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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **Cylinder cover for water-cooled internal combustion engine.**

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Description

The present invention relates to cylinder-head covers for use in a water-cooled internal combustion engine, and particularly to the cooling system incorporated in such covers.

A diagrammatic view of one type of cylinder cover of the prior art is illustrated in Figure 1, and a cross-section of a long cylindrical leg of the same cylindrical cover is shown in Figure 2. In Figure 1, the cylinder cover is shown supporting an exhaust valve 2 over a cylinder, said cover being bolted down onto a cylinder liner 3 located within a cylinder jacket 4. The cylinder liner 3 and cover 1 define a combustion chamber 5 above the associated piston 6. Referring also to Figure 2, a large number of cooling holes 9 are formed in the cylinder cover 1 at a constant spacing around its circumference. Thus, in this arrangement, cooling water which has cooled the cylinder liner 3 enters into an annular cooling chamber 8 defined in the periphery of a long leg 1*a* of said cover and a surrounding sleeve 7 through an inlet path 10 in said sleeve 7. After cooling said long leg 1*a*, which is formed in the lower part of said cover, the water flows through the cooling holes 9 to cool the upper part 1*b* of the combustion chamber wall defined by said cover, and then flows out externally.

However, the aforementioned cooling system in the prior art had the following shortcoming.

Though the long leg 1*a* is cooled only by the cooling water in the cooling chamber 8, since only the outer peripheral portion of said long leg is cooled, the inner peripheral portion, that is, the portion along the part defining the combustion chamber wall 1*c* cannot be cooled sufficiently.

It is therefore an object of the present invention to provide a cylinder cover in which the aforementioned short-coming in the prior art is eliminated and a cooling effect for a long cylindrical leg of the cylinder cover can be enhanced.

In French Patent Application FR—A—2,164,304 there is described a cooling arrangement for a cylinder cover in which a single cooling chamber is provided around a cylindrical leg portion of the cover. The cover has upwardly-directed bores formed therein communicating with the cooling chamber and intersecting with respective radial ducts leading to a further cooling chamber remote from the cylindrical leg. The intersection of bores and ducts in this manner could lead to localised stress and weakening of the cylinder cover and is not considered satisfactory.

In German Patent Specification DE—C—959,866, there is described a cooling arrangement for an internal combustion engine cylinder of a kind having a cylinder liner which is closed at its upper end by an integral wall to define the combustion chamber rather than having a separate cylinder cover. The upper part of the cylinder liner is surrounded by a sleeve which, together with the liner, define two spaced cooling chambers around the outside of the liner, the uppermost chamber being connected through radial bores in the upper wall of the liner with a further cooling chamber formed above the upper wall. The two cooling chambers are interconnected by slanting grooves formed in the outer surface of the liner. Even though the liner is comparatively thin, the grooves in its outer surface extend no closer to the inner surface of the liner than the two chambers they interconnect and could not effectively cool the inner portion thereof adjacent the combustion chamber without seriously weakening the liner by increasing the depth of the grooves.

According to the present invention, there is provided a cylinder cover incorporating a cooling arrangement comprising annular cooling means in the outer peripheral portion of a long cylindrical leg portion of the lower part of the cylindrical cover, and a plurality of circumferentially spaced cooling ducts communicating between said annular cooling means and a further cooling chamber for cooling for example an exhaust valve, characterised in that the annular cooling means comprises upper and lower annular chambers provided in the outer peripheral portion of said leg portion, in that said cooling ducts are connected only from the upper chamber to said further cooling chamber, and in that a plurality of cooling bores are formed within the cylindrical leg portion which extend through the inner portion thereof and which are inclined with their opposite ends opening into the upper and lower annular cooling chambers respectively, the plurality of cooling bores being each drilled in the form of a straight line, from one position on the outer peripheral surface of the long cylindrical leg portion through the leg portion to another position obliquely in the horizontal section and being arranged around the cylindrical leg portion such that they do not intersect.

The above-mentioned and other features and objects of the present invention will become more apparent by reference to the following description of a preferred embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a diagrammatic cross-sectional view showing a cylinder cover in a water-cooled diesel engine of the prior art,

Figure 2 is a partial cross-sectional view showing a long cylindrical leg of the cylinder cover shown in Figure 1,

Figure 3 is a view similar to Figure 2, but of opposite hand, of one preferred embodiment of the present invention,

Figure 4 is a transverse complete, cross-sectional view developed along line IV—IV in Figure 3, as viewed in the direction of the arrows, and,

Figure 5 is a longitudinal cross-sectional view taken along line V—V in Figure 4, as viewed in the direction of the arrows.

Referring now to Figures 3 to 5 of the drawings, the cylinder cover 11 constructed in accordance with the invention has a lower portion in the form of a long cylindrical leg 11*a*, the inner surfaces of the upper portion of the cover 11 and said leg (11*c*

and 11*d* respectively) defining the upper part of a combustion chamber 5. A metal sleeve 12 is fixedly secured to the outer periphery of the long cylindrical leg 11*a*. A lower and an upper annular cooling chamber 14 and 15 respectively, are defined between the outer periphery of the long cylindrical leg 11*a*, and the inner periphery of the metal sleeve 12, and circumferentially spaced cooling holes 9 are provided which communicate the upper cooling chamber 15 which an exhaust valve cooling chamber 16, these cooling holes 9 being drilled in the cylinder cover 11 close to and parallel with the upper wall surface 11*c* of the combustion chambers 5.

In this embodiment further cooling holes 13 are drilled in the long cylindrical leg 11*a* from the lower cooling chamber 14 towards the upper cooling chamber 15 in an obliquely upward direction (see Figure 5) at an angle θ with respect to the vertical direction, these cooling holes 13 thus communicating the respective chambers 14 and 15 with each other. A plurality of such cooling holes 13 are provided so as to encircle the combustion chamber as a whole. As shown in Figures 4 and 5 the cooling holes 13 are formed in straight sections without intersecting each other, that is, without connecting to each other along their length (see numerals 13, 13*a* and 13*b*) and they are arrayed at a constant circumferential spacing. The aforementioned respective cooling holes 13 are provided as close (at a distance *l* — see Figure 4) to the inner peripheral surface 11*d* of the long cylindrical leg 11*a* as is permissable to ensure adequate mechanical strength to withstand gas pressure at this point. "O"-rings 17 and 18 are provided between the periphery of the leg 11*a* and the sleeve 12 for sealing of the annular water chambers 14 and 15.

In operation of the preferred embodiment, upon operation of the engine, cooling water entering, via the inlet 10 through the sleeve 12, into the lower cooling chamber 14 flows into the respective cooling holes 13 as it flows around through the lower cooling chamber 14, and while it is cooling the long cylindrical leg 11*a*, it flows into the upper cooling chamber 15.

The cooling water in the upper cooling chamber 15 enters into the cooling holes 9, and after it has cooled the combustion chamber upper wall portion 11*b* of the cylinder cover 11, it is fed into the exhaust valve cooling chamber 16.

Due to the above-mentioned arrangement, the long cylindrical leg 11*a* as well as the combustion chamber upper wall portion 11*b* of the cylinder cover 11 can be sufficiently cooled. Accordingly, the complete cylinder can be cooled uniformly; hence, unevenness of temperature distribution can be corrected, and thereby thermal stresses in the cylinder cover can be reduced.

In summary, the present invention provides the following advantages:

(1) Since cooling holes are provided in the inner portion of a long cylindrical leg of a cylinder cover, the cooling holes can be disposed close to a wall surface of a combustion chamber. As a result, cooling of the long cylindrical leg can be achieved sufficiently.

(2) Since the cooling holes do not intersect with each other in the long cylindrical leg, concentration of stresses can be mitigated as compared with the prior art cylinder cover described, and hence thermal stresses as well as mechanical stresses in a cylinder cover can be reduced.

Since many changes and modifications could be made to the above construction, and other different embodiments proposed, within the scope of the present invention, it is intended that all matter contained in the above description and/or shown in the accompanying drawings shall be interpreted as illustrative, and not as limiting the scope of the invention.

Claims

1. A cylinder cover (11) incorporating a cooling arrangement comprising annular cooling means in the outer peripheral portion of a long cylindrical leg portion (11a) of the lower part of the cylinder cover (11), and a plurality of circumferentially spaced cooling ducts (9) communicating between said annular cooling means and a further cooling chamber (16) for cooling for example an exhaust valve, characterised in that the annular cooling means comprises upper and lower annular chambers (14, 15) provided in the outer peripheral portion of said leg portion (11a), in that said cooling ducts (9) are connected only from the upper chamber (15) to said further cooling chamber (16), and in that a plurality of cooling bores (13, 13a, 13b) are formed within the cylindrical leg portion (11a) which extend through the inner portion thereof and which are inclined with their opposite ends opening into the upper and lower annular cooling chambers (14, 15) respectively, the plurality of cooling bores (13, 13c, 13b) being each drilled in the form of a straight line, from one position on the outer peripheral surface of the long cylindrical leg portion (11a) through the leg portion to another position obliquely in the horizontal section and being arranged around the cylindrical leg portion (11a) such that they do not intersect.

2. A cylinder cover according to Claim 1, characterised in that said plurality of cooling bores (13, 13a, 13b) are arranged at constant intervals around the cylindrical leg portion (11a) so as to encircle the upper part of the combustion chamber (5) defined thereby.

Patentansprüche

1. Zylinderkopf (11) mit einer Kühlanordnung, die eine ringförmige Kühleinrichtung im äußeren Umfangsbereich einer langen zylindrischen Schürze (11a) des unteren Teiles des Zylinderkopfes (11) umfaßt sowie mit einer Mehrzahl von auf dem Umfang verteilt angeordneten Kühlkanälen (9), die eine leitende Verbindung zwischen der ringförmigen Kühleinrichtung sowie einer weiteren Kühlkammer (16) herstellen, um

beispielsweise ein Auslaßventil zu kühlen, dadurch gekennzeichnet, daß die ringförmige Kühleinrichtung eine obere und eine untere Ringkammer (14, 15) umfaßt, die im äußeren Umfangsbereich der Schürze (11a) vorgesehen sind, daß die Kühlkanäle (9) lediglich die obere Kammer (15) mit der unteren Kühlkammer (16) verbinden, und daß eine Anzahl von Kühlbohrungen (13, 13a, 13b) innerhalb der zylindrischen Schürze (11a) eingeformt sind, die sich durch deren inneren Bereich hindurcherstrecken, mit ihren einander gegenüberliegenden Enden geneigt sind und in die obere bzw. untere Kühlkammer (14, 15) einmünden, und daß die Anzahl von Kühlbohrungen (13, 13c, 13b) jeweils geradlinig gebohrt sind, und zwar von einer Stelle auf der äußeren Umfangsfläche der langen zylindrischen Schürze (11a) durch die Schürze hindurch zu einer weiteren Stelle, die in einem Horizontalschnitt geneigt ist und die um die zylindrische Schürze (11a) herum derart angeordnet sind, daß sie sich nicht schneiden.

2. Zylinderkopf nach Anspruch 1, dadurch gekennzeichnet, daß die Kühlbohrungen (13, 13a, 13b) in gleichen Abständen um die zylindrische Schürze (11a) herum angeordnet sind, derart, daß sie den oberen Teil der hierdurch begrenzten Brennkammer (15) umgeben.

Revendications

1. Culasse (11) de cylindre, pourvue d'un dispositif de refroidissement comprenant des moyens annulaires de refroidissement de la partie périphérique extérieure d'une partie en forme de jupe cylindrique allongée (11a) du bas de la culasse (11), et une série de conduits de refroidissement (9) répartis sur sa circonférence et faisant communiquer lesdits moyens annulaires avec une autre chambre de refroidissement (16), par exemple pour le refroidissement d'une soupape d'échappement, caractérisée en ce que les moyens annulaires de refroidissement comprennent une chambre annulaire supérieure (15) et une chambre annulaire inférieure (14), qui sont ménagées dans la partie périphérique extérieure de ladite jupe (11a), en ce que lesdits conduits de refroidissement (9) relient uniquement la chambre supérieure (15) à ladite autre chambre de refroidissement (16), et en ce qu'une série de trous de refroidissement (13, 13a, 13b) est ménagée dans la jupe cylindrique (11a), ces trous s'étendant à travers la partie intérieure de celle-ci et étant inclinés, leurs extrémités opposées débouchant respectivement dans la chambre annulaire supérieure (15) et la chambre annulaire inférieure (14), ces trous de refroidissement étant forés chacun en ligne droite, d'un emplacement de la surface périphérique extérieure de la jupe cylindique allongée (11a), jusqu'à un autre emplacement en traversant la jupe obliquement par rapport à l'horizontale, et étant disposés sur le pourtour de la jupe cylindrique (11a) de manière à ne pas se couper.

2. Culasse de cylindre selon la revendication 1, caractérisée en ce que lesdits trous de refroidissement (13, 13a, 13b) sont répartis selon des intervalles constants sur le pourtour de la jupe cylindrique (11a) de manière à entourer la partie supérieure de la chambre de combustion (5) délimitée par cette jupe.

FIG.3

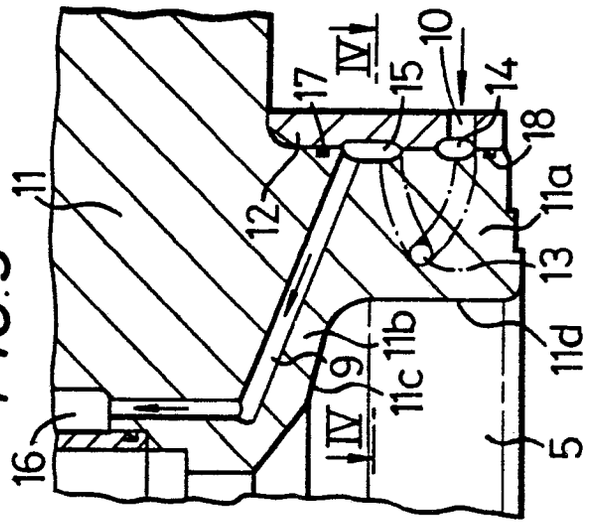


FIG.2

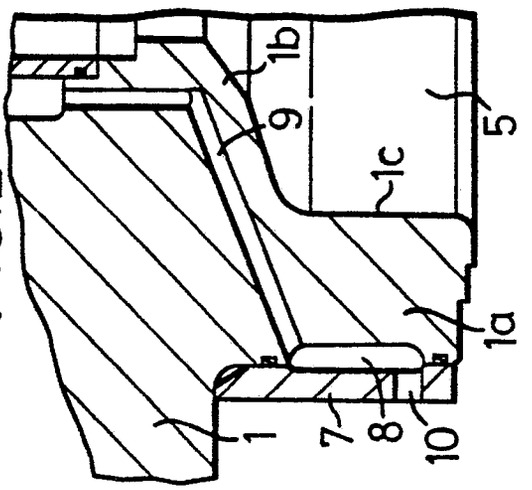
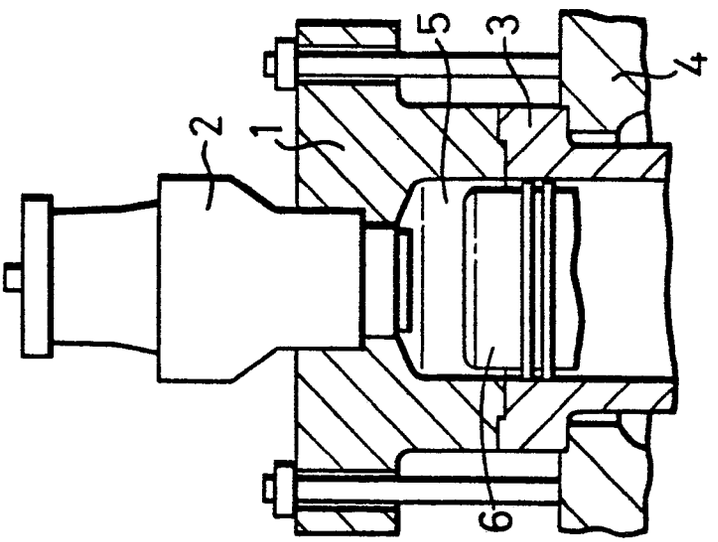


FIG.1



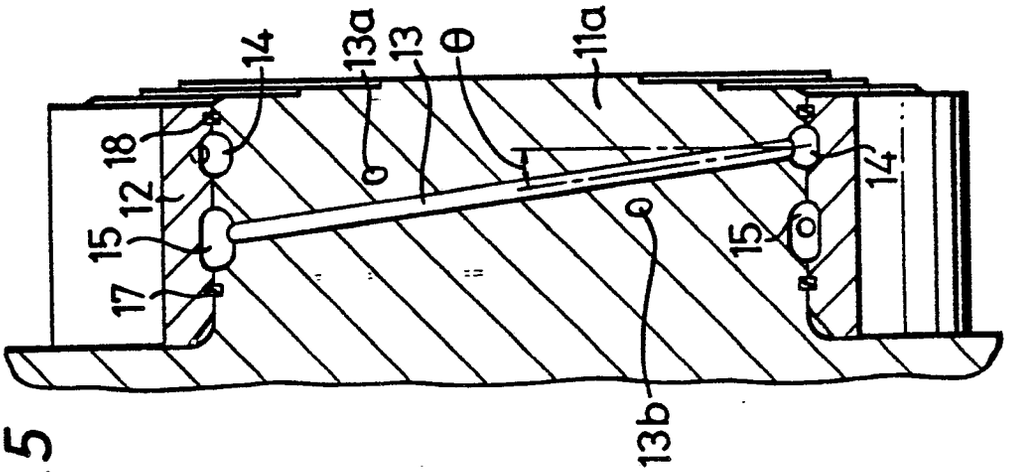


FIG.5

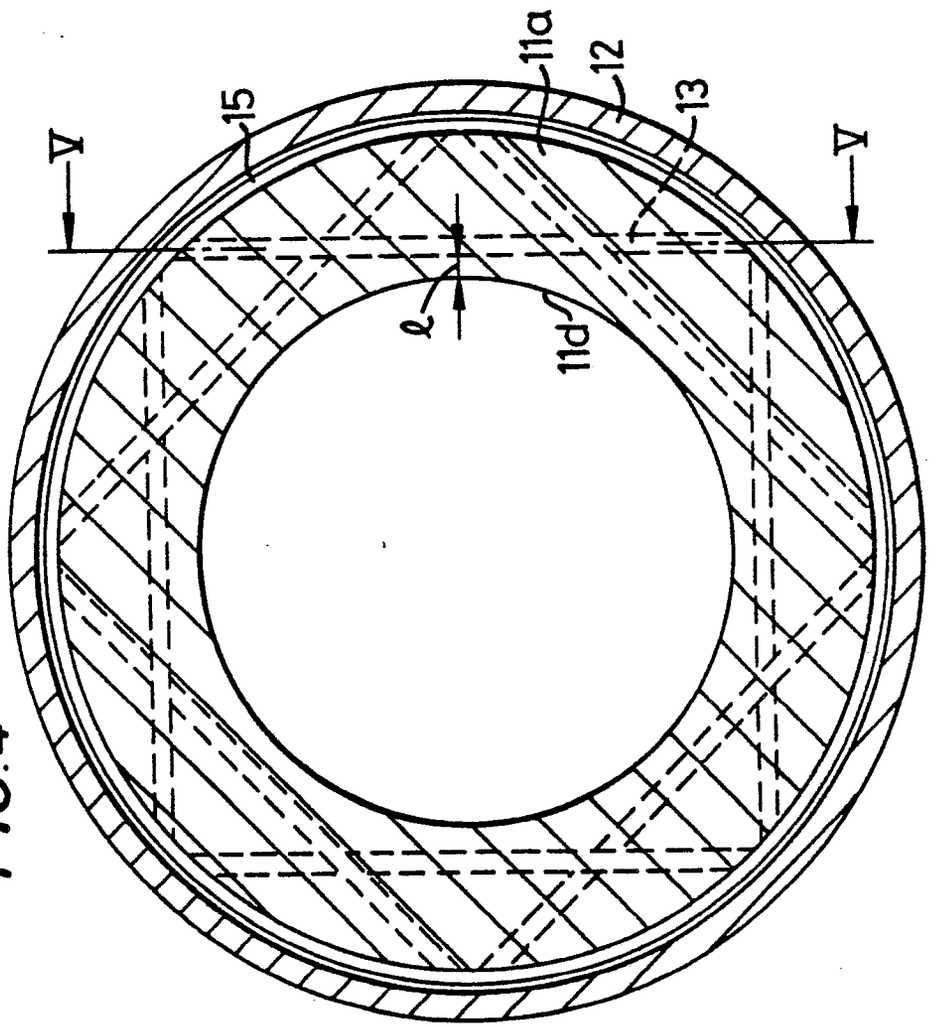


FIG.4