the whirling chamber 33 and pipe 41 of anywhere from 2,000 to 10,000 pounds, depending on the position of the cam 49, and this pressure will cause the valve 34 to open and spray fuel into the combustion chamber of the engine, and as soon as the cam 49 permits the valve 46 to move downward and open the orifice 44, the fuel pressure in chamber 33 and line 44 will instantly be relieved and said valve 34 will quickly close, shutting off the fuel to the engine combustion chamber; however, the fuel will continue to flow through the whirling chamber 33 and pipe 41, and will be maintained at a constant high pressure in line 28, regardless of whether the valve 34 is open

or closed. From the above description, it will be seen that I have provided a fuel injection system whereby I supply fuel from a pump to one or more nozzles at substantially a constant pressure through the nozzle whirler slots, and that during the period fuel is not being injected into the engine cylinder, there is substantially no fuel pressure in the whirling chamber of the nozzle, and that I have provided a nozzle which has a valve operated by fuel pressure, and that I also provide a means of very nicely controlling and varying the pressure of the fuel in the whirling chamber of the nozzle and of varying the duration of injection and the time of injection, with relation to the position of the engine piston.

I claim:—

1. In a fuel injection engine, a cylinder, a piston adapted to reciprocate in said cylinder, a fuel nozzle for injecting fuel into the engine cylinder, a pump for continuously pumping fuel through a chamber of the nozzle located adjacent to the nozzle orifice, a fuel pressure operated valve for controlling the flow of fuel from the nozzle to the engine cylinder, an automatic device for controlling the operation of said fuel pressure operated valve by controlling the pressure of the fuel in the chamber adjacent to the nozzle orifice, substantially as described.

2. In a fuel injection engine, a cylinder, a piston adapted to reciprocate in said cylinder, a fuel nozzle for injecting fuel into the engine cylinder, a pump for continuously pumping fuel through a chamber of the nozzle located adjacent to the nozzle orifice, a fuel pressure operated valve for controlling the flow of fuel from the nozzle to the engine cylinder, an automatic device for controlling the operation of said fuel pressure operated valve by controlling the pressure of the fuel in the chamber adjacent to the nozzle orifice and also varying the duration and controlling the instant of injection with relation to the movement of the engine piston, substantially as described.

3. In an apparatus for injecting fuel into an engine cylinder, a fuel nozzle, a pump for continuously pumping fuel through a chamber located adjacent to the nozzle orifice, a fuel pressure operated valve for controlling the flow of fuel from the nozzle to the engine cylinder, means for controlling the operation of said fuel pressure operated valve, consisting of a valve operated by the engine for regulating and changing the fuel pressure in the chamber adjacent to the nozzle orifice, substantially as described.

4. In an apparatus for injecting fuel into an engine cylinder, a fuel nozzle, a pump for continuously pumping fuel through a chamber located adjacent to the nozzle orifice, a fuel pressure operated valve for controlling the flow of fuel from the nozzle to the engine cylinder, menas for controlling the operation of said fuel pressure operated valve, consisting of, a port in communication with the chamber located adjacent to the nozzle orifice, a valve operated by the engine and cooperating with said port for regulating and changing the fuel pressure in said chamber, substantially as described.

5. In an apparatus for injecting fuel into an engine cylinder, a fuel nozzle, a pump for pumping fuel through a chamber located adjacent to the nozzle orifice, a fuel pressure operated valve for controlling the flow of fuel from the nozzle to the engine cylinder, means for controlling the operation of said fuel pressure operated valve, consisting of, a port in communication with the chamber located adjacent to the nozzle orifice, an automatic valve cooperating with said port for regulating and changing the fuel pressure in said chamber, a slidably mounted cam operated by the engine for controlling the operation of said automatic valve and arranged to vary the lift of said valve when slid in different positions, substantially as described.

In testimony whereof, I have hereunto set my hand.

LEWIS L. SCOTT.