

Description

This invention relates to the construction of an engine having a multipiece block, a cylinder head, a midsupported cylinder liner and the structure used to assemble the components into an engine.

Engines are designed to perform various functions such as power plants for vehicles and generator sets and in a variety of output horsepower. Bore size, length of stroke and compression ratios are varied to produce different horsepower ratings.

Many of today's engines typically use a water-cooled block made from one casting with a replaceable cylinder liner or integral bore within the block. US-A- 4,369,627 discloses an example of one such engine.

US-A- 1,226,820 discloses an engine in which the body comprises an upper base section, a lower base section and a cylinder section which are detachably connected with each other. The cylinder sections of this design has a water space which surrounds substantially the entire length of the cylinder from top to bottom. This requires a precisely aligned core to form the water space, an elaborate cleaning technique and a substantially full length cooling system from top to bottom of the cooled block portion requiring a large cooling system. The assembly technique used to secure the individual cylinders to the upper section is difficult to service and maintain because access to the fastening screws are located within the upper base section.

Some engine designs appear to be moving away from the full length water cooled block or cylinder liner in an attempt to increase efficiency, reduce cost and improve the emissions. US-A- 4,294,203 discloses an engine having an integral head and upper cylinder assembly for use with an integral crankcase and lower cylinder section assembly. The upper and lower assemblies are formed to receive a wet cylinder liner which is directly contacted by the engine coolant over only a portion of the exterior surface of the liner which is received within the upper assembly. Although eliminating the need for a large cooling system, the machining costs and complexity of operations have drastically increased overall cost. The casting process although simplified from Shultz's design still requires a complex core and cleaning process. A deep blind bore is required within the one piece integral head and upper cylinder section assembly to allow for inserting the cylinder liner therein. It has been found from past experience that the bottom portion of such deep bores cause stress concentrators resulting in cracks and failure of similar components such as cylinder liners and blocks.

The same type of area which forms stress concentrators can be seen in US-A- 4,305,348

where the shoulder surface intersects the outer diameter of the cylinder liner. The addition of heat from the combustion chamber further compounds the stresses due to a lack of cooling available around or near the flange at the top of the liner.

US-A-2851020 discloses an engine comprising a cylinder head; a multipiece block having a bottom block portion having a bore therein and a top block portion positioned between the bottom block portion and the cylinder head and having a bore substantially coaxial with the bore in the bottom block portion; means for attaching the cylinder head to the bottom block portion; a midsupported cylinder liner which is flangeless at its upper end, the liner having an upper portion positioned within the bore of the top block portion and a lower portion extending into the bore of the bottom block portion and an annular support surface positioned between the upper portion and the lower portion, the support surface seating on the bottom block portion and the midsupported cylinder liner being fixedly biased between the cylinder head and the bottom block portion; and a piston and ring assembly slidably positioned within the midsupported cylinder liner; and, in accordance with the invention; such an engine is characterized by the cylinder head being attached directly to the bottom block portion; by both the top and bottom block portions each having a plurality of the bores and there being a corresponding plurality of the cylinder liners; by a liquid cooling system having a liquid cooling transfer pump, a heat exchanger, an annular space formed between the upper portion of each cylinder liner and the respective bore of the top block portion, the space being sealed at the top by a compressible seal and at the bottom by a flexible seal between the cylinder liner and the top block portion without any seal-retaining groove in the liner corresponding to the flexible seal, and a plurality of liquid cooling passages in the cylinder head connected in liquid flow relationship with the annular space, the transfer pump and the heat exchanger; and by the cylinder liners being individually insertable into, and removable from, the bores, after removing the cylinder head but without disassembling the multipiece block.

In the accompanying drawings:-

Fig. 1 is a side view of an engine in accordance with of the present invention;
Fig. 2 is an end view of the engine with sections broken away to show the relationship of a cylinder head, top block portion, bottom block portion, midsupported cylinder liner and a piston and ring assembly of one of the cylinders; and,
Fig. 3 is an enlarged broken out section view of the area circumscribed within line III of Fig. 2.

Referring now to the drawings, a multi-cylinder engine 10 includes a multipiece block 14 having a bottom block portion 15 and a top block portion 16. In addition, a cylinder head 17, a plurality of mid-supported cylinder liners 18, a plurality of piston and ring assemblies 19, a camshaft 20 and a liquid cooling system 21 are included in the engine. Further included in the engine is means 22 for communicating liquid flow through the liquid cooling system 21, means 23 for attaching the cylinder head 17 to the bottom block portion 15 and means 24 for sealing liquid flow between the top block portion 16 and the cylinder head 17, the midsupported cylinder liner 18 and the top block portion 16, and the top block portion 16 and the bottom block portion 15. It should be noted that many of the components shown only in Figs. 2 and 3 and hereinafter described in detail are duplicated at each cylinder of the engine.

The bottom block portion 15 has a plurality of bores therein one of which is shown at 28. The top block portion 16 has a plurality of bores therein one of which is shown at 34. The bores 34 in the top block portion 16 are substantially coaxial with the bores 28 in the bottom block portion 15. The top block portion 16 is positioned between the bottom block portion 15 and the cylinder head 17. The means 23 for attaching the cylinder head 17 to the bottom block portion 15 includes a plurality of fasteners 36 which extend through a plurality of holes 40 in the cylinder head 17 and a plurality of holes 42 in the top block portion 16 and threadedly engage a plurality of threaded bores 38 in the bottom block portion 15.

Each midsupported cylinder liner 18 has a lower portion 44 which extends into the bore 28 in the bottom block portion 15 and an upper portion 46 positioned in the bore 34 of the top block portion 16. The midsupported cylinder liner 18 is fixedly biased between the cylinder head 17 and the bottom block portion 15. The upper portion 46 cooperates with the bore 34 in the top block portion 16 forming an annular space 48 therebetween.

The midsupported cylinder liner 18 has an annular support surface 49 positioned between the upper portion 46 and the lower portion 44 and seats on the bottom block portion 15. An end 50 of the midsupported cylinder liner 18 contacts the cylinder head 17 and has an annular groove 51 formed therein. The sealing means 24 includes a compressible gasket 52 positioned between the top block portion 16 and the cylinder head 17. The compressible gasket 52 includes a compressible ring 53 positioned within the groove 51 between the midsupported cylinder liner 18 and the cylinder head 17.

The liquid cooling system 21 includes a heat exchanger 54, an upper flexible hose 55 and a

lower flexible hose 56 connecting the heat exchanger to the engine 10, and a liquid cooling transfer pump 58. The liquid cooling transfer pump 58 is suitably driven by the engine 10 to establish a liquid flow through the cooling system 21. The heat exchanger 54 is connected to the lower hose 56 at one end and the other end of the hose 56 is connected to a passage 60 which communicates with the cooling transfer pump 58. A passage 61 connects the pump 58 with a passage 63 in an inlet cooling manifold 64 extending substantially the entire length of the top block portion 16. The inlet cooling manifold 64 in this embodiment is a separate component from the top block portion 16 and is attached to the top block portion 16 in liquid sealed relationship at one outer edge by a plurality of fasteners 65. Alternatively, the manifold 64 could be an integral part of the top block portion 16. Means 22 for communicating liquid flow through the liquid cooling system 21 includes a series of passages 66, a plurality of passages 68, a plurality of cooling passages 69 and an outlet manifold 70. The passages 66 are positioned between the inlet cooling manifold 64 and the annular spaces 48, the plurality of passages 68 are positioned between the annular spaces 48 and the plurality of cooling passages 69 located in the head. Each cooling passage 69 is connected to the outlet manifold 70 which is connected to the upper hose 55.

A suitable number of passages 74 in the gasket 52 directs communication of liquid flow between the passages 68 and the plurality of liquid cooling passages 69. A plurality of first and second retaining grooves 76,78 within the top block portion 16 and a plurality of first and second flexible seals 80,82 positioned in the respective grooves 76,78 are included in the means for sealing 24. The first flexible seal 80 sealably contacts the midsupported cylinder liner 18 while the second flexible seal 78 sealably contacts the bottom block portion 15.

A bore 98 in the top block portion 16 extends substantially the length of the block and is offset from and perpendicular to the bore 34. The camshaft 20 is rotatably positioned in the bore 98. The piston and ring assemblies 19 are slidably positioned within the midsupported cylinder liners 18 and are movable between a top position 100 and a bottom position 102 to define a stroke "S" of the piston and ring assembly 11. The top block portion 16 has a predetermined height "H₁" preferably selected from the range of about 30% to 100% of the stroke "S". The annular space 48 has a predetermined height "H₂" preferably selected from the range of about 30% to 65% of the stroke "S". The height "H₂" of the annular space 48 can be varied to provide a greater or lesser area of cooling.

Industrial Applicability

The top block portion 16 is positioned over the bottom block portion 15 with the bores 34 in the top block portion 16 substantially coaxial with the bores 28 in the bottom block portion 15. The first and second flexible seals 80,82 are installed in the first and second grooves 76,78 and the midsupported cylinder liner 18 is inserted through the bores 28,34. The piston and ring assemblies 19 can be assembled separately or may be preassembled within the midsupported cylinder liner 18 as is conventional practice. The compressible gasket 52 is positioned on the top block portion 16 with the compressible ring 53 positioned in the annular groove 51. The cylinder head 17 is lowered onto the gasket 52 and the plurality of fasteners 36 inserted through the plurality of holes 40,42 in the cylinder head 17 and top block portion 16 and are threaded into the plurality of threaded bores 38 in the bottom block portion 15. Thus, assembly of the critical parts of the engine 10 is completed. Other conventional components are assembled in their normal way, to complete the engine assembly.

The multipiece block 14 with the preferred features of the illustrated example results in an engine having greater efficiency and lower manufacturing costs. The top block portion 16 is machined flat on the top and bottom in a simple milling operation. The separate inlet cooling manifold 64 is sealably attached to the top block portion 16 and simplifies the cleaning and coring operations reducing cost of the engine 10. All of the bores 34,42 are through bores which do not require a particular depth or bottoming operation as is required in many mid-supported cylinder liner engines. The machining operations for the first and second flexible seal retaining grooves 76,78 are near the surface of the top block portion 16 and provides easy access reducing set up time and costs. The annular spaces 48 can be cast within the top block portion 16 or machined using a simple set up and requiring a minimum of time due to the easy access within the top block portion 16.

The midsupported liners 18 are free of sealing grooves along the upper and lower portions 46,44 reducing the stresses within the structure. The support surfaces 49 transfer the load from the cylinder head 17 through the midsupported liners 18 to the bottom block portion 15 and provides a simple compression loading within the midsupported liners 18. The midsupported cylinder liners eliminate the flange near the top of conventional cylinder liners enabling greater cooling of the piston and ring assemblies near the top of the stroke. This aspect of the invention allows one to move the top ring on the piston nearer to the top of the piston decreasing fuel consumption and reducing emissions.

Another advantage of using the top block portion 16 as disclosed in this invention is the variety of the engine sizes that can be manufactured on a common machining center and with a minimum of component changes. By varying the predetermined height "H₁" of the top block portion 16 and the stroke "S" the horsepower output of the engine can be varied while using the same bottom block portion 15 and cylinder head 17.

The application of the multipiece block 14 within an engine 10 is rewarding from the functional aspect as well as the manufacturing aspect.

The top block portion 16 is used to provide cooling for the midsupported cylinder liners 18 in the area in which combustion takes place. For example, predetermined height "H₂" of the annular spaces 48 is selected so that substantially only the length of the midsupported cylinder liners 18 in which combustion takes place is cooled thus controlling the combustion temperature within the combustion chamber. The top block portion 16 also enables the use of a different material for components of the multipiece block 14. The top block portion 16 in this embodiment is made of an aluminum alloy to utilize the heat rejection characteristics thereof and to permit the camshaft 20 to rotate within the bore 98 without requiring bearings.

The top block portion 16 of the multipiece engine block of the engine of the present invention reduces the manufacturing time and costs by providing a simple structure which is easy to cast and machine. The location of the top block portion 16 between the cylinder head 17 and the bottom block portion 15 reduces the complexity of cores for casting both the top and bottom block portion 16,15. The simplicity of design of the top block portion 16 reduces the set up and machining requirements over present single and multipiece block designs. The ability to vary the height "H₁" and "H₂" of the top block portion 16 and annular spaces 48 allows for the variation of engine size with a minimal change in components within an engine. The variation of height "H₂" enables greater control of the combustion temperatures within the combustion chamber resulting in higher efficiency and lower emissions from such an engine.

Claims

1. An engine (10) comprising a cylinder head (17); a multipiece block having a bottom block portion (15) having a bore (28) therein and a top block portion (16) positioned between the bottom block portion (15) and the cylinder head (17) and having a bore (34) substantially coaxial with the bore (28) in the bottom block portion (15); means for attaching (23) the cylinder head (17) to the bottom block portion



Industrial Applicability

The top block portion 16 is positioned over the bottom block portion 15 with the bores 34 in the top block portion 16 substantially coaxial with the bores 28 in the bottom block portion 15. The first and second flexible seals 80,82 are installed in the first and second grooves 76,78 and the midsupported cylinder liner 18 is inserted through the bores 28,34. The piston and ring assemblies 19 can be assembled separately or may be preassembled within the midsupported cylinder liner 18 as is conventional practice. The compressible gasket 52 is positioned on the top block portion 16 with the compressible ring 53 positioned in the annular groove 51. The cylinder head 17 is lowered onto the gasket 52 and the plurality of fasteners 36 inserted through the plurality of holes 40,42 in the cylinder head 17 and top block portion 16 and are threaded into the plurality of threaded bores 38 in the bottom block portion 15. Thus, assembly of the critical parts of the engine 10 is completed. Other conventional components are assembled in their normal way, to complete the engine assembly.

The multipiece block 14 with the preferred features of the illustrated example results in an engine having greater efficiency and lower manufacturing costs. The top block portion 16 is machined flat on the top and bottom in a simple milling operation. The separate inlet cooling manifold 64 is sealably attached to the top block portion 16 and simplifies the cleaning and coring operations reducing cost of the engine 10. All of the bores 34,42 are through bores which do not require a particular depth or bottoming operation as is required in many mid-supported cylinder liner engines. The machining operations for the first and second flexible seal retaining grooves 76,78 are near the surface of the top block portion 16 and provides easy access reducing set up time and costs. The annular spaces 48 can be cast within the top block portion 16 or machined using a simple set up and requiring a minimum of time due to the easy access within the top block portion 16.

The midsupported liners 18 are free of sealing grooves along the upper and lower portions 46,44 reducing the stresses within the structure. The support surfaces 49 transfer the load from the cylinder head 17 through the midsupported liners 18 to the bottom block portion 15 and provides a simple compression loading within the midsupported liners 18. The midsupported cylinder liners eliminate the flange near the top of conventional cylinder liners enabling greater cooling of the piston and ring assemblies near the top of the stroke. This aspect of the invention allows one to move the top ring on the piston nearer to the top of the piston decreasing fuel consumption and reducing emissions.

Another advantage of using the top block portion 16 as disclosed in this invention is the variety of the engine sizes that can be manufactured on a common machining center and with a minimum of component changes. By varying the predetermined height "H₁" of the top block portion 16 and the stroke "S" the horsepower output of the engine can be varied while using the same bottom block portion 15 and cylinder head 17.

The application of the multipiece block 14 within an engine 10 is rewarding from the functional aspect as well as the manufacturing aspect.

The top block portion 16 is used to provide cooling for the midsupported cylinder liners 18 in the area in which combustion takes place. For example, predetermined height "H₂" of the annular spaces 48 is selected so that substantially only the length of the midsupported cylinder liners 18 in which combustion takes place is cooled thus controlling the combustion temperature within the combustion chamber. The top block portion 16 also enables the use of a different material for components of the multipiece block 14. The top block portion 16 in this embodiment is made of an aluminum alloy to utilize the heat rejection characteristics thereof and to permit the camshaft 20 to rotate within the bore 98 without requiring bearings.

The top block portion 16 of the multipiece engine block of the engine of the present invention reduces the manufacturing time and costs by providing a simple structure which is easy to cast and machine. The location of the top block portion 16 between the cylinder head 17 and the bottom block portion 15 reduces the complexity of cores for casting both the top and bottom block portion 16,15. The simplicity of design of the top block portion 16 reduces the set up and machining requirements over present single and multipiece block designs. The ability to vary the height "H₁" and "H₂" of the top block portion 16 and annular spaces 48 allows for the variation of engine size with a minimal change in components within an engine. The variation of height "H₂" enables greater control of the combustion temperatures within the combustion chamber resulting in higher efficiency and lower emissions from such an engine.

Claims

1. An engine (10) comprising a cylinder head (17); a multipiece block having a bottom block portion (15) having a bore (28) therein and a top block portion (16) positioned between the bottom block portion (15) and the cylinder head (17) and having a bore (34) substantially coaxial with the bore (28) in the bottom block portion (15); means for attaching (23) the cylinder head (17) to the bottom block portion



(15); a midsupported cylinder liner (18) which is flangeless at its upper end, the liner having an upper portion (46) positioned within the bore (34) of the top block portion (16) and a lower portion (44) extending into the bore (28) of the bottom block portion (15) and an annular support surface (49) positioned between the upper portion (46) and the lower portion (44), the support surface (49) seating on the bottom block portion (15) and the midsupported cylinder liner (18) being fixedly biased between the cylinder head (17) and the bottom block portion (15); and a piston and ring assembly (19) slidably positioned within the midsupported cylinder liner (18); characterised by the cylinder head (17) being attached directly to the bottom block portion (15); by both the top and bottom block portions (16, 15) each having a plurality of the bores (28, 34) and there being a corresponding plurality of the cylinder liners (18); by a liquid cooling system (21) having a liquid cooling transfer pump (58), a heat exchanger (54), an annular space (48) formed between the upper portion (46) of each cylinder liner (18) and the respective bore (34) of the top block portion (16), the space being sealed at the top by a compressible seal (53) and at the bottom by a flexible seal (80) between the cylinder liner (18) and the top block portion (16) without any seal-retaining groove in the liner corresponding to the flexible seal (80), and a plurality of liquid cooling passages (69) in the cylinder head (17) connected in liquid flow relationship with the annular space (48), the transfer pump (58) and the heat exchanger (54); and by the cylinder liners (18) being individually insertable into, and removable from, the bores (28,34), after removing the cylinder head (17) but without disassembling the multipiece block.

2. An engine (10) according to claim 1, further including means for sealing (24) between the top block portion (16) and the cylinder head (17), and the top block portion (16) and the bottom block portion (15).
3. An engine (10) according to claim 2, wherein the means for sealing (24) includes a compressible gasket (52) positioned between the top block portion (16) and the cylinder head (17).
4. An engine (10) according to claim 3, wherein each cylinder liner (18) has an end (50) contacting the cylinder head (17) and an annular groove (51) at the end (50), the gasket (52) including a compressible ring (53) positioned

within the groove (51) between the midsupported cylinder liner (18) and the cylinder head (17).

5. An engine (10) according to any one of the preceding claims, wherein each bore (34) in the top block portion (16) has a first retaining groove (76) and the respective flexible seal (80) is positioned within the groove (76), sealingly contacting the cylinder liner (18).
6. An engine (10) according to claim 5, when dependent on any one of claims 2 to 4, wherein the means for sealing (24) further includes a second retaining groove (78) within the top block portion (16) and a second flexible seal (82) positioned within the second groove (78) and sealingly contacting the bottom block portion (15).
7. An engine (10) according to any one of the preceding claims, wherein the bottom block portion (15) includes a plurality of threaded bores (38) therein, the cylinder head (17) includes a plurality of holes (40) therein, the top block portion (16) includes a plurality of holes (42) therein, and the means for attaching (23) includes a plurality of fasteners (36) extending through the holes (40,42) in both the cylinder head (17) and the top block portion (16) and threadedly engaging the plurality of threaded bores (38).
8. An engine (10) according to any one of the preceding claims, including a camshaft (20) and wherein the top block portion (16) has therein a bore (98) extending substantially the length of the top block portion (16) and offset from and perpendicular to the through bore (34) in the top block portion (16), the camshaft (20) being rotatably positioned in the bore (98).
9. An engine (10) according to any one of the preceding claims, wherein the top block portion (16) is made of an aluminium alloy.
10. An engine (10) according to any one of the preceding claims, including a cooling manifold (64) having a passage (63) therein and being connected to the liquid cooling system (21), the cooling manifold (64) being sealably attached to one outer edge of the top block portion (16) and extending substantially the entire length of the top block portion (16) which has a respective passage (66) connected to the respective annular space (48) and the passage (63).



Revendications

1. Moteur (10) comportant une culasse (17) : un bloc en plusieurs pièces formé d'une portion de bloc inférieure (15) renfermant un alésage (28), et d'une portion de bloc supérieure (16) placée entre la portion de bloc inférieure (15) et la culasse (17) et possédant un alésage (34) sensiblement coaxial avec l'alésage (28) prévu dans la portion de bloc inférieure (15) ; des moyens (23) pour fixer la culasse (17) à la portion de bloc inférieure (15) ; une chemise de cylindre (18) supportée au milieu, dont l'extrémité supérieure ne présente pas de bride, la chemise comportant une portion supérieure (46) placée à l'intérieur de l'alésage (34) de la portion de bloc supérieure (16), et une portion inférieure (44) s'étendant dans l'alésage (28) de la portion de bloc inférieure (15), et une surface de support annulaire (49) placée entre la portion supérieure (46) et la portion inférieure (44), ladite surface de support (49) reposant sur la portion de bloc inférieure (15), et la chemise de cylindre (18) supportée au milieu étant sollicitée de façon fixe entre la culasse (17) et la portion de bloc inférieure (15) ; et un ensemble piston et segments (19) placé, couissant, à l'intérieur de la chemise de cylindre (18) supportée au milieu ; caractérisé en ce que la culasse (17) est fixée directement à la portion de bloc inférieure (15) ; en ce que les portions de bloc supérieure et inférieure (16, 15) possèdent chacune une pluralité desdits alésages (28, 34) et en ce qu'il y a une pluralité correspondante desdites chaises de cylindres (18) ; en ce qu'un système de refroidissement par liquide (21) comporte une pompe de transfert (58) de refroidissement par liquide, un échangeur thermique (54), un espace annulaire (48) formé entre la portion supérieure (46) de chaque chemise de cylindre (18) et l'alésage respectif (34) de la portion de bloc supérieure (16), cet espace étant rendu étanche, en haut, par un joint d'étanchéité compressible (53) et, en bas, par un joint d'étanchéité flexible (80), entre la chemise de cylindre (18) et la portion de bloc supérieure (16), sans aucune rainure de retenue de joint d'étanchéité dans la chaise correspondante au joint d'étanchéité flexible (80), et plusieurs passages (69) de refroidissement par liquide, prévus dans la culasse (17) et mis en relation d'écoulement liquide avec l'espace annulaire (48), la pompe de transfert (58) et l'échangeur thermique (54) ; et en ce que les chemises de cylindres (18) sont aptes à être insérées individuellement dans les alésages (28, 34) et à être enlevées de ceux-ci une fois que la culasse (17) est enlevée, mais

sans démontage du bloc en plusieurs pièces.

2. Moteur (10) selon la revendication 1, comprenant également des moyens d'étanchéité (24) entre la portion de bloc supérieure (16) et la culasse (17), et la portion de bloc supérieure (16) et la portion de bloc inférieure (15).
3. Moteur (10) selon la revendication 2, dans lequel les moyens d'étanchéité (24) comprennent un joint d'étanchéité compressible (52) placé entre la portion de bloc supérieure (16) et la culasse (17).
4. Moteur (10) selon la revendication 3, dans lequel chaque chemise de cylindre (18) possède une extrémité (50) qui touche la culasse (17) et une rainure annulaire (51) formée au niveau de ladite extrémité (50), ledit joint d'étanchéité (52) comprenant une bague compressible (53) placée à l'intérieur de la rainure (51), entre la chemise de cylindre (18) supportée au milieu et la culasse (17).
5. Moteur (10) selon l'une quelconque des revendications précédentes, dans lequel chaque alésage (34) prévu dans la portion de bloc supérieure (16) possède une première rainure de retenue (76) et le joint d'étanchéité flexible (80) respectif est placé à l'intérieur de ladite rainure (76), en contact étanche avec la chemise de cylindre (18).
6. Moteur (10) selon la revendication 5 lorsqu'elle est dépendante de l'une quelconque des revendications 2 à 4, dans lequel les moyens d'étanchéité (24) comprennent également une seconde rainure de retenue (78) à l'intérieur de la portion de bloc supérieure (16), et un second joint d'étanchéité flexible (82) placé à l'intérieur de la seconde rainure (78) et en contact étanche avec la portion de bloc inférieure (15).
7. Moteur (10) selon l'une quelconque des revendications précédentes, dans lequel la portion de bloc inférieure (15) renferme plusieurs alésages filetés (38), la culasse (17) renferme plusieurs alésages (40), la portion de bloc supérieure (16) renferme plusieurs alésages (42) et les moyens de fixation (23) comprennent plusieurs attaches (36) qui s'étendent à travers les alésages (40, 42) prévus dans la culasse (17) et la portion de bloc supérieure (16) et viennent en prise par filetage avec les trous filetés (38).
8. Moteur (10) selon l'une quelconque des reven-



dications précédentes, comprenant un arbre à cames (20) et dans lequel la portion de bloc supérieure (16) renferme un alésage (98) s'étendant sensiblement sur la longueur de la portion de bloc supérieure (16) et décalé par rapport à l'alésage débouchant (34) prévu dans ledit bloc (16), et perpendiculaire audit alésage (34), l'arbre à cames (20) étant prévu, rotatif, dans l'alésage (98).

9. Moteur (10) selon l'une quelconque des revendications précédentes, dans lequel la portion de bloc supérieure (16) est réalisée en un alliage d'aluminium.

10. Moteur (10) selon l'une quelconque des revendications précédentes, comprenant un collecteur de refroidissement (64) renfermant un passage (63) et relié au liquide de refroidissement par liquide (21), le collecteur de refroidissement (64) étant fixé de façon étanche à un bord extérieur de la portion de bloc supérieure (16) et s'étendant sensiblement sur toute la longueur de la portion de bloc supérieure (16) qui possède un passage respectif (66) relié à l'espace annulaire respectif (48) et au passage (63).

Patentansprüche

1. Ein Motor (10), der folgendes aufweist:
ein Zylinderkopf (17);
einen mehrteiligen Block mit einem unterem Blockteil (15) mit einer darin befindlichen Bohrung (28) und einem oberen Blockteil (16), welcher zwischen dem unteren Blockteil (15) und dem Zylinderkopf (17) angeordnet ist und eine Bohrung (34) besitzt, die im wesentlichen koaxial mit der Bohrung (28) in dem unteren Blockteil (15) verläuft;
Mittel zum Befestigen (23) des Zylinderkopfes (17) an dem unteren Blockteil (15);
eine mittig getragene Zylinderbüchse (18), die an ihrem oberen Ende flanschlos ist, wobei die Büchse einen oberen Teil (46), welcher in der Bohrung (34) des oberen Blockteils (16) angeordnet ist und einen unteren Teil (44), welcher sich in die Bohrung (28) des unteren Blockteils (15) erstreckt, sowie eine ringförmige Stützoberfläche (49), welche zwischen dem oberen Teil (46) und dem unteren Teil (44) angeordnet ist, besitzt, und wobei die Stützoberfläche (49) auf dem unteren Blockteil (15) sitzt und die mittig getragene Zylinderbüchse (18) fest zwischen dem Zylinderkopf (17) und dem unteren Blockteil (15) vorgespannt ist; und
eine Kolben- und Ringanordnung (19), die gleitend in der mittig getragenen Zylinderbüchse

(18) angeordnet ist;

dadurch gekennzeichnet daß:

der Zylinderkopf (17) direkt an dem unteren Blockteil (15) befestigt ist;

die oberen und unteren Blockteile (16, 15) je eine Mehrzahl von Bohrungen (28, 34) besitzen und daß dort eine entsprechende Mehrzahl von Zylinderbüchsen (18) vorgesehen ist; ein Flüssigkeitskühlsystem (21) mit einer Flüssigkeitskühltransferpumpe (58), einem Wärmeaustauscher (54), ein Ringraum (48), zwischen dem oberen Teil (46) jeder Zylinderbüchse (18) und der entsprechenden Bohrung (34) des oberen Blockteils (16) gebildet ist, wobei der Raum oben durch eine zusammendrückbare Dichtung (53) und unten durch eine flexible Dichtung (80) zwischen der Zylinderbüchse (18) und dem oberen Blockteil (16) abgedichtet ist, ohne irgendeine dichtungshaltende Nut in der Büchse, welche der flexiblen Dichtung (80) entspricht und eine Mehrzahl von Flüssigkeitskühldurchlässen (96) in dem Zylinderkopf (17), die in einer Flüssigkeitsströmungsbeziehung mit dem Ringraum (48) der Transferpumpe (58) und dem Wärmetauscher (54) verbunden sind; und

die Zylinderbüchsen (18), individuell einsetzbar in und herausnehmbar aus den Bohrungen (28, 34) sind und zwar nach Herausnahme des Zylinderkopfes (17), jedoch ohne Auseinandernehmen des mehrteiligen Blocks.

2. Motor (10) nach Anspruch 1 der weiterhin Dichtmittel (24) zwischen dem oberen Blockteil (16) und dem Zylinderkopf (17), und dem oberen Blockteil (16) und dem unteren Blockteil (15) umfaßt.

3. Motor (10) nach Anspruch 2, wobei die Dichtmittel (24) eine zusammendrückbare Dichtung (52) angeordnet zwischen dem oberen Blockteil (16) und dem Zylinderkopf (17) umfaßt.

4. Motor (10) nach Anspruch 3, wobei jede Zylinderbüchse (18) ein Ende (50), welches den Zylinderkopf (17) kontaktiert und eine ringförmige Nut (51) an dem Ende (50) besitzt, und wobei die Dichtung (52) einen zusammendrückbaren Ring (53) umfaßt, der innerhalb der Nut (51) zwischen der mittig getragenen Zylinderbüchse (18) und dem Zylinderkopf (17) angeordnet ist.

5. Motor (10) nach einem der vorhergehenden Ansprüche, wobei jede Bohrung (34) in dem oberen Blockteil (16) eine erste Haltenut (76) besitzt und die entsprechende flexible Dichtung (80), die in der Nut (76) angeordnet ist, in



abdichtender Weise die Zylinderbüchse (18) kontaktiert.

6. Motor (10) nach Anspruch 5, wenn dieser abhängig ist von einem der Ansprüche 2 bis 4, wobei die Dichtmittel (24) weiterhin eine zweite Haltnut (78) innerhalb des oberen Blockteil (16) umfaßt und eine zweite flexible Dichtung (82) innerhalb der zweiten Nut (78) angeordnet ist, und in abdichtender Weise den unteren Blockteil (15) kontaktiert. 5 10
7. Motor (10) nach einem der vorhergehenden Ansprüche, wobei der untere Blockteil (15) eine Mehrzahl von darin befindlichen Gewindebohrungen (38) umfaßt, der Zylinderkopf (17) eine Mehrzahl von darin befindlichen Löchern (40) umfaßt, der obere Blockteil (16) eine Mehrzahl von darin befindlichen Löchern (42) umfaßt, und die Befestigungsmittel (23) eine Mehrzahl von Befestigern (36) umfaßt, welche sich durch die Löcher (40, 42) in dem Zylinderkopf (17) und dem oberen Blockteil (16) erstrecken und Gewindemäßig mit der Mehrzahl von Gewindebohrungen (38) in Eingriff stehen. 15 20 25
8. Motor (10) nach einem der vorhergehenden Ansprüche mit einer Nockenwelle (20) und wobei der obere Blockteil (16) eine darin befindliche Bohrung (98) besitzt, die sich im wesentlichen entlang der Länge des oberen Blockteils (16) und versetzt von und senkrecht zu der hindurchgehenden Bohrung (34) in dem oberen Blockteil (16) erstreckt, wobei die Nockenwelle (20) drehbar in der Bohrung (98) angeordnet ist. 30 35
9. Motor (10) nach einem der vorhergehenden Ansprüche, wobei der obere Blockteil (16) aus einer Aluminiumlegierung hergestellt ist. 40
10. Motor (10) nach einem der vorhergehenden Ansprüche mit einer Kühlsammelleitung (64) mit einem darin befindlichen und mit dem Flüssigkeitskühlsystem (21) verbundenen Durchlaß (63), wobei die Kühlsammelleitung (64) in abgedichteter Weise an der äußeren Kante des oberen Blockteils (16) befestigt ist und sich im wesentlichen entlang der gesamten Länge des oberen Blockteils (16) erstreckt, welcher einen entsprechenden Durchlaß (66) verbunden mit dem entsprechenden Ringraum (48) und dem Durchlaß (63) besitzt. 45 50 55