



- (51) International Patent Classification:
F02M 57/04 (2006.01) *F02M 21/02* (2006.01)
F02M 69/04 (2006.01)
- (21) International Application Number:
PCT/FI2013/051129
- (22) International Filing Date:
3 December 2013 (03.12.2013)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
20135158 22 February 2013 (22.02.2013) FI
- (71) Applicant: WÄRTSILÄ FINLAND OY [FI/FI]; Tarhaajantie 2, FI-65380 Vaasa (FI).
- (72) Inventor: HYVÖNEN, Jari; Himisbackvägen 18, FI-65450 Solf (FI).
- (74) Agent: BERGGREN OY AB; P.O.Box 16, (Antinkatu 3 C), FI-00100 Helsinki (FI).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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(54) Title: FUEL FEEDING ARRANGEMENT

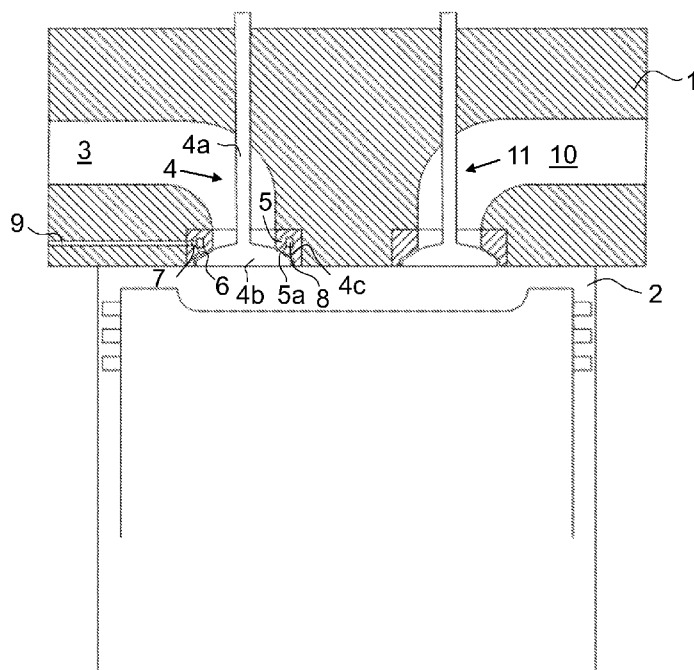


FIG. 1

(57) Abstract: The fuel feeding arrangement for introducing gaseous fuel into a cylinder (2) of a piston engine is used in engines that are provided with a cylinder head (1) for each cylinder (2) of the engine, and each cylinder head (1) comprises an intake port (3), at least one intake valve (4) for opening and closing fluid communication between the intake port (3) and the cylinder (2), a valve seat (5) cooperating with the valve head (4b) of the intake valve (4), and a fuel feeding duct (9). The valve seat (5) is provided with at least one fuel outlet (6) for introducing gaseous fuel into the cylinder (2), and the fuel outlet (6) is in fluid communication with the fuel feeding duct (9) of the cylinder head (1).

WO 2014/128342 A1



Published:

— *with international search report (Art. 21(3))*

Fuel feeding arrangement

Technical field of the invention

The present invention relates to a fuel feeding arrangement for feeding gaseous fuel into a cylinder of a piston engine, as defined in the preamble of claim 1.

Background of the invention

In piston engines, which are operated on gaseous fuel, such as natural gas, the fuel is usually introduced into the intake duct. A separate gas admission valve is needed for each cylinder of the engine for regulating the amount of the gaseous fuel that is supplied into the intake duct. For practical reasons, the gas admission valve is often located at a relatively long distance from the intake valves of the cylinders, which can cause that fuel is trapped in the intake duct when the intake valves are closed. Also the mixing of the fuel and intake air can be insufficient when separate gas admission valves are used.

Summary of the invention

The object of the present invention is to provide an improved fuel feeding arrangement for introducing gaseous fuel into a cylinder of a piston engine. The engine is provided with a cylinder head for each cylinder of the engine, and each cylinder head comprises an intake port, at least one intake valve for opening and closing fluid communication between the intake port and the cylinder, a valve seat cooperating with the valve head of the intake valve, and a fuel feeding duct. The characterizing features of the arrangement according to the invention are given in the characterizing part of claim 1.

According to the invention, the valve seat is provided with at least one fuel outlet for introducing gaseous fuel into the cylinder, the fuel outlet being in fluid communication with the fuel feeding duct of the cylinder head.

When gaseous fuel is introduced into the cylinders of the engine via fuel outlets that are arranged in valve seats, the fuel can be introduced close to the intake valves. The high flow velocity of the intake air through the gap between

the valve seat and the intake valve lowers the static pressure in the gap, and lower pressure is needed for the gas supply.

- According to an embodiment of the invention, the fuel outlet is arranged on the inner perimeter of the valve seat. When the fuel outlets are on the inner perimeter of the valve seat, the intake valves can be used for initiating and terminating fuel feeding into the cylinder, and no separate gas admission valve is needed. According to another embodiment of the invention, the fuel outlet is arranged in an area, which is covered by the valve head of the intake valve when the intake valve is closed. The intake valve thus blocks the fuel outlets when being closed, and fuel flow into the intake port is prevented. The fuel feeding starts simultaneously with the intake valve opening, and the valve opening duration is thus utilized maximally. This is beneficial especially when short intake valve opening duration is used. Also, no gas is trapped in the intake port.
- 15 According to an embodiment of the invention, the valve seat is provided with a plurality of fuel outlets. Preferably, the fuel outlets are distributed evenly around the valve seat. With a plurality of fuel outlets, a uniform gas flow into the cylinder can be achieved. Mixing of the fuel and the intake air is more effective than in engines with separate gas admission valves.
- 20 According to another embodiment of the invention, the fuel outlets are inclined towards the cylinder. According to another embodiment of the invention, the fuel outlets are inclined towards the tangent of the valve seat. By inclining the fuel outlets towards the cylinder, the flow can be enhanced. Inclination towards the tangent creates swirl, which enhances mixing.
- 25 According to an embodiment of the invention, the valve seat is a separate insert. The valve seat insert can comprise an annular channel, which is arranged inside the valve seat insert and to which the fuel outlets and the fuel feeding duct are connected. The fuel outlets can be connected to the fuel feeding duct also by an annular channel, which is arranged between the valve seat insert
- 30 and the cylinder head.

Brief description of the drawings

Embodiments of the invention are described below in more detail with reference to the accompanying drawings, in which

Fig. 1 shows a cross-sectional view of a cylinder head of a piston engine according to an embodiment of the invention, and

Fig. 2 shows a cross-sectional view of a cylinder head according to another embodiment of the invention.

Description of embodiments of the invention

10 In figure 1 is shown as a simplified illustration a cross-sectional view of part of a cylinder head 1 of a piston engine. The engine is a large internal combustion engine, such as a main or an auxiliary engine of a ship or an engine that is used at a power plant for producing electricity. The engine is operated on gaseous fuel, such as natural gas. The engine can comprise spark plugs for igniting the gaseous fuel, or liquid fuel can be used as pilot fuel, which ignites the

15 gaseous fuel. The engine comprises a plurality of cylinders 2. Each cylinder 2 of the engine is provided with an own cylinder head 2. The cylinder head 1 comprises an intake port 3, through which intake air is introduced into the cylinder 2, and an exhaust port 10 for conducting exhaust gases out of the cylinder 2. The cylinder head 1 also comprises at least one intake valve 4, which is used for opening and closing fluid communication between the intake port 3 and the cylinder 2, and at least one exhaust valve 11 for opening and closing fluid communication between the exhaust port 10 and the cylinder 2. The intake valve 4 comprises a valve stem 4a and a valve head 4b. The cylinder

20 head 1 is further provided with a valve seat 5. In the embodiment of the figure 1, the valve seat 5 is a separate part that is attached to the cylinder head 1. The valve seat 5 is arranged in the lower part of the cylinder head 1 and cooperates with the valve head 4b of the intake valve 4. The inner perimeter of the valve seat 5 is provided with a chamfered section 5a. The valve head 4b of the intake valve 4 is provided with a similar surface 4c. When the intake valve 4 is closed, the chamfered surface 4c of the intake valve 4 rests against the chamfered section 5a of the valve seat 5 and the intake valve 4 is tightly closed.

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The cylinder head 1 also comprises a fuel feeding duct 9, through which gaseous fuel can be fed into the cylinder 2. For feeding the fuel into the cylinder 2, the valve seat 5 is provided with fuel outlets 6, which are in fluid communication with the fuel feeding duct 9 of the cylinder head 1. In the embodiment of figure 1, the valve seat 5 comprises a plurality of fuel outlets 6. The fuel outlets 6 are distributed evenly around the valve seat 5. The valve seat 5 also comprises an annular channel 8, to which the fuel outlets 6 are connected. A fuel inlet 7 connects the annular channel 8 to the fuel feeding duct 9 of the cylinder head 1. In the embodiment of figure 1, the fuel outlets 6 are inclined towards the cylinder 2. The fuel flow is thus pointed towards the combustion chamber. The fuel outlets 6 are also inclined towards the tangent of the valve seat 5. By the inclination towards the tangent, a swirling movement is induced, which facilitates mixing of the fuel and the intake air. The fuel outlets 6 are arranged on the inner perimeter of the valve seat 5. The fluid communication between the fuel outlets 6 and the cylinder 2 is thus closed when the intake valve 4 is closed. In the embodiment of figure 1, the fuel outlets 6 are in the area that is covered by the valve head 4b of the intake valve 4 when the intake valve 4 is closed, i.e. in the chamfered section 5a of the valve seat 5. The fuel is thus prevented from flowing into the intake port 3 when the intake valve 4 is closed. The intake valve 4 thus regulates the supply of the gaseous fuel and no separate gas admission valve is needed.

The embodiment of figure 2 differs from the embodiment of figure 1 in that the annular channel 8, through which the fuel is supplied to the fuel outlets 6 of the valve seat 5, is not arranged inside the valve seat insert 5. Instead, the annular channel 8 is between the cylinder head 1 and the valve seat insert 5. In the embodiment of figure 2, the cylinder head 1 is provided with a groove, which forms the annular channel 8, but the groove could also be arranged on the outer perimeter or on the upper surface of the valve seat insert 5. The annular channel 8 could also be located above the valve seat insert 5. In the embodiment of figure 2, the annular channel 8 is connected directly to the fuel feeding duct 9.

It will be appreciated by a person skilled in the art that the invention is not limited to the embodiments described above, but may vary within the scope of the appended claims.

Claims

1. A fuel feeding arrangement for introducing gaseous fuel into a cylinder (2) of a piston engine, which engine is provided with a cylinder head (1) for each cylinder (2) of the engine, and each cylinder head (1) comprises
 - 5 - an intake port (3),
 - at least one intake valve (4) for opening and closing fluid communication between the intake port (3) and the cylinder (2),
 - a valve seat (5) cooperating with the valve head (4b) of the intake valve (4), and
 - 10 - a fuel feeding duct (9),**characterized** in that the valve seat (5) is provided with a plurality of fuel outlets (6) for introducing gaseous fuel into the cylinder (2), the fuel outlets (6) being in fluid communication with the fuel feeding duct (9) of the cylinder head (1).
- 15 2. An arrangement according to claim 1, **characterized** in that the fuel outlets (6) are arranged on the inner perimeter of the valve seat (5).
3. An arrangement according to claim 2, **characterized** in that the fuel outlets (6) are arranged in the area, which is covered by the valve head (4b) of the intake valve (4) when the intake valve (4) is closed.
- 20 4. An arrangement according to any of the preceding claims, **characterized** in that the fuel outlets (6) are distributed evenly around the valve seat (5).
5. An arrangement according to any of the preceding claims, **characterized** in that the fuel outlets (6) are inclined towards the cylinder (2).
6. An arrangement according to any of the preceding claims, **characterized**
25 in that the fuel outlets (6) are inclined towards the tangent of the valve seat (5).
7. An arrangement according to any of the preceding claims, **characterized** in that the valve seat (5) is a separate insert.
8. An arrangement according to claim 7, **characterized** in that the valve seat insert (5) comprises an annular channel (8), which is arranged inside the
30 valve seat insert (5) and to which the fuel outlets (6) and the fuel feeding duct (9) are connected.

9. An arrangement according to claim 7, **characterized** in that an annular channel (8) is arranged between the cylinder head (1) and the valve seat insert (5) for establishing fluid communication between the fuel feeding duct (9) and the fuel outlets (6).

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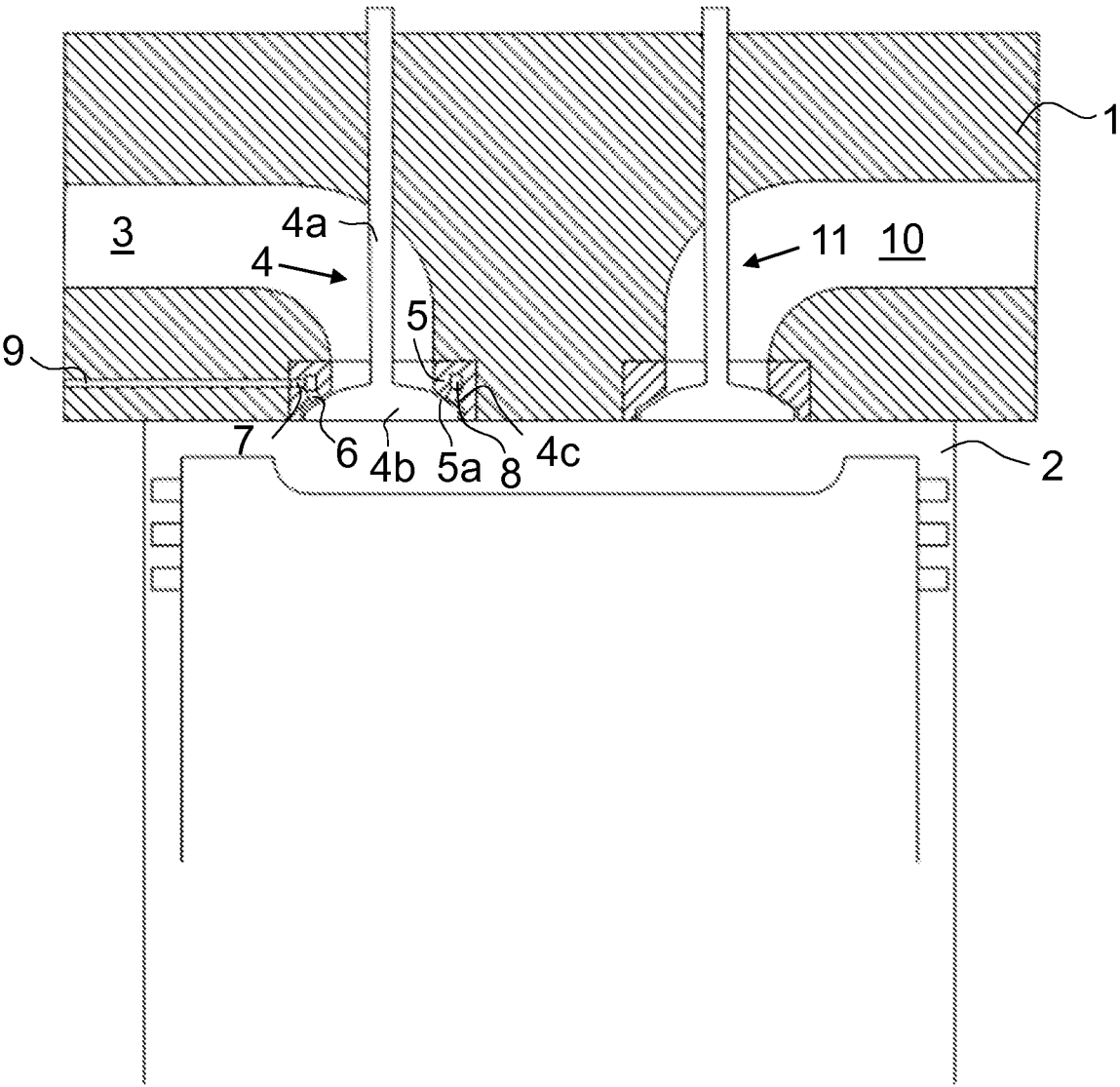


FIG. 1

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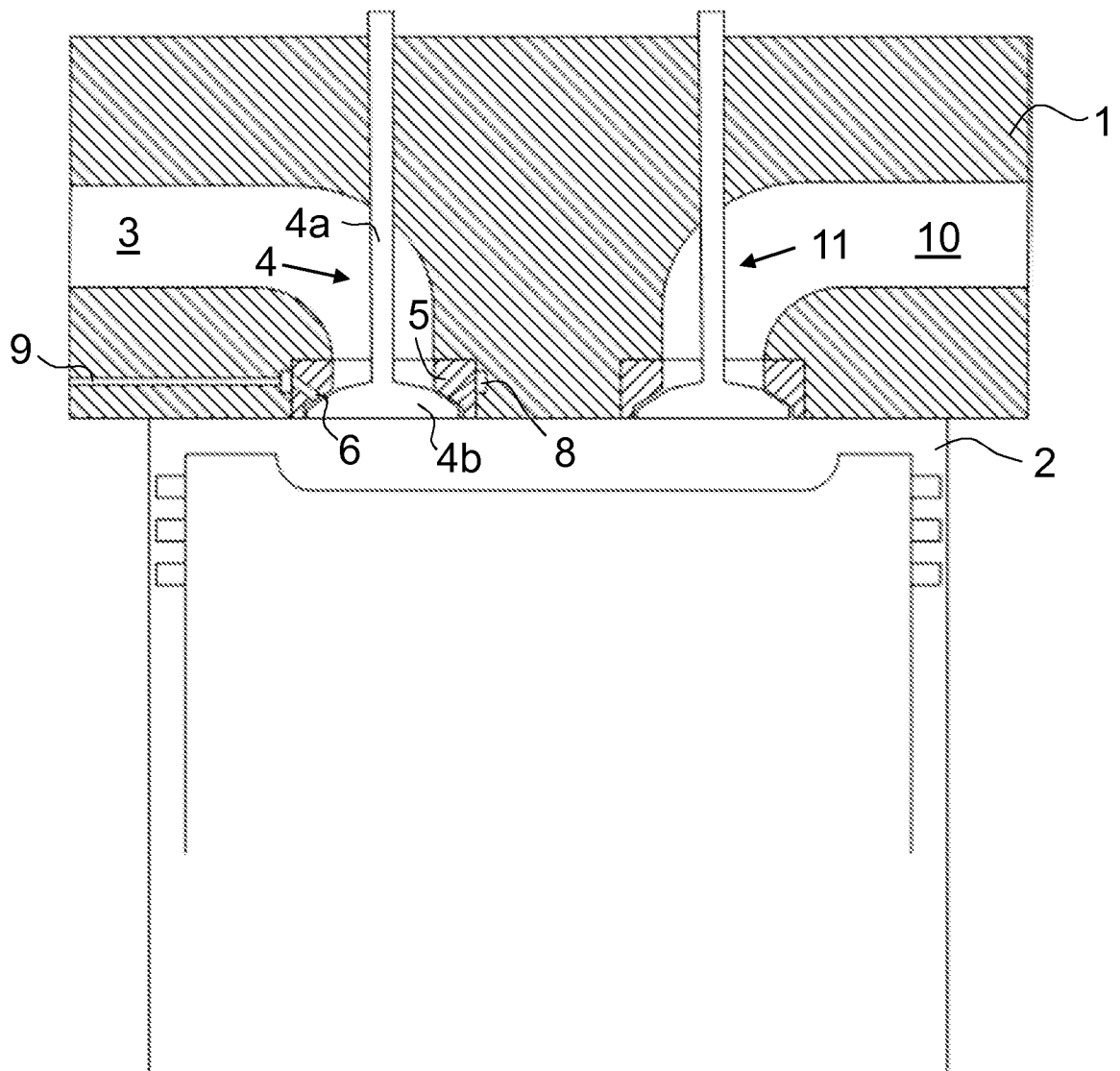


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2013/051129

A. CLASSIFICATION OF SUBJECT MATTER

INV. F02M57/04 F02M69/04 F02M21/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F02M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2005 273600 A (NISSAN DIESEL MOTOR CO) 6 October 2005 (2005-10-06) figures 1-4	1-9
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X	----- JP 2008 232062 A (IHI CORP; NIIGATA POWER SYSTEMS CO LTD) 2 October 2008 (2008-10-02) figures 1-9	1



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

19 February 2014

Date of mailing of the international search report

26/02/2014

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Morales Gonzalez, M

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/FI2013/051129

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