

[54] **INTERNAL COMBUSTION ENGINE WITH INTERMEDIATE PIPE INSERTED IN PASSAGE BETWEEN CYLINDER HEAD AND CRANKCASE**

[75] Inventor: **Ulrich Conrad**, Ludwigsburg, Germany
[73] Assignee: **Daimler-Benz Aktiengesellschaft**, Stuttgart-Unterturkheim, Germany

[22] Filed: **Sept. 1, 1972**

[21] Appl. No.: **285,646**

[30] **Foreign Application Priority Data**
Sept. 1, 1971 Germany..... P 21 43 734.3

[52] U.S. Cl..... **123/41.84**, 123/193 CH, 92/171
[51] Int. Cl..... **F02f 1/10**
[58] Field of Search..... 123/41.82, 41.84, 123/193 C, 193 H, 193 CH, 193 R; 92/171

[56] **References Cited**
UNITED STATES PATENTS

2,378,045 6/1945 Sorensen et al. 123/41.72 X
2,730,085 1/1956 Brill 123/41.82 X

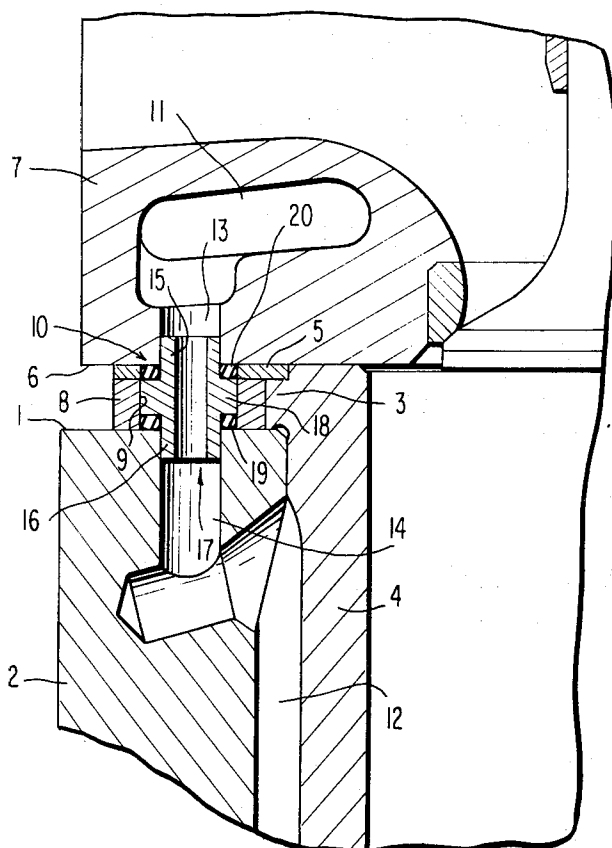
3,363,608 1/1968 Scherenberg et al. ... 123/193 CH X
3,410,256 11/1968 Herschmann 123/193 R X
3,436,085 4/1969 Polk 123/193 CH X
3,577,961 5/1961 Deutschmann 123/41.82 X
3,653,369 4/1972 Fangman et al. 123/193 CH

Primary Examiner—Al Lawrence Smith
Attorney—Paul M. Craig, Jr. et al.

[57] **ABSTRACT**

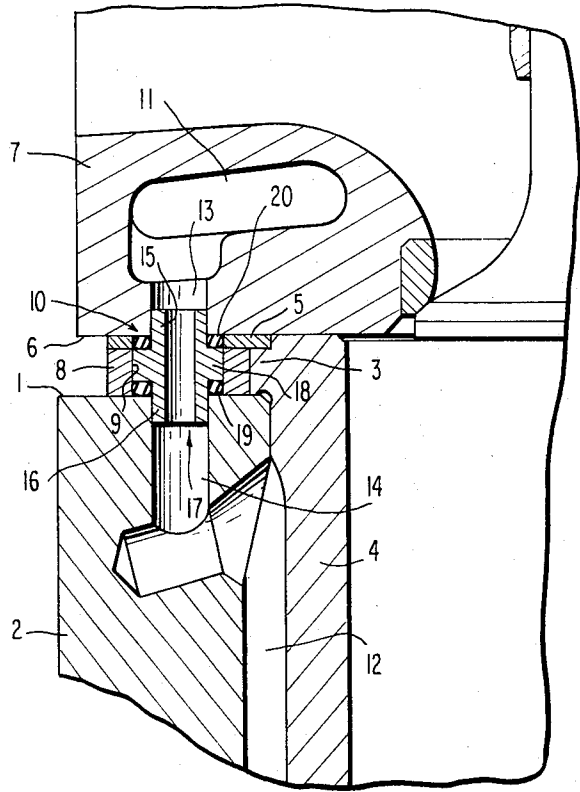
An internal combustion engine in which the cylinder head is secured at the crankcase by means of cylinder head bolts and in which rigid spacer elements are provided between the cylinder head and the crankcase within the area of the cylinder head bolts; the radial collar of the liquid-cooled cylinder liner is mounted directly on the separating surface of the crankcase facing the cylinder head while an intermediate pipe is inserted into the through-passage for the cooling water between the cylinder head and crankcase; the intermediate pipe includes a radial collar and one annular seal each is inserted between the separating surface of the cylinder head and the radial collar of the intermediate pipe as also between the separating surface of the crankcase and the radial collar.

6 Claims, 1 Drawing Figure



PATENTED OCT 16 1973

3,765,385



INTERNAL COMBUSTION ENGINE WITH INTERMEDIATE PIPE INSERTED IN PASSAGE BETWEEN CYLINDER HEAD AND CRANKCASE

The present invention relates to an internal combustion engine in which the cylinder head is secured at the crankcase by means of cylinder head bolts and non-yielding, rigid spacer elements arranged between these housing parts within the area of the cylinder head bolts are provided, and in which the radial collar of the liquid-cooled cylinder liners is mounted directly on the separating surface of the crankcase on the side of the cylinder head and an intermediate pipe is inserted into the through-passage for the cooling water between cylinder head and crankcase which is sealed off by means of sealing rings. In one prior art internal combustion engine (German Patent 1,301,655) of this type, the spacer elements serve to relieve the crankcase from disadvantageous notch stresses within the area of the seats for the wet cylinder liners. Metal seals are inserted between the collar of the cylinder liners and the cylinder head, which seal the combustion spaces in a gas-tight manner with respect to the separating joint between cylinder head and crankcase. Three separating joints result therefrom which have to be sealed separately with respect to the cooling water passage between cylinder head and crankcase.

The present invention is concerned with the task to provide a structurally simple and effective seal of the cooling water passage with respect to the three separating joints between cylinder head, gas seal, spacer element and crankcase. The underlying problems are solved according to the present invention in that the intermediate pipe or tubular member includes a radial collar, and in that one sealing ring each is inserted between the separating surface of the cylinder head and the collar as also between the separating surface of the crankcase and the collar. It is achieved by the present invention that only two seals are required for the three separating joints. The intermediate pipe or tubular member is clamped-in essentially non-displaceably by its collar so that no wear occurs. Commercially available O-rings can be used as sealing elements so that the expenditures for the replacement and renewal of the seal of the cooling water passage are small.

If the arrangement is made in such a manner that the pipe ends on both sides of the collar are axially displaceably inserted into a respective bore of the cylinder head and of the crankcase, then a uniform compression at the seals will be established by reason of the free displaceability of the intermediate pipe.

Accordingly, it is an object of the present invention to provide an internal combustion engine with an intermediate pipe inserted into the cooling water through-passage between cylinder head and crankcase which avoids the aforementioned shortcomings and drawbacks encountered in the prior art by simple means.

Another object of the present invention resides in a liquid-cooled internal combustion engine which reduces the number of seals required for effectively sealing the intermediate pipe inserted into the cooling water passage between cylinder head and crankcase.

A further object of the present invention resides in an internal combustion engine of the type described above which reduces the number of seals necessary in the connection for the cooling liquid between crankcase and cylinder head.

A still further object of the present invention resides in an internal combustion engine with intermediate pipes inserted into the through-passages for the cooling water between cylinder head and crankcase which not only utilizes relatively few parts but permits the use of commercially available seals thus reducing the cost in case of replacement of worn seals.

Another object of the present invention resides in an internal combustion engine of the type described above which not only assures a uniform compression of the seals but also minimizes stresses in the various parts.

These and other objects, features and advantages of the present invention will become more apparent 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:

The single FIGURE is a partial cross-sectional view through the crankcase and cylinder head of an internal combustion engine in accordance with the present invention.

Referring now to the single FIGURE of the drawing, reference numeral 1 designates therein the separating surface of the crankcase 2. The radial collar 3 of the wet cylinder liner 4 is mounted directly on the separating surface 1 of the crankcase 2. The collar 3 is sealed with respect to the separating surface 6 of the cylinder head 7 by means of a metallic gas seal 5 of conventional construction. A distance or spacer plate 8 is inserted between the crankcase 2 and the cylinder head 7; the spacer plate 8 is provided with an aperture 9 for the collar 3 and with a cooling water passage generally designated by reference numeral 10 between the crankcase 2 and the cylinder head 7. The cooling water through-passage 10 connects a cooling water space 11 of the cylinder head 7 with the annular cooling water space 12 between cylinder liner 4 and of the crankcase 2. The cooling water space 11 is in communication with a bore 13 within the cylinder head 7 which terminates in the separating surface 6, and the cooling water space 12 is in communication with a bore 14 of the crankcase 2 which terminates in the separating surface 1. A respective pipe end 15 and 16 of an intermediate pipe or tubular member 17 engage displaceably in the corresponding bore 13 and 14. The intermediate pipe 17 is provided with a radial collar 18 within the area of the aperture 9. One annular seal 19 and 20 each is arranged between the collar 18, on the one hand, and the separating surfaces 1 and 6, on the other, respectively.

The three separating joints between the crankcase 2 and the collar 3, between the collar 3 and the gas seal 5 as well as between the gas seal 5 and the cylinder head 7 are sealed off in a liquid-tight manner with respect to the cooling water through-passage 10 by means of the parts 18, 19 and 20.

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 of numerous changes and modifications as known to those 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 as are encompassed by the scope of the appended claims.

What I claim is:

1. An internal combustion engine which includes a crankcase, a cylinder head secured at the crankcase by means of cylinder head bolts, said cylinder head and

3

crankcase being provided with mutually facing separating surfaces, spacer means arranged between the cylinder head and crankcase within the area of the cylinder head bolts, liquid-cooled cylinder liner means provided with a radial collar mounted on the separating surface of the crankcase facing the cylinder head, a passage being provided for the cooling water between the cylinder head and the crankcase, intermediate pipe means inserted into said passage and annular seal means for sealing said passage, characterized in that the intermediate pipe means includes a substantially radial collar means, and in that an annular seal means is inserted between the separating surface of the cylinder head and the collar means as also between the separating surface of the crankcase and the collar means.

2. An internal combustion engine according to claim 1, characterized in that the ends of the pipe means are inserted axially displaceably on both sides of the collar means into a respective bore provided in the cylinder head and the crankcase.

4

3. An internal combustion engine according to claim 1, characterized in that the spacer means are substantially non-yielding and rigid.

5 4. An internal combustion engine according to claim 3, characterized in that the radial collar of the liquid-cooled cylinder liner means is mounted directly on the separating surface of the crankcase facing the cylinder head.

10 5. An internal combustion engine according to claim 4, characterized in that the ends of the pipe means are inserted axially displaceably on both sides of the collar means into a respective bore provided in the cylinder head and the crankcase.

15 6. An internal combustion engine according to claim 1, characterized in that the radial collar of the liquid-cooled cylinder liner means is mounted directly on the separating surface of the crankcase facing the cylinder head.

20

* * * * *

25

30

35

40

45

50

55

60

65