April 16, 1957 S. MEURER 2,788,773

REGULATION OF THE PISTON TEMPERATURE
IN INTERNAL COMBUSTION ENGINES

Filed Aug. 25, 1955 2 Sheets-Sheet 1

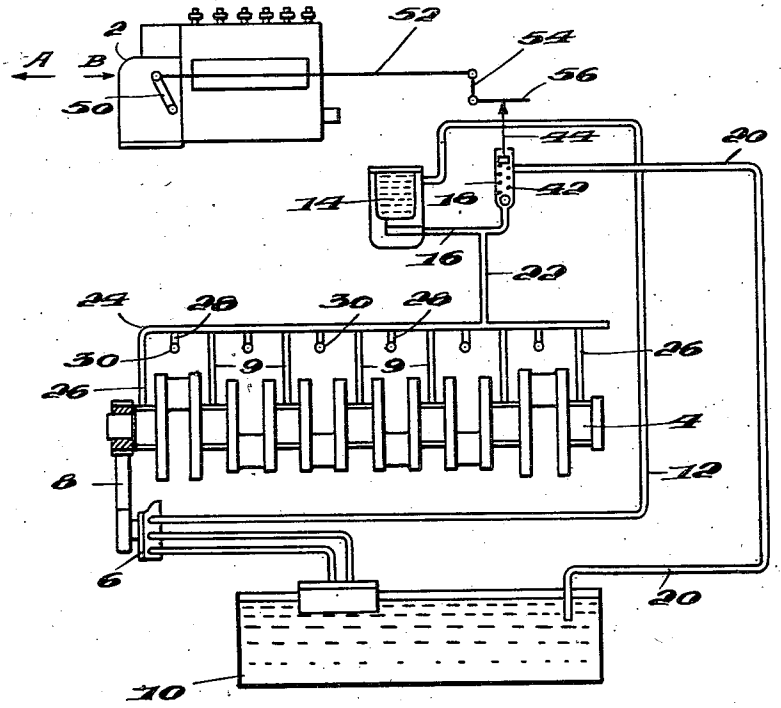


Fig. 1.

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Fig. 2.

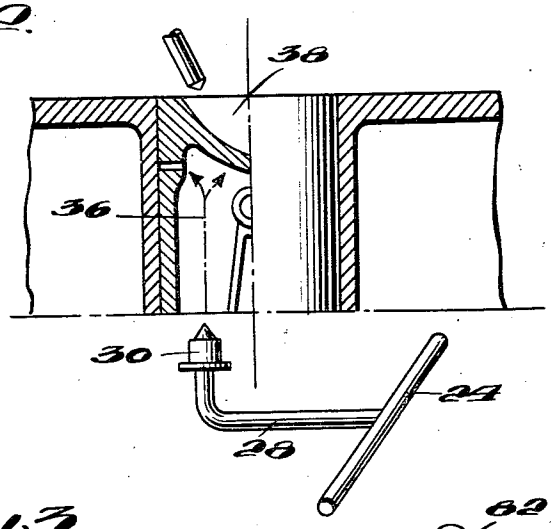


Fig. 3.

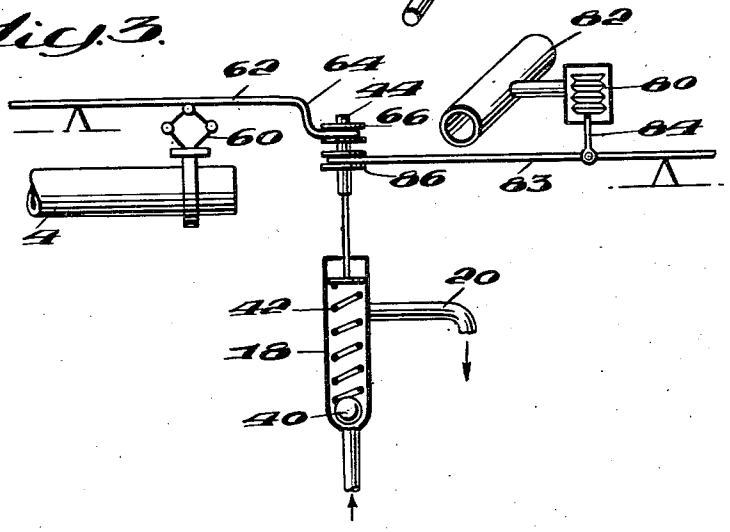
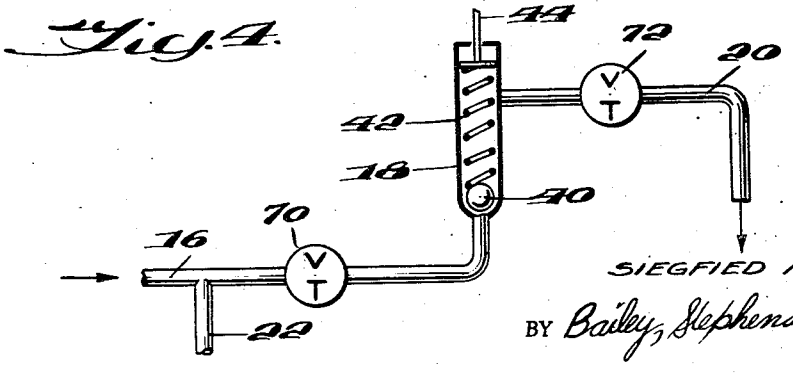


Fig. 4.



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REGULATION OF THE PISTON TEMPERATURE IN INTERNAL COMBUSTION ENGINES

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Application August 25, 1955, Serial No. 530,454

Claims priority, application Germany August 27, 1954

5 Claims. (Cl. 123—41.35)

This invention relates to the regulation of the piston temperature in internal combustion engines, and in particular is directed to pistons used in internal combustion engines as disclosed in the copending application of Meurer et al., Serial No. 480,432, filed January 7, 1955, for "Operation of Internal Combustion Engines."

It is often desirable to maintain the piston temperature within a certain range in an internal combustion engine. This is particularly true with regard to internal combustion engines as disclosed in the aforesaid application Serial No. 480,432, wherein substantially all the fuel is first deposited as a film upon the wall of a combustion chamber, vaporized therefrom and then burned. In order to keep the piston from becoming unduly heated, the piston is cooled by being washed with oil as disclosed in the copending application of Meurer Serial No. 450,677, filed August 18 1954, now Patent No. 2,741,519, granted April 10, 1956, for "Piston Engine." In this disclosure the underside of the combustion chamber is cooled by a jet of oil coming from a nozzle directed toward the interior of the piston, the nozzle being connected to the oil circulating system for the engine, and preferably connected to the pressure lubrication system. All nozzles of the various pistons are connected to the oil circulating system. Each nozzle contains a valve set to a certain valve opening pressure, this being similar to a fuel injection nozzle. Accordingly, the oil pressure in the lubrication system is maintained when the motor is idling.

A disadvantage in the cooling system of Patent 2,741,519 lies in that it operates always at the same pressure, which is the pressure maintained in the oil circulating system, and the cooling is not adjusted to the variable heat and load conditions encountered by the engine. When the engine is running under partial or full load, a greater cooling effort is required, whereas when the motor is lightly loaded or is idling, the cooling can be stopped entirely in order to keep a relatively high piston temperature.

The objects of this invention are to provide a means for obtaining an automatic regulation of the piston temperature, and to produce a means whereby the pistons are cooled by oil jets connected to the engine oil circulating system.

In general, these objects are obtained by providing oil jet nozzles which are set to open at a pressure below that of the highest pressure of the oil circulating system for the engine, but higher than the pressure of the oil circulating system when the engine is idling.

According to the invention, external supplemental control means are provided for varying the pressure of the oil delivered to the nozzles from the engine oil circulating system. These external control means are dependent upon the engine load and/or the temperature of the engine, and/or the engine speed, and are derived, for example, from the fuel injection pump, the temperature of the exhaust gases, and/or the R. P. M. of the engine. The individual oil jet nozzles are provided with means for keeping the opening pressure of each nozzle at a

desired and invariable value. On the other hand, a spring-loaded pressure regulating valve is positioned in the oil delivering system, with this valve being acted upon by the various load, speed, or temperature control elements, and the valve otherwise kept inactive by by-pass means.

A further feature of the invention lies in that the oil pressure of the circulating system effective on the nozzles is adjusted automatically by means of this regulating valve. To achieve this, a spring-pressed valve is used with the compression on the spring being varied in accordance with the control elements. For example, the valve is actuated from the throttle lever for the engine injection pump so that by placing the control element to a half engine load position, the by-pass effect of the pressure regulating valve is changed so that the pressure in the oil circulating system remains below the opening pressure of the oil jet nozzles. On the other hand, if the throttle lever for the injection pump is placed to full load position, the by-pass effect of the pressure regulating valve is prevented so that the pressure in the oil circulating system rises above the opening pressure of the oil jet nozzles and oil is jetted through said nozzles. This way, the oil pressure is externally adjustable over a selected range.

Exhaust gas thermostat means may be employed for actuating the spring-pressed valve. When the engine temperature falls below a certain point, the oil pressure will be reduced to such a degree that the oil jet nozzles cease to operate.

The spring-pressed valve may also be additionally controlled by an engine speed responsive member coupled to the valve.

Furthermore, the oil pressure of the circulating system for the engine can be regulated as a function of the engine speed by means of a throttle valve arranged after the spring-pressed regulating valve, and this throttle valve will, independently of a spring regulating valve, bring about a higher or lower oil pressure when the engine speed changes.

The means by which the objects of the invention are obtained are described more fully with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of the oil pressure control system;

Figure 2 is a diagrammatic detail view of an oil jet nozzle for cooling a piston;

Figure 3 is a diagrammatic view of the control elements for controlling the spring-pressed regulating valve; and

Figure 4 is a diagrammatic view of the throttle valves for controlling the engine oil circulating pressure.

Figure 1 shows the crankshaft 4 of an internal combustion engine (not shown in particular). Oil pump 6 is driven from the crankshaft by gears 8. Oil is pumped from oil sump 10 through pump 6 and line 12 to oil strainer 14, from which the oil is led through line 16 into spring-pressed control valve 18, and then through line 20 back to sump 10. From line 16 an oil line 22 is joined to oil manifold line 24. From manifold 24 branch lines 26 lead to the crankshaft bearings. Second branch lines 28, each one for each piston, lead from manifold 24 to cooling oil injection nozzles 30, note Figure 2.

The jet of oil 36 from nozzle 30 impinges on the underside of combustion chamber 38 of the piston to cool the piston head and combustion chamber, said oil further serving to lubricate the cylinder as set forth in the aforesaid application Serial No. 450,677. The opening pressure of each valve 30 is set so that the valve opens only when the oil pressure exceeds a certain value, for example, three atmospheres, this being lower than the highest pressure in the engine oil circulating system.

Spring-pressed valve 18 contains a ball 40 normally held upon its seat by spring 42. Compression on this spring is adjustable by means of rod 44 extending outwardly of the valve. Line 20 constitutes a by-pass line.

In Figure 1 the oil pressure is regulated as a function of the setting of the fuel injection pump 2. Throttle lever 50 for the fuel injection pump 2 is connected by rod 52 to bell crank 54, one arm 56 of which engages rod 44. When throttle lever 50 is moved in the direction of arrow A to engine idling position, the spring 42 in valve 18 is relieved, and, therefore, the oil in line 16 will flow through the valve into by-pass line 20, and the oil pressure in manifold 24 will drop below the opening pressure of nozzles 30. Accordingly, the pistons will not be cooled.

When lever 50 is moved in the direction of arrow B to full engine speed, spring 42 is compressed, thus closing valve 18 and putting the full oil pressure into manifold line 24. Consequently, there is a pressure rise in nozzles 30, and the oil jets 36 are actuated to cool the piston under this condition. Rod 52 and the compression of spring 42 are pre-adjusted so that cooling oil emerges from nozzles 30 at a predetermined pressure.

As shown in Figure 3, the regulation of the oil pressure can be obtained by means of an engine speed responsive element. On crankshaft 4 is a speed responsive governor-like element 60 which actuates the lever 62 engaged by arm 64 with a collar 66 on rod 44. As the engine speed increases, the compression on spring 42 is increased, thus closing ball valve 42 and raising the oil pressure in manifold line 24. Jets of cooling oil are therefore discharged from nozzles 30 to cool the pistons.

In Figure 4 the throttle valves 70 and 72 are included in lines 16 and 20, respectively. The opening of valve 70 is adjusted so that, for example, only a pre-determined amount of oil flows through by-pass line 20 when the engine is running at half speed, while at the same time the oil pressure in manifold 24 exceeds the opening pressure in nozzles 30. On the other hand, the nozzles 30 will operate independently of valve 18 when the engine speed increases to a point above the opening pressure of nozzles 30.

In operation, assuming that the oil cooling nozzles 30 are set to an opening pressure of three atmospheres, oil will be jetted from the nozzles when the pressure of the oil circulating system rises above three atmospheres. Valve 18 is connected with throttle lever 50 so that the oil pressure up to half the degree of admission in the fuel injection pump remains below three atmospheres. When the lever 50 is moved to produce a higher degree of admission for a load higher than that existing for example, at half the mean effective pressure of the engine, the oil pressure will rise to 4 or 4.5 atmospheres so that cooling oil will be emitted from nozzles 30.

An additional control of valve 18 can be obtained from the heat of the exhaust gases, as shown in Figure 3. The thermostat 80 is connected to engine exhaust pipe 82 so as to be responsive to the heat of the exhaust gases. The thermostat 80 regulates lever 83 through rod 84, lever 83 being engaged with the collar 86 on rod 44. As thermostat 80 expands, lever 83 will be depressed, thus increasing the compression on spring 42 to close ball valve 40, and thus increase the oil pressure in manifold 24. The cooling system of this invention is particularly advantageous in multi-cylinder engines as it is possible to selectively activate the individual oil cooling nozzles for the various pistons in the engine.

Having now described the means by which the objects of the invention are obtained,

I claim:

1. Means for regulating the temperature of pistons in an internal combustion engine, having pistons cooled by oil jets emerging from oil injection nozzles connected to the oil circulating system of the engine, with the opening pressure of the nozzles being lower than the highest pressure in the engine oil circulating system, and higher than the pressure of that system when the motor is idling, comprising an oil supply pump connected to said nozzles, and a regulating valve joined to said pump for varying the oil pressure to said nozzles in dependence upon the running conditions of said engine.

2. Means as in claim 1, including a throttle lever connected to a fuel injection pump for said engine, and said regulating valve being a spring compressed by-pass valve, further comprising an adjusting member connected to said valve for affecting the spring compression of said valve, means connecting said member to said throttle lever, whereby upon adjustment of said lever to half-load position or below, the by-pass effect of said valve is so changed that by reason of the increased back-flow of oil to the oil sump, the pressure in the oil circulating system remains below the discharge pressure of the nozzles.

3. Means as in claim 1, said regulating valve being a spring compressed by-pass valve, further comprising an exhaust gas temperature responsive thermostat for actuating said regulating valve so that when a drop of temperature of the exhaust gas goes below a certain temperature, the by-pass effect of the valve is changed by reason of an increased back-flow of oil to the oil sump, and the pressure in the oil circulating system drops below the discharge pressure of the nozzles.

4. Means as in claim 1, further comprising a fuel injection pump for said engine, and means for controlling said regulating valve, by both the throttle lever of said injection pump and a regulating element dependent upon the engine speed.

5. Means as in claim 4, further comprising throttle valve means in the oil circulating system of the engine for controlling the flow of oil through said regulating valve and having a cross-section set so that above a desired and predetermined engine speed, a pressure in the oil circulating system exists which is above the opening pressure of the cooling oil injection nozzles.

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