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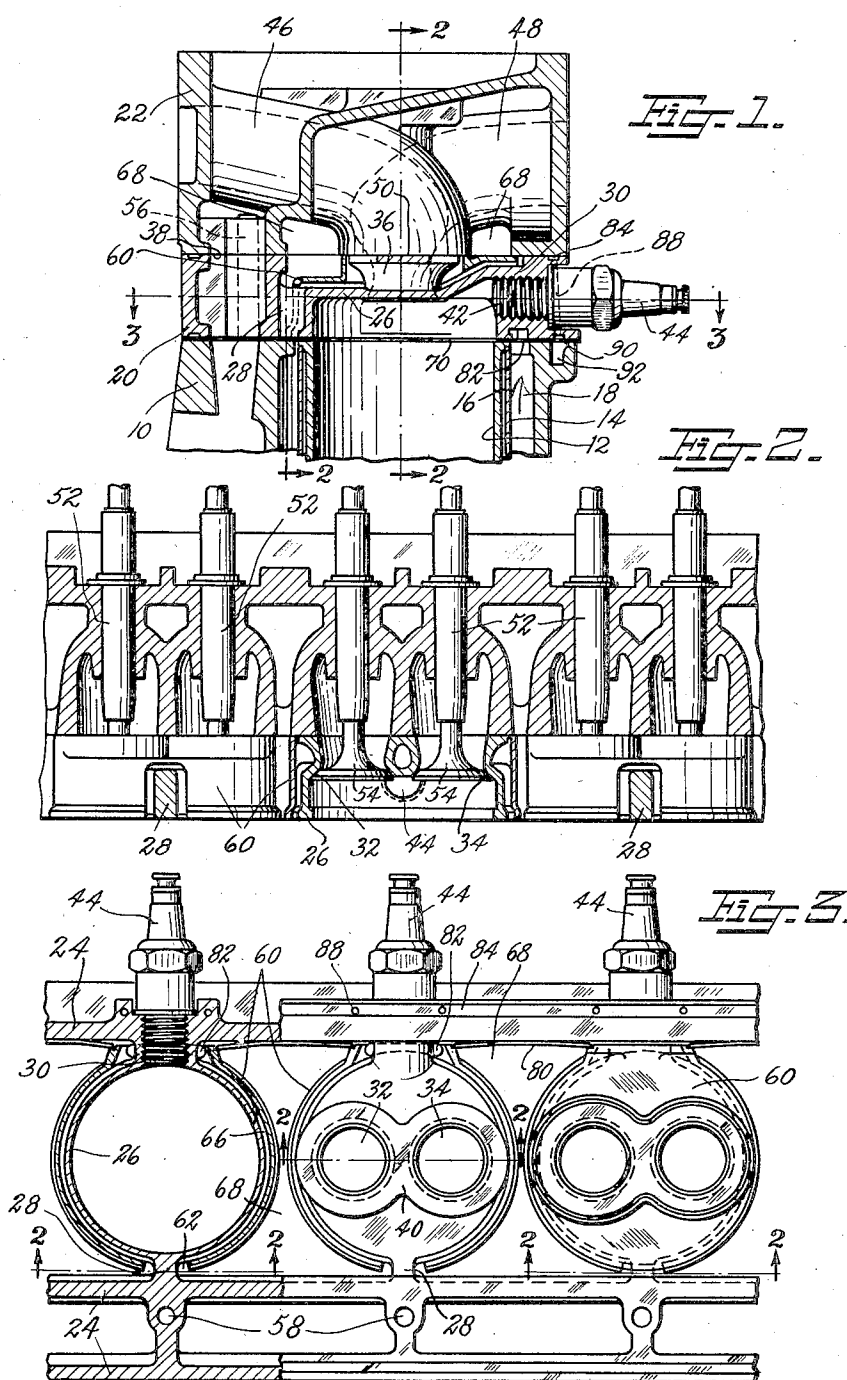
N. F. ANDERSSON

2,029,602

INTERNAL COMBUSTION ENGINE

Filed April 7, 1934

2 Sheets-Sheet 1



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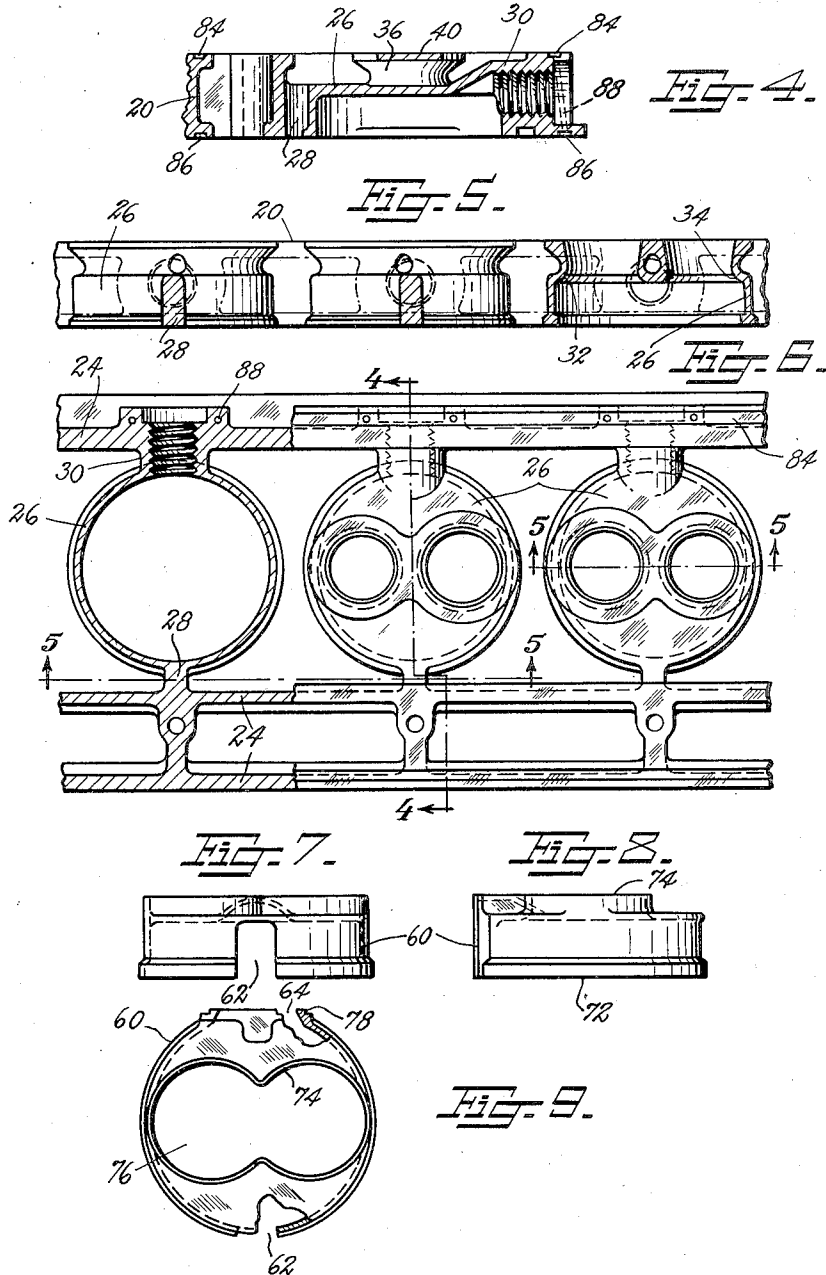
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UNITED STATES PATENT OFFICE

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INTERNAL COMBUSTION ENGINE

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In Germany April 13, 1933

14 Claims. (Cl. 123—173)

The present invention relates to internal combustion engines and has particular reference to internal combustion engines of the kind in which cooling is effected by circulation of oil in thin films over the portions of the engine cylinder or cylinders which require cooling. Still more particularly the invention relates to internal combustion engines of the above kind in which cooling is effected by circulation of oil in thin films under pressure as disclosed in the application of Fredrik Ljungström, Serial No. 661,250, filed March 17, 1933.

In engines in which cooling is effected in the above described manner, it is important that jacket spaces be provided the dimensions of which can be made accurate within close limits, and this is usually accomplished by using separate parts to provide the walls defining the jacket spaces. Such construction involves the use of a greater number of parts than in the forms of construction in which the engine's jackets are cast integrally with the cylinders and cylinder heads, and a general object of the present invention is to provide an improved form of construction in which these parts, which must be most accurately formed if jacket spaces with required accuracy are to be produced, may be made in the form of a relatively simple and easily produced casting.

The invention is particularly concerned with the cylinder head structure, and in order to secure the results which it is the object of this invention to obtain, a cylinder head structure is employed in which separate upper and lower cylinder head parts are provided, between which parts one or more separate fluid guiding members are interposed to provide the channels for circulation of cooling oil in thin films over the combustion chamber walls forming a portion of the structure of the lower cylinder head part.

The more specific nature of the invention, together with further and more detailed objects thereof may best be understood from a consideration of the ensuing description of a preferred form of construction for a multiple cylinder engine of the overhead valve type. It will be understood that the invention is equally applicable to single cylinder engines.

In the accompanying drawings forming a part of this specification and illustrating the embodiment herein described:

Fig. 1 is a vertical section, partly in elevation, of the upper portion of an engine cylinder embodying the invention;

Fig. 2 is a longitudinal section taken on the

lines 2—2 of Figs. 1 and 3 and showing three of the cylinders of a multiple cylinder engine;

Fig. 3 is a plan view, partly in section, of the structure shown in Fig. 2 and taken approximately on the line 3—3 of Fig. 1;

Fig. 4 is a section taken on the line 4—4 of Fig. 6;

Fig. 5 is a section taken on the line 5—5 of Fig. 6;

Fig. 6 is a plan view, partly in section, of a cylinder head part;

Fig. 7 is a side elevation of a fluid guiding member forming part of the cylinder head structure;

Fig. 8 is a side elevation of the member shown in Fig. 7 and taken at right angles to Fig. 7; and

Fig. 9 is a top plan view, partly in section, of the member shown in Fig. 7.

Referring now to the drawings, 10 indicates the main cylinder block of a multiple cylinder engine in which are located cylinder barrels 12 and oil cooling jackets 14. The members 12 and 14 provide oil cooling jacket spaces 16 for the separate cylinders which are in communication with a common chamber 18 in the block 10, to which the cooling oil is supplied.

The cylinder head structure comprises a lower cylinder head part 20 and an upper cylinder head part 22. The terms "upper" and "lower" as used herein refer to an engine in which the cylinders are vertically upright in the usual manner, the lower cylinder head part 20 constituting an intermediate part between the main cylinder block and the upper cylinder head part 22. The lower cylinder head part is formed by a casting which comprises an outer rim portion designated generally at 24, and a plurality of transverse portions 26 forming the walls of the combustion chambers of the several cylinders. The transverse portions 26 are joined to the side walls of the rim portion 24 by means of the laterally extending ribs 28 and 30, and, as will be observed from Figs. 3, 5 and 6, these transverse portions are longitudinally separated. The reason for such separation will be explained later. Each of the transverse portions 26 is provided with valve seat openings 32 and 34 from which openings short, upwardly extending gas passages are formed by the walls 36. As will be observed from Fig. 1, the rim portion of the lower cylinder head part has a plane face 38, and walls 36 terminate in an upper plane face 40 lying in the same plane as the face 38 of the rim portion.

The lateral ribs 30 are relatively heavy in cross-section and are provided with suitable threaded

bores 42 for spark plugs 44. The upper cylinder head part is in the form of a casting having a plane rim-like lower face adapted to engage the upper face 38 of the lower cylinder head part 20 and having cored therein the gas passages 46 and 48, the walls of which terminate in plane surfaces 50, adapted to contact the surfaces 40 of the lower cylinder head part. Passages 46 and 48 register with the valve seat openings 32 and 34 in the lower cylinder head part, and the upper cylinder head part is provided with the valve guides 52 for valves 54, which are adapted to engage the valve seats provided by openings 32 and 34. The upper and lower head parts are held against lateral displacement with respect to each other by means of a number of dowel pins 56 fitting in suitable holes 58 in the two cylinder head parts. A plurality of fluid guiding members 60 are interposed between the two cylinder head parts. These members, as will be seen from Figs. 7 to 9, may be said to be generally cup-like in form, and are adapted to fit over and generally encompass the combustion chamber walls formed by the transverse portions 26 of the lower cylinder head part. At their opposite sides the members 60 are cut away as at 62 and 64 to provide spaces for the laterally extending ribs 28 and 30. As will be observed from Fig. 3, the cut-away portions 62 of members 60 are wider than the width of the ribs 28, so as to provide communication between the jacket space 66 and the spaces 68 between adjacent guide members.

The lower face of the lower cylinder head part is plane and is adapted to seat against a plane gasket 70 interposed between this part and the upper plane face of the cylinder block 10. The lower faces 72 of the fluid guiding members 60 are also plane and are adapted to seat against the gasket 70 when these members are in operative position between the two cylinder head parts.

As will be seen from Fig. 1, the guiding members 60 are adapted to be held in engagement with the gasket 70 due to contact of the surfaces 50 of the upper cylinder head part with the upper surfaces 74 of the guide members. The upper surfaces 74 of these members are provided at the perimeter of central openings 76 through which the walls 36 of the lower cylinder head part project to make contact with surfaces 50 of the upper cylinder head part. The cylinder head parts are held together by the usual cylinder head bolts (not shown), and the cylinder head structure as a whole is held to the main cylinder block by similar bolts of usual form and arrangement. The openings 64 in the guide members 60 are somewhat wider than the ribs 30, as will be seen from Fig. 3 and the walls of the members adjacent these openings are preferably ridged as at 78 to receive the ends of spring strips 80, which bear against the rim portion 24 and serve to separate the jacket spaces 66 from the intermediate spaces 68 at the side where the strips 80 are located. The gasket 70 is provided with openings 82 (Figs. 1 and 3), which afford communication between the jacket spaces 66 around the combustion chambers and the space 18 in the main cylinder block.

In the above described arrangement, the flow of cooling oil is as follows: Oil is supplied by suitable means (not shown) to the jacket space 16 around the cylinder barrels, from which it flows to the space 18 in the cylinder block. From this space the oil flows through the openings 82 to the jacket spaces 66 around the combustion chamber walls, and from these spaces it flows through

the openings 62 to the space 68 in the upper cylinder head part which surrounds the gas passages. From this space the oil flows through a suitable outlet opening to be conveyed to the usual cooler forming a part of the cooling system. In order to obtain the desired character of oil flow across the walls of the combustion chambers as above described, the gasket 70 is advantageously imperforate above the space 18 except for the openings 82 so that all of the oil passing to the head from space 18 flows through the openings 82 around the walls of the spark plug openings and across the cylinder head jacket spaces to the openings 62. Since in systems of this character the oil is usually circulated under pressure, it is advantageous to provide grooves such as those indicated at 84 and 86 (see Fig. 4) in the upper and lower faces of the lower cylinder head part, which serve as channels for collecting oil leaking past the surfaces which are subjected to pressure. Grooves 84 and 86 are conveniently connected by means of passages 88 so that oil from groove 84 can drain into groove 86. Groove 86 is connected through a suitable opening 90 in the gasket 70 with a drain groove 92 in the main block 10, from which groove oil is removed through a suitable drain passage (not shown).

A construction such as that just described provides a number of important advantages, of which the most important are summarized below:

By making the cylinder head structure of two separable parts the castings required for these parts are made relatively simple and free from complicated coring. Furthermore, the use of the separable parts with the separately inserted fluid guiding members makes it relatively simple and easy to obtain passages for cooling fluid which are uniformly carried to fine close limits. This is a highly important factor in constructions adapted to be used with oil cooling of the kind contemplated.

By making the upper and lower faces of the lower cylinder head part plane, and by having all of the faces forming joints located in common planes, the machining of the parts is rendered simple and inexpensive, and this arrangement further makes practical the production of sufficiently smooth and accurate faces of the two cylinder head parts to enable these parts to be joined without using an intermediate gasket.

The fluid guiding members may be either cast or pressed from sheet metal, and, as will be observed from the drawings, the joints between these members and the parts with which they are in contact are arranged so that they are not subjected to the high pressures generated within the combustion chamber. This enables the gasketless joint structure between the head parts to be employed without risk either of leakage of combustion gases into the oil space, or the leakage of oil into the combustion space or gas passages.

The construction of the lower cylinder head part is particularly advantageous because of the manner in which expansion and contraction are permitted without setting up undesirable strains in the cylinder head structure.

In oil cooling systems of the character described, the combustion chamber walls attain relatively high temperatures during normal operation, these temperatures being in many instances considerably above the temperature which the rim portion of the cylinder head part attains in normal operation. By forming the lower cylinder head part in the manner described, ex-

pansion of the transverse portions of the cylinder head part which form the combustion chamber walls can take place relatively freely, since the long side walls of the rim portions of the casting provide a certain degree of flexibility readily permitting lateral expansion. By separating the transverse portions of the cylinder head parts full freedom for expansion longitudinally is provided for the combustion chamber walls, whereas if the transverse portions forming the combustion chamber walls were joined longitudinally, the combined expansion of all of the combustion chambers would produce highly undesirable strains in the casting, since the total longitudinal expansion of all the transverse portions in normal operation is considerably greater than the longitudinal expansion of the sides of the rim portion.

From the foregoing description it will be evident to those skilled in the art that changes and modifications in the specific construction described by way of illustration may be made without departing from the spirit and scope of the invention, which is to be understood as embracing all structures falling within the terms of the appended claims.

What I claim is:

1. In an oil-cooled internal combustion engine of the kind in which cooling oil is forced over the cylinder parts in thin films, a cylinder head structure comprising a lower part providing combustion chamber walls having valve seat and spark plug openings therein, an upper part having valve guides and gas passages therein, and separate means interposed between portions of said parts shaped to guide cooling oil in thin films over substantially the entire area of said combustion chamber walls.

2. In a multiple cylinder internal combustion engine of the kind in which cooling oil is forced in thin films over the cylinder parts, a cylinder head structure comprising a lower cylinder head part having an outer rim portion and a plurality of transverse portions integral with the rim portion and providing combustion chamber walls for a plurality of cylinders, an upper cylinder head part adapted to be secured to the lower cylinder head part, and separate means interposed between portions of said parts shaped to provide channels for separately circulating cooling oil in thin films over substantially the entire area of the walls of each combustion chamber.

3. In a multiple cylinder internal combustion engine of the kind in which cooling oil is forced in thin films over the cylinder parts, a cylinder head structure comprising a lower cylinder head part having an outer rim portion and a plurality of transverse portions integral with the rim portion and providing combustion chamber walls for a plurality of cylinders, an upper cylinder head part adapted to be secured to the lower cylinder head part, and a plurality of separate fluid guiding members interposed between portions of said cylinder head parts shaped to provide channels for separately circulating cooling oil in thin films over substantially the entire area of the walls of each combustion chamber.

4. In a multiple cylinder internal combustion engine of the kind in which cooling oil is forced in thin films over the cylinder parts, a cylinder head structure comprising a lower cylinder head part having an outer rim portion and a plurality of integral transverse portions connected to the opposite sides of the rim portion by laterally extending ribs, each of said transverse portions providing combustion chamber walls for a sep-

arate cylinder having valve seat openings therein and one of the ribs associated with each of said transverse portions having a spark plug opening therein, an upper cylinder head part having valve guides and gas passages therein, and a plurality of separate fluid guiding members interposed between said cylinder head parts shaped to provide channels for separately circulating cooling oil in thin films over substantially the entire area of the walls of each combustion chamber.

5. In a multiple cylinder internal combustion engine of the kind in which cooling oil is forced in thin films over the cylinder parts, a cylinder head structure comprising a lower cylinder head part having an outer rim portion and a plurality of longitudinally separated transverse portions connected to the opposite sides of the rim portion by laterally extending ribs, each of said transverse portions providing combustion chamber walls for a separate cylinder having valve seat openings therein and one of the ribs associated with each of said transverse portions having a spark plug opening therein, an upper cylinder head part having valve guides and gas passages therein, and a plurality of separate fluid guiding members interposed between said cylinder head parts shaped to provide channels for separately circulating cooling oil in thin films over substantially the entire area of the walls of each combustion chamber.

6. In a multiple cylinder overhead valve internal combustion engine of the kind in which cooling oil is forced in thin films over the cylinder parts, a cylinder head structure comprising a lower cylinder head part having an outer rim portion and a plurality of longitudinally separated circular transverse portions connected to the opposite sides of the rim portion by laterally extending integral ribs, said transverse portions providing combustion chamber walls having valve seat openings therein, an upper cylinder head part having valve guides and gas passages therein, and a plurality of generally cup-shaped fluid guiding members interposed between portions of said cylinder head parts, each of said members being spaced from one of said transverse portions and shaped to provide space for circulation of cooling oil in thin films over substantially the entire area of the walls of each combustion chamber.

7. In an internal combustion engine of the kind in which cooling oil is forced in thin films over the cylinder parts a cylinder head structure comprising a lower cylinder head part providing combustion chamber walls having valve seat and spark plug openings therein, said part having a plane upper face, an upper cylinder head part having valve guides and gas passages therein and a plane lower face adapted to seat against the upper face of the lower cylinder head part, and a fluid guiding member interposed between portions of said cylinder head parts, said member being shaped to provide space for circulation of cooling oil in thin films over substantially the entire area of the walls of the combustion chamber, and having an upper face adapted to be engaged by a portion of the lower face of said upper cylinder head part.

8. In a multiple cylinder overhead valve internal combustion engine of the kind in which cooling oil is forced in thin films over the cylinder parts, a cylinder head structure comprising a lower cylinder head casting having a rim portion and a plurality of transverse portions joined to the rim portion by laterally extending ribs, each

of said transverse portions providing combustion chamber walls for a different cylinder having valve seat openings and walls forming gas passages projecting upwardly from said valve seat openings, the ends of the last-mentioned walls and the upper face of the rim portion lying in the same plane, an upper cylinder head casting having a plane lower face and walls providing gas passages adapted to register with the gas passages in said lower casting, and fluid guiding members interposed between said castings and shaped to form spaces for circulation of cooling oil in thin films over substantially the entire area of said combustion chamber walls, said members having upper faces adapted to abut against cooperating face portions of the plane lower face of the upper casting.

9. Cylinder head structure for an oil cooled engine comprising a casting having a rim portion and a transverse portion connected to the rim portion by laterally extending ribs, said transverse portion forming combustion chamber walls for a cylinder and one of said ribs having a spark plug opening therein and a fluid guiding member adapted to fit over said transverse portion and shaped to form jacket space for circulation of cooling oil in thin films over substantially the entire area of said combustion chamber walls, said fluid guiding member having cut-away portions through which said ribs pass and there being space between said ribs and the edges of said cut-away portions to provide an inlet and an outlet for said jacket space.

10. In a multiple cylinder internal combustion engine of the kind in which cooling oil is forced in thin films over the cylinder parts, a cylinder head structure comprising a lower cylinder head part having an outer rim portion and a plurality of integral transverse portions connected to the opposite sides of the rim portion by laterally extending ribs, each of said transverse portions providing combustion chamber walls for a separate cylinder and each of said transverse portions being separated from the remaining transverse portions, an upper cylinder head part adapted to be secured to the lower cylinder head part, and separate means interposed between portions of said parts providing channels for separately circulating cooling oil in thin films over substantially the entire area of the walls of each combustion chamber.

11. In a multiple cylinder internal combustion engine of the kind in which cooling oil is forced in thin films over the cylinder parts, a cylinder head structure comprising a lower cylinder head part having an outer rim portion and a plurality of longitudinally separated transverse portions connected to the opposite sides of the rim portion by laterally extending ribs, each of said transverse portions providing combustion chamber walls for a separate cylinder having valve seat openings therein and one of the ribs associated with each of said transverse portions having a spark plug opening therein, an upper cylinder head part having valve guides and gas passages therein, and a plurality of separate fluid guiding members interposed between said cylinder head parts, each of said fluid guiding members encompassing the perimetral walls of a separate combustion chamber to provide a channel for circulating cooling oil in thin films over such walls and having a top portion closely adjacent the top combustion chamber wall to provide a channel for circulating cooling oil in a thin film over said top combustion chamber wall.

12. In an internal combustion engine of the kind in which cooling oil is forced in thin films over the cylinder parts, a cylinder head structure comprising a lower cylinder head part providing combustion chamber walls having valve seat and spark plug openings therein, said part having an upper face comprising plane portions, an upper cylinder head part having valve guides and gas passages therein and a lower face comprising plane portions adapted to seat against complementary plane portions of the upper face of the lower cylinder head part, and a fluid guiding member interposed between portions of said cylinder head parts, said member providing space for circulation of cooling oil in thin films over substantially the entire area of the walls of said combustion chamber and having an upper face adapted to be engaged by a portion of the lower face of said upper cylinder head part to hold said member in position.

13. In a multiple cylinder overhead valve internal combustion engine of the kind in which cooling oil is forced in thin films over the cylinder parts, a cylinder head structure comprising a lower cylinder head casting having a rim portion and a plurality of transverse portions joined to the rim portions by laterally extending ribs, each of said transverse portions being longitudinally spaced from the adjacent transverse portions at each side thereof and providing combustion chamber walls for a different cylinder having valve seat openings and walls forming gas passages projecting upwardly from said valve seat openings, an upper cylinder head casting having walls providing gas passages adapted to register with the gas passages in said lower casting, and separate fluid guiding members interposed between said castings, said fluid guiding members being generally cup-shaped and providing spaces around said combustion chamber walls for circulation of cooling oil in thin films, and said members having upper faces adapted to abut against cooperating face portions of the lower face of the upper casting to hold them in position.

14. In a multiple cylinder overhead valve internal combustion engine of the kind in which cooling oil is forced in thin films over the cylinder parts, a cylinder head structure comprising a lower cylinder head casting having a rim portion and a plurality of transverse portions joined to the rim portion by laterally extending ribs, each of said transverse portions being longitudinally spaced from the adjacent transverse portions at each side thereof and providing combustion chamber walls for a different cylinder having valve seat openings and walls forming gas passages projecting upwardly from said valve seat openings, at least one of the laterally extending ribs associated with each of said transverse portions having a spark plug opening there-through, an upper cylinder head casting having walls providing gas passages adapted to register with the gas passages in said lower casting, and a plurality of separate fluid guiding members interposed between said castings to form spaces for circulation of cooling oil in thin films around said combustion chamber walls, each of said fluid guiding members being of generally cup-like form and having recesses through which said laterally extending ribs extend and an upper face adapted to abut against the ends of the walls providing the gas passages in said upper cylinder head casting.