Sept. 23, 1969 A. M. CASTAREDE 3,468,295

CYLINDER HEADS OF INTERNAL COMBUSTION ENGINES

Filed Oct. 16, 1967 2 Sheets-Sheet 1

FIG. 8

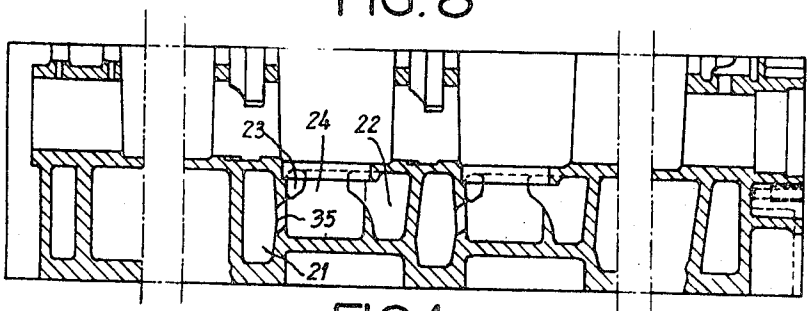


FIG. 1

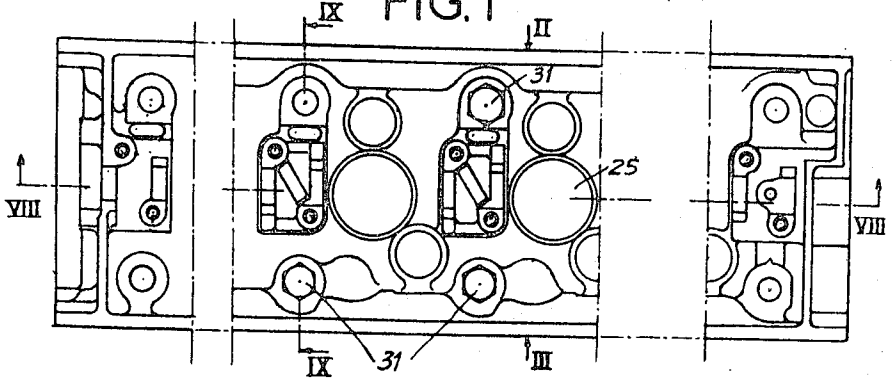


FIG. 4

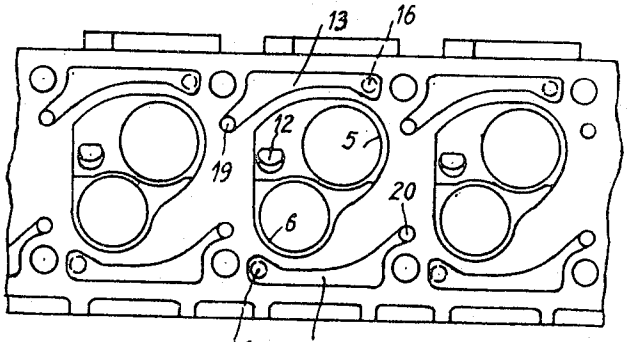


FIG. 7

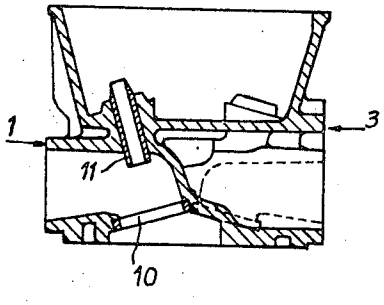
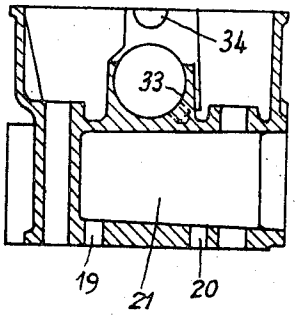


FIG. 9



Sept. 23, 1969 A. M. CASTAREDE 3,468,295

CYLINDER HEADS OF INTERNAL COMBUSTION ENGINES

Filed Oct. 16, 1967 2 Sheets-Sheet 2

FIG.5

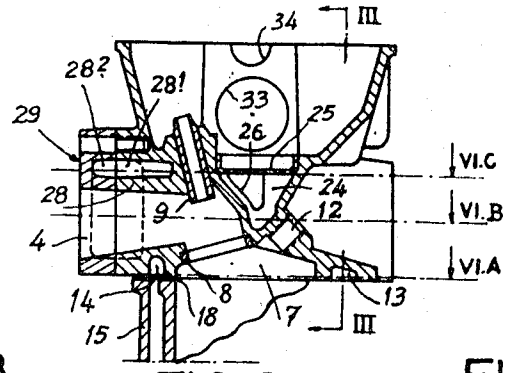


FIG.3

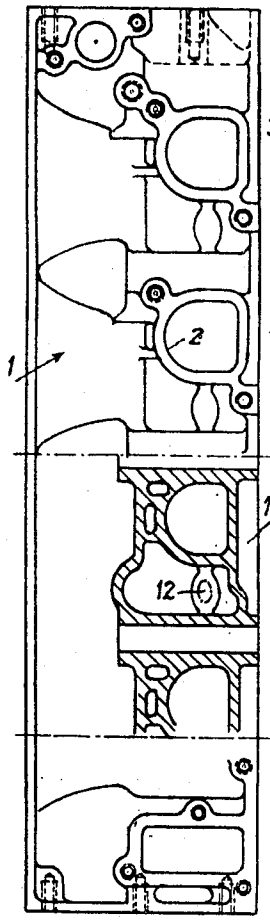
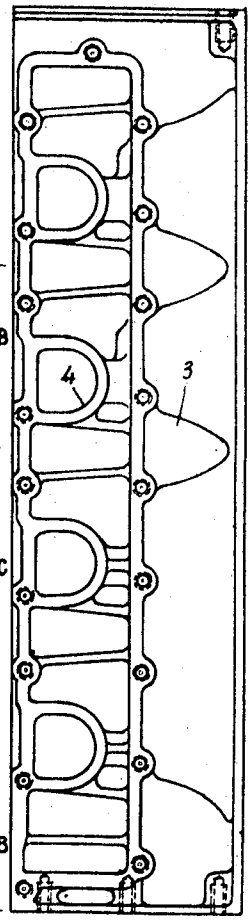


FIG.6

FIG.2



United States Patent Office 3,468,295 Patented Sept. 23, 1969

3,468,295

CYLINDER HEADS OF INTERNAL COMBUSTION ENGINES

Armand M. Castarede, Billancourt, France, assignor to Regie Nationale des Usines Renault, Billancourt, France, and Societe Industrielle et Commerciale des Automobiles Peugeot, Paris, France

Filed Oct. 16, 1967, Ser. No. 675,407
Claims priority, application France, Nov. 8, 1966, 82,893
Int. Cl. F02b 75/20; F02f 1/36
U.S. Cl. 123—41.74 3 Claims

ABSTRACT OF THE DISCLOSURE

A metal die-cast cylinder head for a water-cooled, overhead camshaft internal combustion engine having the valves disposed on either side of the longitudinal plane containing the axes of the engine cylinders, said valves being inclined in relation to said axes, and combustion chambers of semi-spherical configuration into which open the inlet and exhaust ports leading to the cylinder head side adjacent to the corresponding valves, characterised in that the valves of same combustion chamber have their centers disposed on a line forming an angle of 40° to 60° with said longitudinal plane.

This invention relates to improvements in the design of internal combustion engine cylinder heads with a view to facilitate the die casting thereof.

This invention is concerned more particularly with light alloy cylinder heads of the type comprising semi-spherical combustion chambers for water-cooled, overhead camshaft internal combustion engines, which are designed to constitute a one-piece main casting produced in a high-speed automatic die-casting machine.

The advantage of manufacturing a cylinder head of this type according to the die-casting technique is obvious to anybody conversant with the art, but it is also known that serious difficulties are experienced when attempting to die-cast parts of this character under satisfactory conditions, i.e. by maintaining a high production rate and at the same time a high quality standard at a cost comparing favorably with parts produced according to any other known methods.

Another requirement is that an easier casting operation cannot be obtained at the expense of the technical characteristics of the part, notably by modifying the cooling efficiency thereof or making it more brittle.

Experience teaches that these requirements cannot be met unless the thicknesses of the various internal and external walls and partitions of the cylinder head are kept at values as constant as possible.

This obviously leads to strictly banish the use of pins or pegs for forming longitudinal water passages or ducts in the cylinder head, for on the one hand these pins must have a substantial taper whereby the cross-sectional area of the resulting passage decreases appreciably from the ends to the middle of the cylinder head, the thickness of the corresponding walls increasing, on the contrary, at least at various locations, thus impairing the cooling efficiency; on the other hand, these pins must also fit through other mould impressions and therefore require an accurate and costly adjustment; besides, removing these pins from the mould is a time-robbing operation

and reduces the production rate, not to mention their great fragility and the fact that their breakage is not an exceptional occurrence, thus further reducing said production rate.

The present invention provides a cylinder head consisting of a one-piece main casting wherein the arrangement of the various portions is selected and the design thereof improved with a view to permit a high-rate production of identical cylinder heads by using an equipment free of any pins, spindles or pegs.

More particularly, the die-cast cylinder head according to this invention for a water-cooled, overhead camshaft internal combustion engine, wherein the valves are disposed on either side of a longitudinal plane containing the axes of the engine cylinders and inclined in relation to said plane, with semi-spherical combustion chambers connected to the inlet and exhaust ports opening on the cylinder-head side corresponding to the relevant valves, is characterised in that:

The valve of a same chamber have their centers disposed on a line forming an angle of 40° to 60° with said longitudinal plane;

The spark plugs are disposed between the inlet ports;

The cooling circuit comprises, around the exhaust ports, cavities disposed transversely to said longitudinal plan and widening towards the adjacent side so that they can be formed during the die-casting operation by means of projections carried by the side walls of the mould, and furthermore, at the top of each combustion chamber, another cavity widening upwards so that these cavities can likewise be obtained by means of mould projections, these last-named top cavities being adapted subsequently to be sealed by a plug, the first-named transverse cavities being sealed by a lid causing them to communicate with one another and constituting a longitudinal water outlet;

Said transverse cavities communicate with said combustion chamber cavities through passages formed at least partially during the die-casting operation;

Said transverse cavities are connected to water supply passages consisting of recesses formed in the gasket or joint plane of the cylinder head and extending beneath the inlet and exhaust ports;

Said recesses have one end connected with a feed hole formed in the cylinder-head gasket and the opposite end connected to the aforesaid transverse cavities.

A typical form of embodiment of a cylinder head according to this invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a fragmentary plan view from above of a cylinder head according to this invention;

FIGURE 2 is a side view of the cylinder head, as seen in the direction of the arrow II of FIGURE 1;

FIGURE 3 is another side view of the cylinder head but as seen in the direction of the arrow III of FIGURE 1, with a fragmentary section taken upon the line III—III of FIGURE 5;

FIGURE 4 is a plan view from beneath of the cylinder head;

FIGURE 5 is a cross section taken upon the line V—V of FIGURE 6 along the axis of an exhaust valve seat on the one hand and the axis of a tapped spark-plug hole on the other hand;

FIGURE 6 is a fragmentary horizontal section taken upon the lines VIA—VIA, VIB—VIB and VIC—VIC of FIGURE 5;

FIGURE 7 is a cross section taken through the axis of an inlet port;

FIGURE 8 is a longitudinal section of the cylinder head, taken upon the line VIII—VIII of FIGURE 1; and

FIGURE 9 is a cross section taken upon the line IX—IX of FIGURE 1.

The cylinder head illustrated by way of example in the drawings is of a type suitable for a four-cylinder engine, but it will readily occur to anybody conversant with the art that the cylinder head structure according to this invention is applicable as well to an engine having a greater number of cylinders, for example a six-cylinder engine.

This cylinder head comprises a lateral wall **1** into which open the inlet ports **2**, and an opposite lateral wall **3** into which open the exahust ports **4**. These inlet and exhaust ports lead on the the other hand respectively at **5** and **6** into combustion chambers **7** of the so-called semi-spherical type.

In FIGURE 5, the reference numeral **8** designates the seat of an exhaust valve having a guide **9**, and in FIGURE 7 the reference numeral **10** designates an inlet valve seat, **11** being the corresponding valve guide.

The axes of the inlet and exhaust valve seats of each cylinder are disposed on either side of the cylinder axis on a line *a–b* inclined by about 50° to the longitudinal center line AB of the cylinder head, this angle lying as already disclosed within the range of 40° to 60°. From the following disclosure it will be readily apparent that this arrangement is particularly adequate for properly designing the cooling circuit path around the exhaust ports while giving to the inlet valves and ports the maximum desirable dimensions; neither the side-by-side disposal of the valves along the longitudinal center line of the cylinder head, nor the disposal of these valves on either side of this line, i.e. on an axis extending at right angles thereto, would be adequate. A tapped hole **12** receiving the spark plug opens into the combustion chamber in the vicinity of the inlet valve seat. Thus, the spark plugs are disposed in the hollows formed between adjacent inlet ports as clearly shown in FIGURE 3.

Moreover, the cooling circuit is completed by cavities **13** and **14** formed beneath the inlet and exhaust pipes, their shapes being visible in elevation in FIGURE 5 and in plane view in FIGURES 4 and 6.

The cooling water from the cylinder block roughly sketched at **15** in FIGURE 5 is delivered by a conventional water pump (not shown) and flows through the holes **16** and **17** of the cylinder head gasket **18** into said cavities **13** and **14** (these holes being therefore shown in dash lines in FIGURE 4).

The water subsequently flows through holes **19, 20** into the water chambers surrounding the exhaust ports, said chambers consisting of cavities **21, 22** and **23** all of which open into the lateral wall **3**. These cavities have a cross-sectional area tapering down from this wall inwards, so that they can easily be formed by conventional die-casting technques by means of projections carried by the corresponding inner faces of the side walls of the mould.

It will also be noted that said cavities **21, 22** and **23** properly surround the exhaust ports **4** except the central portion thereof, in the vicinity of the inlet ends of these ports which open into the combustion chamber. This end portion of each exhaust port is cooled by providing cavities **24** formed in the space available between each exhaust port and the inlet port and also the relevant spark plug.

These last-named cavities **24** are substantially funnel-shaped as shown in FIGURE 5 and also result from the penetration of mould projections during the die-casting operation, these projections being an integral part of the upper portion of the mould, thereby removing the hitherto known difficulties resulting from the use of pins. The arrangement of the inlet and exhaust ports and of the spark plug hole is such that these cavities **24** can be given a shape widening considerably upwards, thus facilitating

inasmuch the stripping of the part from the mould. On the other hand, their horizontal sections can be designed to follow as close as possible the port contours so as to maintain very regular wall thicknesses throughout, a feature particularly beneficial for producing sound castings characterised by a uniform cooling in actual service.

The aforesaid cavities **24** are adapted to be sealed at their top by a plug **25**. Under these plugs the cavities **24** (as shown in FIGURE 6, section VIC) permit the mutual communication of cavities **22** and **23** through passages **26** and **27**.

Besides, during the cylinder head machining operations a hole **35** connecting the cavity **21** with the lower portion of cavity **24** (see FIGURE 8) is formed through the partition separating these cavities. The cooling water flowing into said cavity **21** through the hole **19** as already explained hereinabove can thus flow through the cavity **24** and subsequently through cavities **22** and **23**.

The water circulating through the various cylinder-head cavities is discharged via a longitudinal passage or duct **28** comprising a first portion 28^1 pertaining to the cylinder head and of a second portion 28^2 formed in a sealing plate **29** fitted to the lateral face **3** of the cylinder head so as to isolated all the water chambers from the outside while interconnecting them.

The duct **28** leads to a water outlet port **30**.

In connection with the specific cylinder head design according to this invention it may also be emphasized that the bolts used for fastening it to the cylinder block are disposed substantially at the corners of a square, for each cylinder, as shown at **31** in FIGURE 1.

On the exhaust ports side these bolts extend through the water cavities **21** (see FIGURE 6) and the tightening efforts are transmitted through the pair of lateral ribs constituting the sides of these cavities, said ribs being reinforced accordingly.

It may also be noted that the above-described arrangement is such that the bearings **33** for supporting the camshaft and the half-bearings **34** intended for supporting the rocker shafts (not shown) can be cast integrally with the cylinder head.

While the above description refers to a single form of embodiment of the cylinder head constituting the subject-matter of this invention, it will be readily understood that this construction is given by way of example only and that various modifications and variations may be brought thereto without departing from the spirit and scope of the invention.

I claim:

1. A metal die-cast cylinder head for water-cooled, overhead camshaft internal combustion engines having the valves disposed on either side of the longitudinal plane containing the axes of the engine cylinders, said valves being inclined in relation to said axes, and combustion chamber of semi-spherical configuration into which open the inlet and exhaust ports leading to the cylinder head side adjacent to the corresponding valves, the valves of each combustion chamber have their centers disposed on a line forming an angle of 40° to 60° with said longitudinal plane, ignition spark plugs disposed adjacent the inlet ports, and a cooling circuit comprising, about the exhaust ports, a plurality of cavities extending transversely to the aforesaid longitudinal plane, and having cross-sectional dimensions increasing towards the sides of the cylinder head so that they can be formed during the die-casting operation by means of inner projections carried by the mould, and, above each combustion chamber, another cavity flaring upwards so as to be likewise adapted to be formed by a mould projection and to receive a sealing plug therein, said transverse cavities being sealed by a lid whereby they communicate with each other to constitute a longitudinal water outlet passage, said transverse cavities further communicating with said upflaring cavity through passages formed at least partially by moulding.

2. A cylinder head according to claim 1 in which said transverse cavities are also connected to water passages consisting of recesses formed in the plane of a cylinder head gasket and extending beneath the inlet and exhaust ports.

3. A cylinder head according to claim 1 in which said recesses have one end connected to a supply hole formed in a cylinder head gasket and the other end connected to said transverse cavities.

References Cited

UNITED STATES PATENTS

1,608,759	11/1926	Angle	123—41.77
2,395,712	2/1946	Bachle	123—41.76 X
2,767,694	10/1956	Boghossian.	
2,954,023	9/1960	Lampredi.	
2,974,654	3/1961	Bouvy.	
3,094,977	6/1963	Sampietro.	
3,186,387	6/1965	Kolbe et al.	123—41.82 X
3,219,019	11/1965	Palmer.	
3,221,723	12/1965	Williamson	123—41.82 X
3,306,271	2/1967	Turlay.	

AL LAWRENCE SMITH, Primary Examiner

U.S. Cl. X.R.

123—59, 41.82, 193, 195