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INTERNAL COMBUSTION ENGINE WITH LIQUID-COOLED CYLINDER LINERS

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FIG. 1

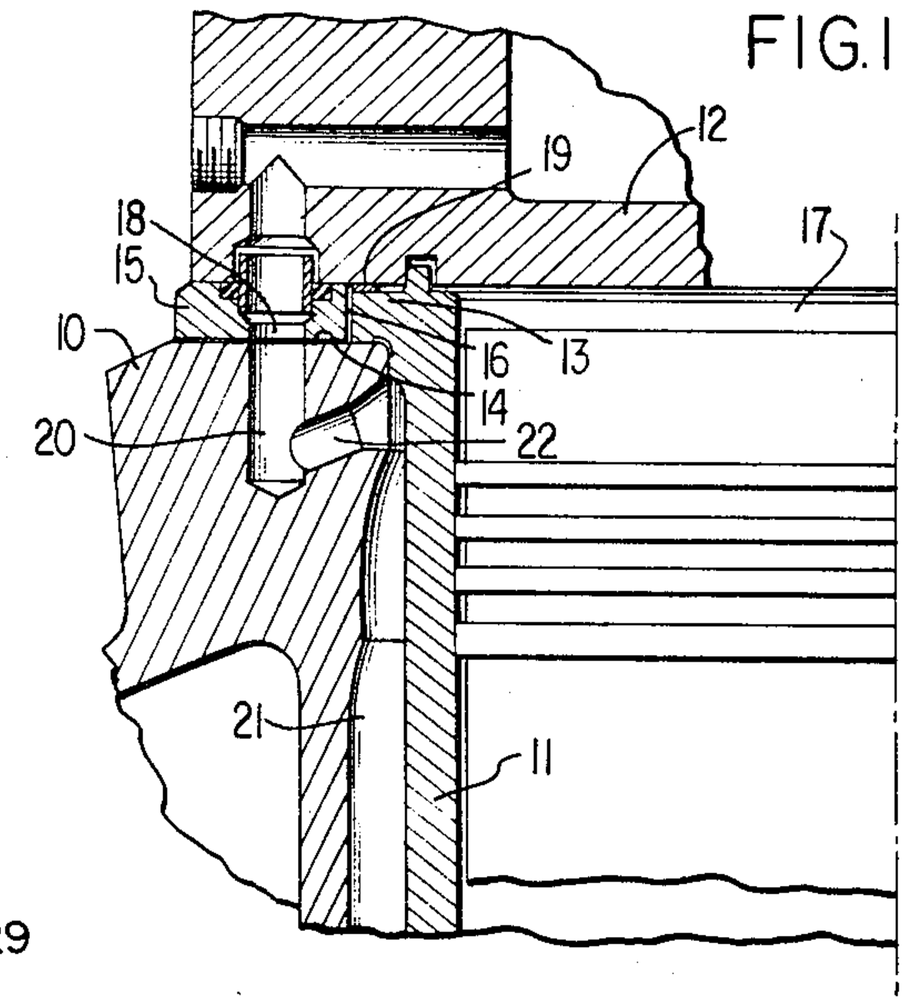
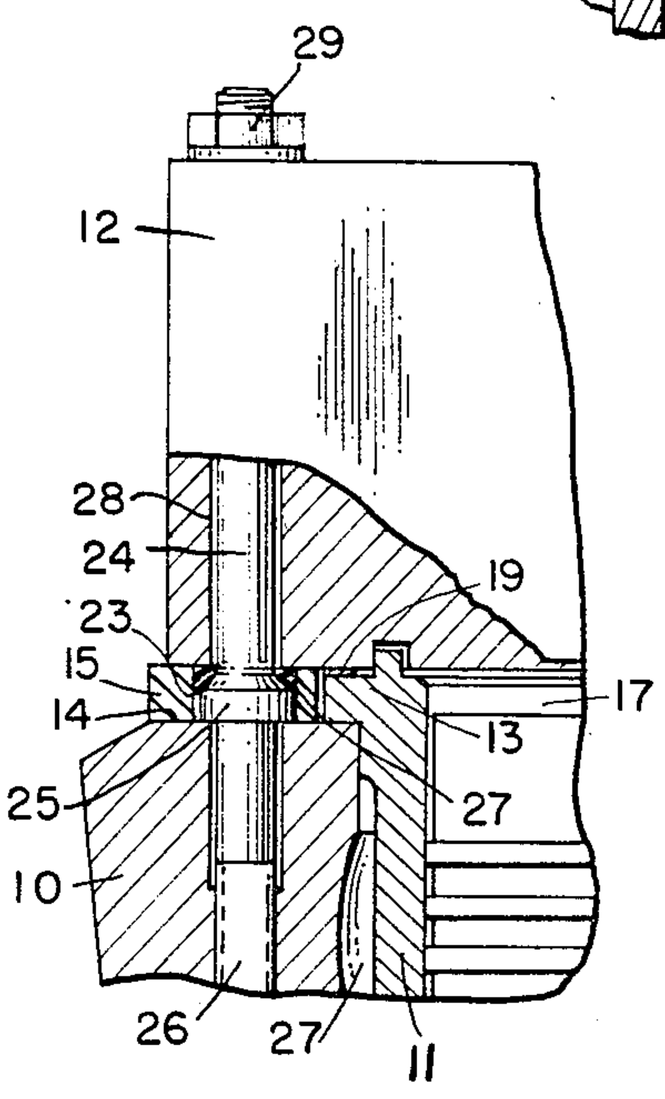


FIG. 2



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INTERNAL COMBUSTION ENGINE WITH LIQUID-COOLED CYLINDER LINERS

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9 Claims. (Cl. 123—41.84)

ABSTRACT OF THE DISCLOSURE

An internal combustion engine having liquid-cooled cylinder liners, whose ends facing the cylinder head are each provided with a radial collar for the securing at the crankcase, and in which the cylinder head is secured at the crankcase by means of cylinder head bolts. The radial collar engages the topmost flat surface of the crankcase. A rigid spacer plate is provided between the crankcase topmost flat surface and the cylinder head for absorbing substantially all of the forces exerted by the cylinder head bolts. An easily compressible sealing ring is provided between the radial collar and the cylinder head, which will not unduly stress the radial collar. The liquid cooling bores extend through the spacer plate and into the annular space between the crankcase and the liners closely adjacent to the respective radial collars.

Background of the invention

With internal combustion engines of the aforementioned type, it is known to provide the seat at the crankcase for the collar of the cylinder liner recessed with respect to the separating joint between the crankcase and the cylinder head. Disadvantageous notch loads and stresses are created thereby at the seat of the crankcase by the cylinder head securing means in that seals which project over the separating surface at the crankcase and which are supported at the liner collar, are compressed for increasing the sealing effect. As a result of the notch stresses, cracks form at the crankcase within the area of the seat for the cylinder liners so that the crankcase is destroyed or damaged.

It is known in connection with internal combustion engines for purposes of sealing the separating joint between the crankcase and the cylinder head that at least one of the two parts is provided in proximity of its outer edges, outside of the area of the cylinder head bolts and the sealing rings, with non-yielding spacer bars on which rests the cylinder head, comparable to a doubly supported beam, in such a manner that upon tightening of the cylinder head bolts a considerable bending of the cylinder head in the direction toward the sealing rings compressed thereby takes place. This known support and securing of the cylinder head, constructed in the manner of a bending bearer, could provide no suggestion for the present invention.

Summary of the invention

The aim underlying the present invention essentially consists in eliminating the notch stresses of the crankcase which occur in the manner described above in an internal combustion engine of the aforementioned type and to relieve the cylinder head from the disadvantageous static bending loads and stresses of the cylinder head securing means. For this purpose, the radial collar of each cylinder liner is placed in accordance with the present invention upon the crankcase and non-yielding spacer pieces are arranged within the area of the cylinder head bolts between the crankcase and the cylinder head. In one embodiment of the present invention, a spacer plate is provided between the crankcase and the cylinder head which is provided with apertures for the passages of the combustion spaces, cooling water spaces, oil lines and the like between the crankcase and the cylinder block.

Accordingly, it is an object of the present invention to provide an internal combustion engine having liquid-cooled cylinder liners which eliminates by extremely simple means, the aforementioned shortcomings and drawbacks encountered in the prior art constructions.

Another object of the present invention resides in a liquid-cooled internal combustion engine having cylinder liners cooled by a liquid in which notch stresses are avoided at the seat of the crankcase notwithstanding a completely satisfactory and tight securing of the cylinder head to the cylinder block.

A further object of the present invention resides in an internal combustion engine having liquid-cooled cylinder liners which assure greater life expectancy by the elimination of the danger of cracking of the crankcase.

Still another object of the present invention resides in a liquid-cooled internal combustion engine which not only achieves all of the aforementioned aims and objects by simple and operationally reliable means but which additionally improves the cooling of the cylinder liners in an effective manner.

Brief description of the drawing

These and further objects, features, and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, one embodiment in accordance with the present invention and wherein:

FIGURE 1 is a partial cross-sectional view through the crankcase of an internal combustion engine in accordance with the present invention; and

FIGURE 2 is a partial cross-sectional view through a different portion of the engine of FIGURE 1 showing the cylinder head bolts.

Detailed description of the drawing

Referring now to FIGURE 1 of the drawing, reference numeral **10** designates therein a crankcase of an internal combustion engine of conventional constructon and not shown in detail herein. A liquid-cooled cylinder liner **11** is inserted into the crankcase **10**. The cylinder liner **11** is provided at the end facing the cylinder head **12** with a radial collar **13**. The collar **13** is placed upon the separating surface **14** of the crankcase **10**. A spacer plate **15** is arranged between the crankcase **10** and the cylinder head **12**. The spacer plate **15** is provided with apertures **16** for the combustion spaces **17** and with further apertures **18** for the cooling liquid passage.

The cylinder head **12** is secured at the crankcase **10** in a conventional manner by means of cylinder head bolts (not shown) extending through the spacer plate **15**. A seal **19** is arranged between the collar **13** of the cylinder liner **11** and the cylinder head **12** by means of which the combustion space **17** is sealed in a gas-tight manner against the cylinder head **12** and the cylinder liner **11**.

The cross section of the crankcase **10** is devoid of any notches within the support or abutment area of the radial collar **13** so that the danger of crack formation within this area of the crankcase is avoided in a far-reaching manner.

With tightened cylinder head bolts, the cylinder head **12** is exposed statically essentially only to those loads and stresses which result from the compressing of the cylinder head seals **19**.

The apertures **18** of the spacer plate **15** for the passage

of the cooling liquid are in communication with axial bores **20** in the crankcase **10**. The cooling liquid flows through the annular space **21** between the crankcase **10** and the cylinder liner **11**; the annular space **21** is in communication by way of radial connecting bores **22** with the axial bores **20** of the crankcase.

Since the radial collar **13** of the cylinder liner is not mounted in the crankcase recessed with respect to the separating surface **14** but instead is placed or mounted upon this surface, the radial connecting bores **22** for the passage of the cooling liquid can be moved more closely to the end of the cylinder liner **11** near the cylinder head and therewith the cooling of the cylinder liner can be improved in an effective manner.

Generally, corresponding numerals are used in FIGURE 2 for corresponding elements shown in FIGURE 1. The spacer plate **15** is provided with passage bores **23** for the cylinder head bolts **24**. The bolts **24** are threaded into the crankcase with the threaded studs **26** thereof and are supported with a collar **25** upon the separating surface **14**. A gasket **27** is concentrically positioned about each bolt **24** between the respective collar **25** and the cylinder head **12**. The cylinder head **12** is provided with bores **28** through which the cylinder head bolts **24** extend. The tensioning of the bolts is accomplished by means of the nuts **29** threadably engaging the bolts **24**.

While I have shown and described only one embodiment in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible to numerous changes and modifications as known to a person skilled in the art, and I therefore do not wish to be limited to the details shown and described herein, but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

I claim:

1. An internal combustion engine comprising: a cylinder head; a crankcase having a flat surface facing said cylinder head; a plurality of pistons within said crankcase; cylinder liners surrounding said pistons, respectively, and spaced from said crankcase to form cooling liquid conducting spaces; cylinder bolt means securing said cylinder head to said crankcase; each of said cylinder liners being provided with radial collar means having one surface axially facing, parallel to and directly opposite from said crankcase surface; and essentially non-yielding spacer means arranged within the area of the cylinder bolt means engaging said crankcase surface and said cylinder head for directly and rigidly absorbing substantially all of the clamping force of said bolt means.

2. The internal combustion engine according to claim **1**, wherein said spacer means is constituted by a spacer plate being provided with aperture means for the cylinder bolt means and with passage means for the cooling liquid and the combustion spaces opposite the pistons.

3. The internal combustion engine according to claim **2**, wherein said crankcase includes approximately axial bore portions and connecting bore portions extending at an angle to said axial bore portions and terminating in the annular spaces formed between the cylinder liners and the crankcase, said spacer means being provided with aperture means in alignment with said axial bore portions, and said connecting bore means being located relatively close to the collar means.

4. The internal combustion engine according to claim **1**, wherein said crankcase includes approximately axial bore portions and connecting bore portions extending at an angle to said axial bore portions and terminating in the annular spaces formed between the cylinder liners and the crankcase, said spacer means being provided with aperture means in alignment with said axial bore portions, and said connecting bore means being located relatively close to the collar means.

5. The internal combustion engine according to claim **1**, wherein said surface of the crankcase directly engages said collar means, and is the exposed relatively plane topmost surface of the crankcase means.

6. The internal combustion engine according to claim **4**, wherein said surface of the crankcase directly engages said collar means, and is the exposed relatively plane topmost surface of the crankcase means.

7. The internal combustion engine according to claim **3**, wherein said surface of the crankcase directly engages said collar means, and is the exposed relatively plane topmost surface of the crankcase means.

8. The internal combustion engine according to claim **2**, wherein said radial collar means are disposed within respective ones of said passage means for the combustion spaces opposite the pistons; and including readily compressible annular sealing rings between said radial collar means and said cylinder head; said cylinder head and liners having interengaging annular tongue and groove means radially inwardly of respective ones of said sealing rings.

9. The internal combustion engine according to claim **3**, wherein said connecting bore means is axially spaced at its inner end from said crankcase surface a distance substantially corresponding to the thickness of said spacer means.

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