



(11) **EP 1 948 913 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
17.02.2010 Bulletin 2010/07

(51) Int Cl.:
F01M 1/08 ^(2006.01) **F01M 5/00** ^(2006.01)

(21) Application number: **05814828.9**

(86) International application number:
PCT/EP2005/013382

(22) Date of filing: **10.11.2005**

(87) International publication number:
WO 2007/054124 (18.05.2007 Gazette 2007/20)

(54) **LUBRICATION SYSTEM AND INTERNAL COMBUSTION ENGINE COMPRISING SUCH A SYSTEM**
SCHMIERSYSTEM UND SOLCH EIN SYSTEM UMFASSENDE VERBRENNUNGSMOTOR
SYSTEME DE LUBRIFICATION ET MOTEUR A COMBUSTION INTERNE COMPORTANT UN TEL
SYSTEME SYSTEM

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR**

(43) Date of publication of application:
30.07.2008 Bulletin 2008/31

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(56) References cited:
EP-A- 1 362 993 US-A- 5 483 928

- **PATENT ABSTRACTS OF JAPAN** vol. 010, no. 176 (M-491), 20 June 1986 (1986-06-20) & JP 61 025906 A (FUJI HEAVY IND LTD), 5 February 1986 (1986-02-05)
- **PATENT ABSTRACTS OF JAPAN** vol. 007, no. 250 (M-254), 8 November 1983 (1983-11-08) & JP 58 135312 A (NISSAN JIDOSHA KK), 11 August 1983 (1983-08-11)
- **PATENT ABSTRACTS OF JAPAN** vol. 014, no. 056 (M-0929), 31 January 1990 (1990-01-31) & JP 01 280610 A (MAZDA MOTOR CORP), 10 November 1989 (1989-11-10)

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] This invention concerns a lubrication system for an internal combustion engine. It also concerns an internal combustion engine including at least such a system.

BACKGROUND OF THE INVENTION

[0002] It is known to use oil to lubricate moving parts of an internal combustion engine, e.g. to feed the interface between a crankshaft and one or several bearings. To this purpose, one creates an hydrostatic bearing with a film of which minimizes friction. It is also known e.g. from US-A 5,220,891 and EP1 362 993, to use fraction of a quantity of oil, provided by a pump in order to lubricate the moving parts of an engine, in order to feed some piston cooling jets. An oil cooler is provided on the main line of the lubricating system, downstream of the pump, which implies that the totality of oil delivered to the engine is cooled down, irrespectively of its future use. For at least a part of the oil, this cooling is not necessary, which means that a part of the power used to run the oil cooler is wasted. Such a cooling can even be an inconvenient for the part of oil intended to form a film, at an interface between moving parts.

SUMMARY OF THE INVENTION

[0003] The invention aims at providing a lubrication system which is adapted to feed oil to a crankshaft and to at least one piston cooling jet, this system being more efficient to cool oil and needing less power than the ones of the prior art, which means that the overall fuel consumption of an engine equipped with such a system can be lower than the one of engines equipped with systems of the prior art.

[0004] To this purpose, the invention concerns a lubrication system for an internal combustion engine, this system comprising a pump feeding a main line, providing oil to at least a support interface for a crankshaft of the engine, and a auxiliary line dedicated to supplying oil to at least one piston cooling jet, characterized in that an oil cooler is mounted on this auxiliary line.

[0005] Thanks to the invention, the oil cooler is adapted to lower temperature of the part of the oil which is actually provided to the piston cooling jets. Cooling of the pistons is very efficient since the temperature of oil sprayed by the jets onto the piston is relatively low. This increases the lifetime of the pistons. On the other hand, oil provided to the interface between the crankshaft and its bearings can be at a relatively high temperature, which is advantageous since oil viscosity decreases with temperature. In other words, friction at the interface between the crankshaft and the bearing(s) is lower than with relatively cold oil, so that less power is needed to drive the crankshaft. However, since an oil cooler is provided in the circuit, a

part of oil redirected towards the sump is cooled. Therefore there is no risk that oil temperature in the sump and at the interface exceeds a pre-set value.

[0006] According to further aspects of the invention, the lubrication system might incorporate one or several of the following features:

- The oil cooler is a liquid coolant/oil heat exchanger.
- The oil cooler is an air/oil heat exchanger.
- The system comprises several piston cooling jets, whereas the oil cooler is mounted on a part of the auxiliary line which feeds all these piston cooling jets.

[0007] The invention also concerns an internal combustion engine comprising at least a crankshaft and at least a piston cooling jet, this engine including also at least a lubrication system as mentioned here-above.

BRIEF DESCRIPTION OF THE DRAWING

[0008] The invention will be better understood on the basis of the following description, which is given in correspondence with the annexed figure and as an illustrative example, without restricting the object of the invention. The annexed figure, is a scheme of a lubrication system according to the invention.

DETAILED DESCRIPTION OF SOME EMBODIMENTS

[0009] The lubrication system represented on figure 1 is adapted to be mounted onto an internal combustion engine 1 of a vehicle, e.g. a truck. Engine 1 comprises a crankshaft 11 and several cylinders 12, only two cylinders being represented on figure 1. A piston 13 is slideably movable within each cylinder 12, between a top dead centre position and a bottom dead centre position represented on figure 1. A piston cooling jet 15 is provided for each cylinder 12 and is adapted to direct a flow of oil towards its piston 13, in particular when it is near its bottom dead centre position, as represented by arrows A₁.

[0010] Crankshaft 11 is supported by one or several bearings 16. Only one bearing 16 is represented on figure 1. Oil is to be fed to each interface I between a bearing 16 and crankshaft 11.

[0011] To this purpose, a lubrication system 2 includes a pump 21 adapted to suck oil from a sump or oil pan 22. Pump 21 feeds a main line 23 which extends up to each interface I. Main line 23 is divided into two parts, namely an upstream part, 231 and a downstream part 232. Upstream part 231 extends from pump 21 to a point P where an auxiliary line 24 starts. Downstream part 232 extends from point P to the or each interface I.

[0012] Auxiliary line 24 takes off, at point P, a part of the flow of oil fed by pump 21 to interface I. Auxiliary line 24 feeds all pistons cooling jets 15 and includes a common duct 241 which feeds several branches 242, each branch 242 being dedicated to one jet 15.

[0013] Oil provided to crankshaft 11 or to piston cooling

jets 15 is directed, after use, to sump parts 221 and 222. These parts are connected to the main sump 22.

[0014] An oil cooler 25 is mounted on common duct 241 between separation point P and first branch 242. Therefore, oil cooler 25 can lower the temperature of all the oil sent to the piston cooling jets 15, without influence on the temperature of the oil provided to interface I by main line 23.

[0015] Oil cooler 25 is a water/oil type heat exchanger which is fed by cold or warm water as shown by arrow A₂, warm or hot water being taken away, as shown by arrow A₃. Considering the temperature of the oil in line 25, the temperature of water within heat exchanger 25 is close to 100°C. In order to keep water in liquid state at this temperature, water is mixed with ethylene glycol or another anti-boiling agent.

[0016] Thanks to the location of heat exchanger 25 on auxiliary line 24, which is dedicated to feeding piston cooling jets 15, cooling of oil occurs only for the quantity of oil which is used as cooling medium for pistons 13, whereas oil provided to the interface I can be at a temperature higher than oil provided to jets 15.

[0017] As an example, one can consider an engine 1 mounted onto a truck where pump 21 delivers 120 l/mn of oil, oil entering pump 21 being at a temperature of 118°C. If one considers that two thirds of oil pumped by pump 21 are directed to crankshaft/bearing interface I, then 80 l/mn of oil are used to create a film of oil at this interface, at a temperature of 118 °C. The remaining 40 l/mn of oil go through heat exchanger 25 and their temperature is lowered from 118°C to about 96°C, which means that cooling of pistons 13 is very efficient. This increases pistons lifetime. As a comparison, if heat exchanger 25 were mounted onto the upstream part 231 of main line 23, oil coming out of this heat exchanger would be at a temperature of about 110°C, which means that its viscosity would be higher, so that friction at interface I would also be higher.

[0018] Thanks to the better efficiency of the oil film at the or each interface I, one can decrease the overall fuel consumption of engine 1 equipped with lubrication system 2 according to the invention since the overall friction is lowered by an amount of 0,2 to 0,8 kW. Moreover, the power needed to run heat exchanger 25 is fully used since all oil going through this exchanger has to be cooled.

[0019] According to alternative embodiments which are not represented, other types of liquid coolant oil coolers can be used with the invention, e.g. an oil/oil cooler. Air/oil coolers can also be used with the invention.

LIST OF REFERENCES

[0020]

1 engine

11 crankshaft

12 cylinder

13 piston

15 piston cooling jet

16 bearings

2 lubrication system

21 pump

22 sump

221 sump part

222 sump part

23 main line

231 upstream part

232 downstream part

24 auxiliary line

241 common duct

242 branch

25 oil cooler - heat exchanger

A₁ arrows

A₂ arrow

A₃ arrow

I interface between 11 and 16

P separation point

Claims

1. A lubrication system (2) for an internal combustion engine (1), said system comprising a pump (21) feeding a main line (23), providing oil to at least a support interface (I) for a crankshaft (11) of the engine, and an auxiliary line (24) dedicated to supplying oil to at least one piston cooling jet (15), **characterized in that** an oil cooler (25) is mounted on said auxiliary line.
2. A lubrication system according to claim 1 **characterized in that** said oil cooler is a liquid coolant/oil heat exchanger (25).
3. A lubricating system according to claim 1 **characterized in that** said cooler is an air/oil heat exchanger.
4. A lubricating system according to one of the previous claims **characterized in that** it comprises several piston cooling jets (15) and **in that** said oil cooler (25) is mounted on a part (241) of said auxiliary line which feeds all piston cooling jets.
5. An internal combustion engine comprising at least a

crankshaft (11) and at least a piston cooling jet (15) **characterized in that** it includes at least a lubrication system (2) according to one of the previous claims.

Patentansprüche

1. Schmiersystem (2) für eine Verbrennungskraftmaschine (1), wobei das System eine Pumpe (21) umfasst, die eine Hauptleitung (23), die wenigstens eine Lagerschnittstelle (I) für eine Kurbelwelle (11) des Motors mit Öl versorgt, und eine Hilfsleitung (24) speist, die für eine Zufuhr von Öl zu wenigstens einem Kolbenkühlstrahl (15) bestimmt ist, **dadurch gekennzeichnet, dass** an der Hilfsleitung ein Ölkühler (25) angebracht ist. 10
2. Schmiersystem nach Anspruch 1, **dadurch gekennzeichnet, dass** der Ölkühler ein Flüssigkühlmittel/Öl-Wärmetauscher (25) ist. 20
3. Schmiersystem nach Anspruch 1, **dadurch gekennzeichnet, dass** der Kühler ein Luft/Öl-Wärmetauscher ist. 25
4. Schmiersystem nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es mehrere Kolbenkühlstrahlen (15) umfasst und dass der Ölkühler (25) an einem Teil (241) der Hilfsleitung angebracht ist, der alle Kolbenkühlstrahlen speist. 30
5. Verbrennungsmotor mit wenigstens einer Kurbelwelle (11) und wenigstens einem Kolbenkühlstrahl (15), **dadurch gekennzeichnet, dass** er wenigstens ein Schmiersystem (2) nach einem der vorhergehenden Ansprüche umfasst. 35

Revendications

1. Un système de lubrification (2) pour un moteur à combustion interne (1), ledit système comprenant une pompe (21) qui alimente une ligne principale (23), fournissant de l'huile à au moins une interface de support (I) pour un vilebrequin (11) du moteur, et une ligne auxiliaire (24) dédiée à la fourniture d'huile à au moins un gicleur de refroidissement de piston (15), **caractérisé en ce qu'un** refroidisseur d'huile (25) est monté sur ladite ligne auxiliaire. 40
2. Un système de lubrification selon la revendication 1 **caractérisé en ce que** ledit refroidisseur d'huile est un échangeur de chaleur liquide refroidissant / huile (25). 45
3. Un système de lubrification selon la revendication 1 **caractérisé en ce que** ledit refroidisseur d'huile est 50

un échangeur de chaleur air / huile.

4. Un système de lubrification selon l'une des revendications précédentes, **caractérisé en ce qu'il** comprend plusieurs gicleurs de refroidissement de piston (15) et **en ce que** ledit refroidisseur d'huile (25) est monté sur une partie (241) de ladite ligne auxiliaire qui alimente tous les gicleurs de refroidissement de piston. 55
5. Un moteur à combustion interne comprenant au moins un vilebrequin (11) et au moins un gicleur de refroidissement de piston (15) **caractérisé en ce qu'il** comporte au moins un système de lubrification (2) selon l'une des revendications précédentes.

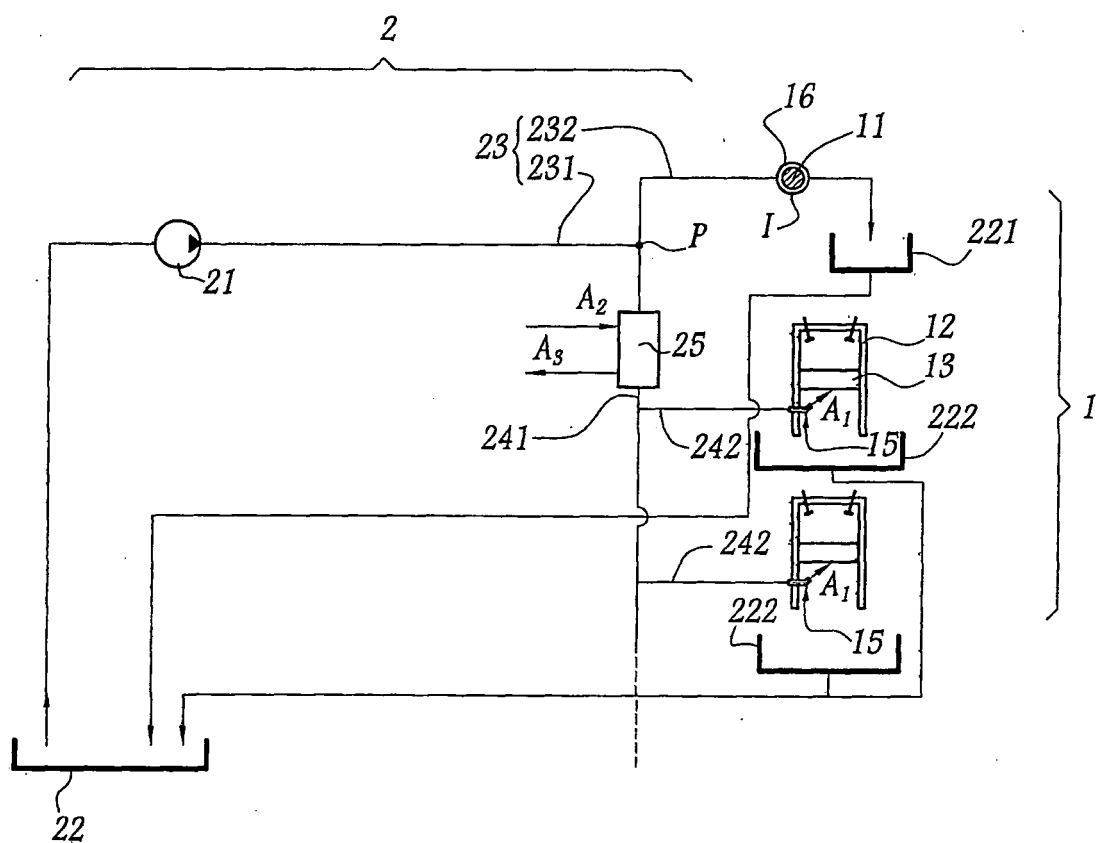


Fig. 1

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5220891 A [0002]
- EP 1362993 A [0002]