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(54) A cylinder liner for an internal-combustion engine and an engine provided with such a liner

(57) An internal-combustion engine (5) comprising an engine block (6) provided with at least one cylinder (7), a liner (8) fitted in the cylinder (7) and a cylinder head (12) mounted on the engine block (6); the liner (8) comprises a cylindrical side wall (9) and an upper collar (20) accommodated in a seating (17) of the engine block surrounding the cylinder (7) and provided with an elastically deformable portion (16) projecting upwards, in the undeformed condition, beyond an upper surface (14) of the engine block (6) so that when the cylinder head (12) is mounted on the engine block (6) this portion (16) is deformed and co-operates elastically in a fluidtight manner with a lower surface (13) of said cylinder head.

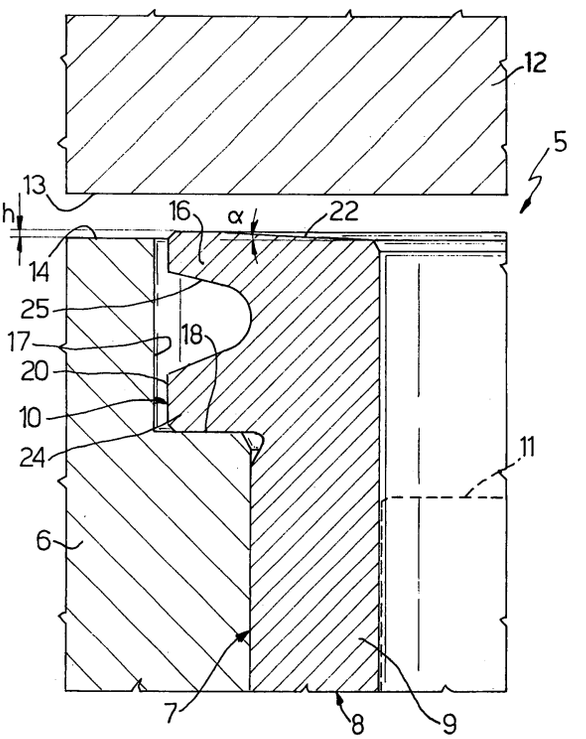

Fig. 1

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Description

[0001] The present invention relates to a cylinder liner for an internal-combustion engine and an engine comprising such a liner.

[0002] Internal-combustion engines generally comprise an engine block cast from a suitable metal alloy, generally cast iron or an aluminium alloy, and defining a plurality of cylinders, and a cylinder head which is mounted fluid-tightly on the engine block with the interposition of a gasket.

[0003] The cylinders are lined internally with respective sleeves or liners which are made from a material (generally special cast iron) designed to resist the mechanical, thermal and chemical stresses to which they are subjected by the gases resulting from combustion; the liners have to undergo high precision machining so as to guide properly the reciprocating motion of the associated piston.

[0004] Furthermore, the liners are normally provided with an upper outer collar which is accommodated in an annular recess of the engine block surrounding the respective cylinder.

[0005] With a view to achieving the required gas-tightness, the cylinder head has a lower surface which is adapted to be connected with a corresponding upper surface of the engine block with the interposition of a flat gasket. This gasket extends substantially over the entire interface surface between the engine block and the cylinder head, and it is provided with a series of openings corresponding to the cylinders and to the various ducts for the circulation of coolant and lubricant. Advantageously, with a view to ensuring fluidtightness in the annular zone surrounding the cylinders in the presence of gas pressures in the order of 180 bar, the known gaskets have elastic annular zones, of increased thickness, which co-operate with the collars of the cylinder liners.

[0006] These gaskets are rather expensive and they contribute in a not inconsiderable manner to the overall production costs of the engine and to the possible costs of subsequent servicing operations which involve their replacement.

[0007] Another problem associated with the use of a gasket is the fact that the tightening of the screws used for clamping the cylinder head on the engine block results in non-uniform distribution of the contact pressures, which is higher in the vicinity of the screws and lower in the intermediate zones.

[0008] The control of the effective contact pressures on the gasket and, therefore, the efficiency of the seal, is critical and imposes very restricted production tolerances which are difficult and expensive to maintain.

[0009] It is the object of the present invention to devise an internal-combustion engine which makes it possible to eliminate the gasket between the engine block and the cylinder head, as well as the problems associated therewith.

[0010] According to the present invention, this object is achieved by an internal-combustion engine comprising an engine block provided with at least one cylinder, a liner fitted in said cylinder, a cylinder head mounted on said engine block and sealing means interposed between said engine block and said cylinder head so as to provide a gas-tight connection around said cylinder, characterised in that said sealing means comprise an annular elastic element forming part of said liner and adapted to co-operate fluidtightly with said cylinder head.

[0011] According to a preferred embodiment of the invention, the cylinder liner comprises a cylindrical side wall and an upper collar forming a single body with the side wall and accommodated in a seating of the engine block coaxial to the cylinder and integrally defining said elastic element.

[0012] With a view to a better understanding of the invention a preferred form of embodiment will be described, by way of example below, with reference to the accompanying drawings, in which:

Figure 1 is a partial section of an internal-combustion engine with the cylinder head and the engine block separated from one another, and

Figure 2 is a section analogous to that in Figure 1, with the cylinder head mounted on the engine block.

[0013] Referring now to Figures 1 and 2, the reference numeral 5 generally denotes an internal-combustion engine comprising an engine block 6 provided with a plurality of cylinders 7, only one of which is partly illustrated. The engine 5 further comprises a cylinder head 12, partly illustrated, which is adapted to be fastened to the engine block 6 by means of screws (not shown); the cylinder head 12 defines the combustion chambers (not shown for simplicity) and accommodates in known manner the inlet and exhaust valves of the cylinders, which are also not shown. The cylinder head 12 is bounded at the bottom by a lower flat surface 13 adapted to be connected with a corresponding upper flat surface 14 of the engine block 6.

[0014] The cylinder 7 is lined internally with a liner 8 comprising a cylindrical side wall 9 and an outer annular collar 10 which is securely fastened to an upper end of the side wall 9. The collar 10 can be integral with the side wall 9, as shown in the drawings, or applied thereto.

[0015] The collar 10 is accommodated in an annular seating 17 of the engine block 6, which is coaxial to the cylinder 7 and which is defined by a recess in the upper surface 14 surrounding the cylinder 7, and it abuts against a shoulder 18 downwardly delimiting the seating 17.

[0016] The side wall 9 is machined internally with the maximum degree of precision, so as to guide with minimum wear the reciprocating motion of a corresponding piston 11 (indicated schematically in dashed line), and it is produced from a material (for example a special cast iron or stainless steel) designed to resist the mechanical

and thermal stresses and the chemical corrosion of the combustion gases.

[0017] According to the invention, the liner 8 is provided with an annular elastic element 16 adapted to be deformed elastically when the cylinder head 12 is installed on the engine block 6 and to co-operate fluidtightly with the lower surface 13 of the cylinder head 12 as a result of the elastic reaction caused by this deformation.

[0018] Preferably, the element 16 is formed by a deformable portion of the collar 10 and has an upper free surface 22 which can be force-fitted against the flat surface 13 of the cylinder head 12. Advantageously, the element 16 is defined by an annular groove 25 which is provided in a lateral surface 20 of the collar 10 and which separates it from a lower portion 24 of the substantially rigid collar 10 co-operating with the shoulder 18 of the engine block 6.

[0019] According to the preferred embodiment illustrated, the force-fit between the free surface 22 of the elastic element 16 and the surface 13 of the cylinder head is achieved in that the elastic element 16 projects upwards by an amount h with respect to the flat surface 14 of the engine block 6 when the cylinder head 12 is detached from the engine block 6 as in Figure 1, and the elastic element 16 is in an undeformed condition. In particular, the free surface 22 is formed with a slight countersinking α so as to exhibit, in section, a profile increasing from the inside (where it is substantially level with the upper surface 14 of the engine block 6) to the outside, where it projects with respect to the surface 14.

[0020] The free surface 22 is disposed level with the surface 14 of the engine block 6 following the elastic deformation caused by the fastening of the cylinder head 12 on the engine block 6, as indicated in Figure 2.

[0021] To achieve a gas-tight seal at the maximum pressures which can be attained inside the cylinders of modern diesel engines, advantageously the extent of the projection h with respect to the surface 14 of the engine block 6 may be of the order of magnitude of several hundredths of a millimetre, for example between 0.01 and 0.1 mm, and preferably between 0.03 and 0.065 mm. In turn, the countersinking α of the free surface 22 with respect to a plane perpendicular to the axis of the liner 8 may be between 1° and 3°and, preferably, equal to about 2°.

[0022] When the cylinder head 12 is being tightened on the engine block 6, the elastic element 16 bends and brings the free surface 22 level with the flat surface 14 of the engine block 6. In this way the elastic element 16 exerts an elastic force against the flat surface 13 of the cylinder head 12 so as to ensure a perfect gas-tight seal of the liner 8 of the cylinder 7, at the maximum pressure provided for the operation of the engine 5.

[0023] With a view to compensating for any production tolerances between the height of the seating 17 of the engine block 6 and that of the collar 10 of the liner 8, it is possible to provide between the collar 10 and the shoulder 18 of the seating 17 a compensating thickness which is known per se and is not indicated in the drawings.

[0024] It is evident from the foregoing that the combustion gas seal may be achieved, according to the present invention, without the use of a gasket between the engine block 6 and the cylinder head 12 of the engine 5. In this way the problems associated with the use of the above-mentioned conventional means are eliminated.

[0025] Optionally, to ensure a seal between the engine block 6 and the cylinder head 12 around the ducts for the coolant and the lubricating oil, which are less critical, it is possible to use an adhesive or simple sealing rings of the type known as O-rings.

[0026] It is evident that the engine described and, in particular, the liner 8 designed in accordance with the invention, can be subject to modifications and improvements without departing from the scope of the claims. For example, the collar 10 and the side wall 9 of the liner 8 can be produced as separate parts and assembled subsequently. The collar 10 and the surface 22 can be of any shape suitable for the purpose.

[0027] Finally, the invention can be applied to various types of internal-combustion engine, diesel or controlled ignition, including air-cooled engines and two-stroke engines.

Claims

1. An internal-combustion engine (5) comprising an engine block (6) provided with at least one cylinder (7), a liner (8) fitted in said cylinder (7), a cylinder head (12) mounted on said engine block (6) and sealing means (16) interposed between said engine block (6) and said cylinder head (12) so as to provide a gas-tight connection around said cylinder (7), **characterised in that** said sealing means comprise an annular elastic element (16) forming part of said liner (8) and adapted to co-operate fluidtightly with said cylinder head (12).

2. An engine according to claim 1, **characterised in that** the liner (8) comprises a cylindrical side wall (9) and a collar (10) extending outwardly from an upper end of the side wall (9) and accommodated in an annular seating (17) of the engine block (6), said annular elastic element being formed by at least one portion of said collar (10).

3. An engine according to claim 2, **characterised in that** said collar (10) has a peripheral annular groove which defines an elastically deformable upper portion of said collar forming said annular elastic element, and a lower portion arranged to abut against a lower shoulder of said seating.

4. An engine according to claim 2 or 3, **characterised in that** said elastic element (16) is bounded upwardly by a free surface which projects with respect to an upper surface of said engine block (6) when said elastic element (16) is not deformed and which is adapted to co-operate in a force-fit with said cylinder head following the mounting of said cylinder head (12) on said engine block.

5. An engine according to claim 4, **characterised in that** said free surface (22) has a countersinking (α) with a profile increasing from the inside towards the outside so as to project with respect to the upper surface (14) of said engine block (6) along an outer edge thereof.

6. An engine according to claim 5, **characterised in that** said countersinking (α) is between 1° and 3°.

7. An engine according to any one of the preceding claims, **characterised in that** said free surface (22) projects with respect to the upper surface (14) of said engine block by an amount of between 0.01 and 0.1 mm.

8. A liner (8) for a cylinder (7) of an internal-combustion engine (5) provided with a engine block (6) defining said cylinder (7) and with a cylinder head (12), **characterised by** comprising an annular elastic element (16) adapted to co-operate fluidtightly with said cylinder head (12) of said engine (5).

9. A liner according to claim 8, **characterised by** comprising a cylinder side wall (9) and a collar (10) extending externally from an upper end of the side wall (9), said annular elastic element (16) being formed by at least one portion of said collar (10).

10. A liner according to claim 9, **characterised in that** said collar (10) has a peripheral annular groove (25) which defines an elastically deformable upper portion of said collar (10), forming said annular elastic element (16), and a lower portion (24) adapted to be arranged in abutment against a lower shoulder of a seating (17) of said engine block (6).

11. A liner according to any one of claims 8 to 10, **characterised in that** said elastic element (16) is bounded upwardly by a free surface (22) adapted to co-operate in a force-fit with said cylinder head (12) following the mounting of said cylinder head (12) on said engine block (6).

12. A liner according to claim 11, **characterised in that** said free surface (22) has a countersinking (α) with a profile increasing from the inside towards the outside.

13. A liner according to claim 12, **characterised in that** said countersinking (α) is between 1° and 3°.

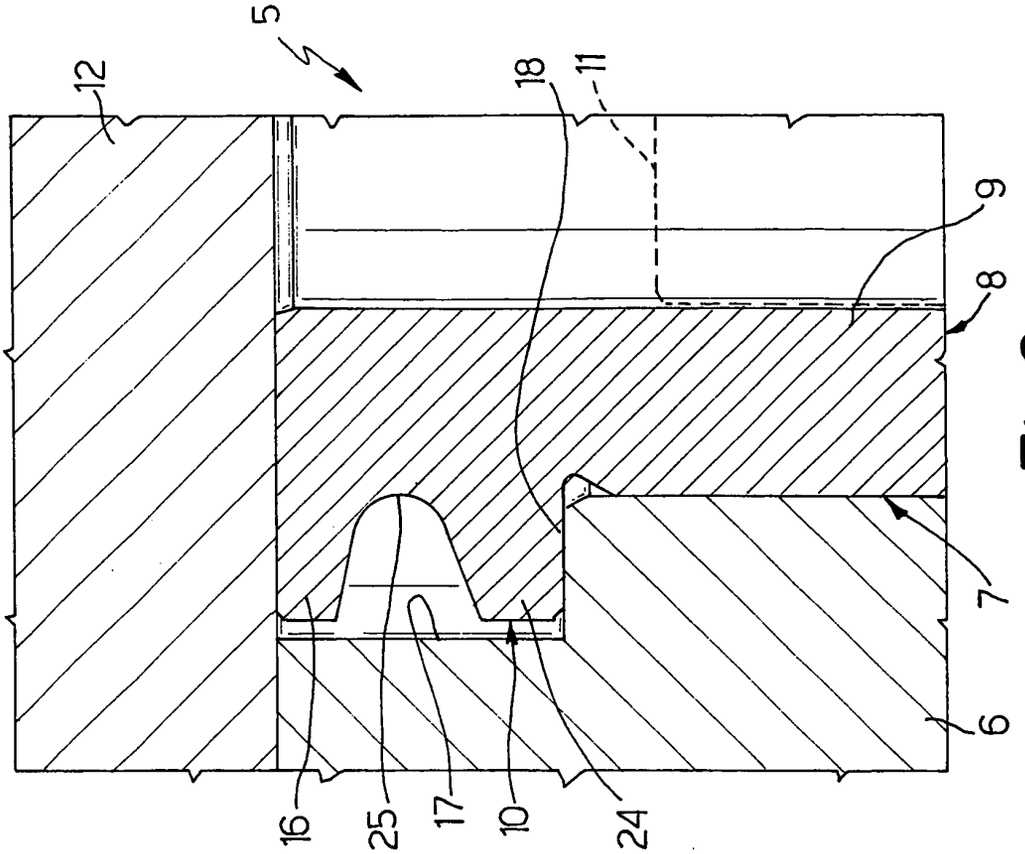
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Fig.2

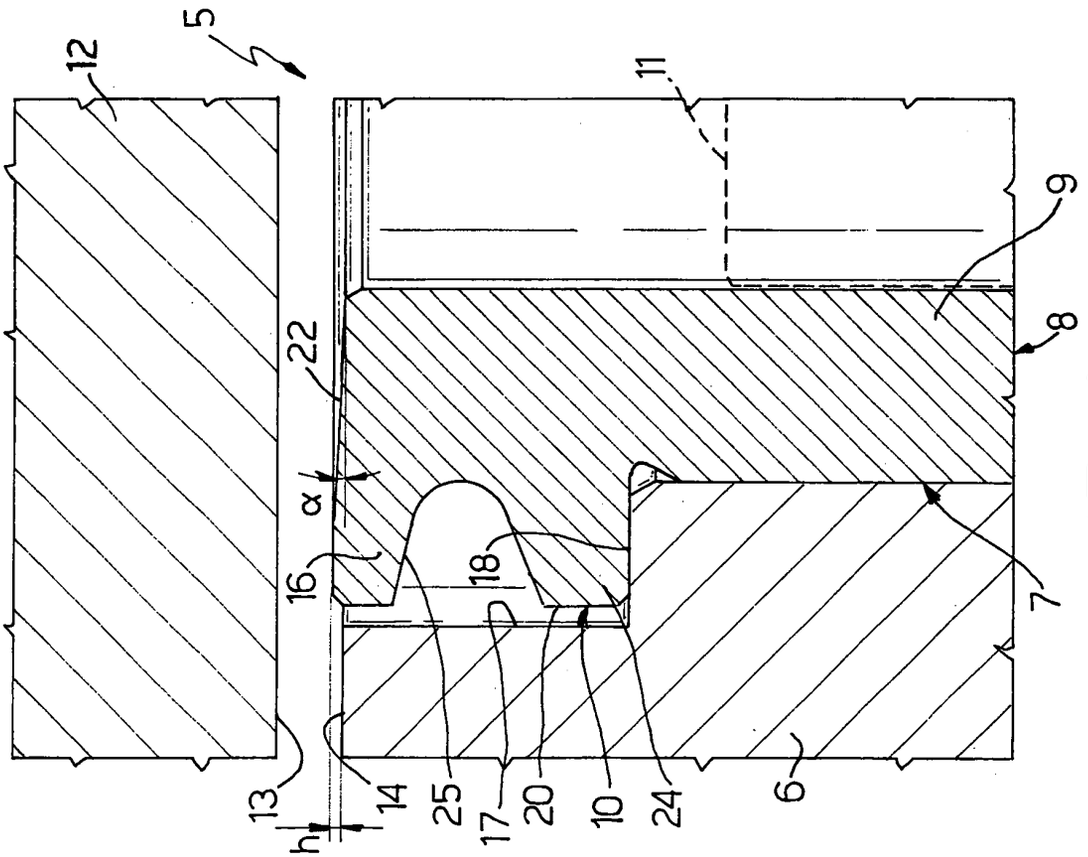
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Fig.1

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EUROPEAN SEARCH REPORT

Application Number
EP 03 01 7193

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	DE 35 30 411 A (KLOECKNER HUMBOLDT DEUTZ AG) 26 February 1987 (1987-02-26) * figures 1-3 * * abstract * * claims 1-7 *	1-3	F02F1/10 F02F1/16
X	DE 24 42 352 A (DAIMLER BENZ AG) 18 March 1976 (1976-03-18) * figure 1 * * claims 1-4 *	1-3,8,9	
A	DE 12 09 373 B (DAIMLER BENZ AG) 20 January 1966 (1966-01-20) * figure 1 * * claims 1-4 *	1,4-7, 12,13	
A	DE 24 42 738 A (DAIMLER BENZ AG) 18 March 1976 (1976-03-18) * figure 1 * * claims 1,2 *	1,4-7, 12,13	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) F02F F16J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25 August 2003	Wassenaar, G

CATEGORY OF CITED DOCUMENTS

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25-08-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3530411 A	26-02-1987	DE 3530411 A1	26-02-1987
DE 2442352 A	18-03-1976	DE 2442352 A1	18-03-1976
DE 1209373 B	20-01-1966	NONE	
DE 2442738 A	18-03-1976	DE 2442738 A1	18-03-1976

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