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(54) **A head of light material for internal combustion engines, with sintered steel inserts, and a method for its manufacture.**

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Description

BACKGROUND TO THE INVENTION

The present invention derives from research which aims to enable the generalised use of light materials (typically aluminium and its alloys) for producing heads for internal combustion engines with excellent qualities of thermal-shock resistance, particularly in the region of the so-called bridge separating two adjacent intake/exhaust valves which open into the top of the cylinder of the engine.

The requirement to produce heads of this type is particularly marked in compression-ignition (diesel-cycle) engines, possibly supercharged.

The use of inserts (for example, composites of aluminium and silicon carbide fibres) which are intended to be incorporated by fusion in the mass of light alloy constituting the head, in correspondence with the parts exposed to the combustion chambers of the engine, has already been suggested for this purpose in the past.

This solution, however, encounters the difficulty of obtaining a good anchorage of the material of the inserts to the light-alloy mass, since the fibres of the insert give rise to problems of wettability by the alloy in the fused state.

Moreover, this solution is rather expensive due to the high cost of the fibres used to make the inserts.

OBJECT AND SUMMARY OF THE INVENTION

The object of the present invention is to provide a head for internal combustion engines, having the features set forth in the pre-characterising portion of Claim 1, which is known, e.g. from US-A-3081754 of indirectly, GB-A-711739 having high resistance to the thermal and/or mechanical shocks caused during operation of the engine, and with an intrinsically simple structure which can be produced easily and cheaply on an industrial scale.

According to the present invention, this object is achieved by virtue of a head of the type specified above having the further features called for in Claim 1, e.g. a head characterised in that :

the at least one part (flame plate) is constituted by a sintered steel insert, and

the at least one aperture is defined by a further insert of sintered maraging steel.

For the purposes of a precise understanding of the invention, it should be stated that the term "light material", as used in the present description and in the Claims which follow, should be interpreted in its broadest technical meaning which generally includes aluminium, similar light metals, and alloys thereof.

A further subject of the invention is a method for the production of a head for internal combustion engines of the type specified above.

The invention is based on the production of a head for internal combustion engines of light material (for example, aluminium alloy) which has flame plates with integral valve seats of sintered form.

As well as avoiding any breakages due to thermal shock, this solution has the further technical advantage resulting from the fact that the valve seats integrated in each flame plate are made of sintered maraging steel which has properties of good resistance to wear and impacts when hot.

Moreover, it should be stated that the solution of making the valve seats from sintered maraging steel is — in itself — already known in the art, as can be seen from Italian patent No. 732,610.

The main characteristic of the present invention is that the flame plate is made of conventional sintered steel, whilst the valve seats are made of sintered maraging steel, all — preferably — by means of a single sintering operation. The flame plate/valve seats assembly thus produced is subsequently set into the mass of light alloy constituting the head by fusion.

It is possible, using this method, to obtain optimum adhesion of the insert constituting the flame plate (with the integral valve seats) to the light material constituting the head.

In this way, the possibility of cracks forming in the head due to thermal shock is reduced. The various flame plates of the head are in fact made of a material which has a high resistance to thermal shock.

DETAILED DESCRIPTION OF THE INVENTION

The invention will now be described, purely by way of non-limiting example, with reference to the appended drawings, in which :

Figure 1 is a view of a light-alloy head for an internal combustion engine produced according to the invention, seen from an imaginary point located within one of the cylinders of the engine,

Figure 2 is a section taken on the line II-II of Figure 1,

Figure 3 is a view of another head for an internal combustion engine produced according to the invention, seen from a viewpoint approximately corresponding to that of Figure 1, and

Figure 4 is a section taken on on the line IV-IV of Figure 3.

In the drawings, the part of a head for an internal combustion engine (not illustrated as a whole) which is situated above one of the cylinders of the engine is indicated 1.

More precisely, this is the region of the head which defines the top of the combustion chamber of the cylinder.

The inlet and exhaust ducts 2, 3 open into this portion of the head and are intended to be opened and closed alternately by respective valves, not shown for

clarity of illustration. The tubular sliding ducts for the stems of these valves are visible, however, and are indicated 4.

In the head of Figures 1 and 2, which is a head for compression-ignition (diesel-cycle) engines, the presence of a precombustion chamber 5 is also envisaged — according to a known solution — into which face two seats for the mounting of a fuel injector 6 and a pre-ignition plug 7, respectively.

In the head of Figures 3 and 4, which is a head for a controlled-ignition (Otto-cycle) engine, a central threaded aperture 8 is provided in the top of the cylinder in a central position between the two diametrally-opposed inlet and exhaust ducts 2 and 3, and is intended to house the sparking plug (not shown for clarity of illustration).

In both cases, the body of the head 1 is constituted by a mass of light material, for example, an aluminium alloy.

The parts of the head which are intended to face the tops of the various cylinders of the engine (that is, the flame plates) are, however, constituted by sintered steel inserts 9 incorporated by fusion into the light-alloy mass of the head.

The inserts 9 are generally cylindrical in shape and the end ports of the inlet and exhaust ducts 2 and 3 naturally pass through them.

In the case of the head for compression-ignition engines of Figures 1 and 2, the sintered steel insert 9 constituting the flame plate has an appendage 9a delimiting an approximately cylindrical cavity into which a profiled part 10 for defining the lower portion of the precombustion chamber 5 is inserted (for example, by driving or co-sintering).

Further annular-shaped inserts 11 profiled so as to form the valve seats for the inlet and exhaust valves are incorporated in the sintered steel inserts 9 in correspondence with the end ports of the inlet and exhaust ducts 2 and 3.

The inserts 11 are also produced by sintering, using sintered maraging steel.

This type of steel is widely known in the art, as can be seen by consulting the corresponding entry in the Dizionario d'Ingegneria dell'Unione Tipografico — Editrice Torinese (UTET), vol. VII, page 507-508, Turin — 1974.

Inserts 12 of sintered material similar to that used for producing the flame plates 9 or the valve seats 11 define the tubular sliding ducts for the valve stems.

The heads 1 according to the invention are produced using the powder metallurgy technology, the flame plates 9 and the valve seats 11 being formed separately.

The latter are fitted into the corresponding recesses in the flame plate 9 in the " green " state (that is, only just formed).

The unit thus formed is then sintered.

The material used for making the flame plate 9 is characterised in that it has auto-densifying properties, so that it incorporates the valve seats 11 at the sintering stage. As these valve seats are produced in the same sintering operation, they are permanently fitted in the flame plate 9.

In particular, since the materials constituting the flame plate 9 and the valve seats 11 are both sintered steels, the possibility of cracks forming in the head 1 in use, particularly in the bridging region which separates the two adjacent valve seats 11, is eliminated.

The whole is achieved by means of a simple manufacturing method which can be carried out cheaply on an industrial scale.

Claims

1. A head for an internal combustion engine, including at least one part (9) which is intended to define the top of a respective cylinder of the engine, with at least one aperture (2, 3) defining a seat for a respective valve, wherein the head as a whole is constituted by a mass (1) of light material, characterised in that :

the at least one part (9) is constituted by a sintered steel insert, and

the at least one aperture (2, 3) is defined by a further insert (11) of sintered maraging steel.

2. A head according to Claim 1, characterised in that the sintered steel insert (9) is incorporated in the light-metal mass (1) by fusion.

3. A head according to Claim 1 or Claim 2, characterised in that the further insert (11) of sintered maraging steel is incorporated in the sintered steel insert (9).

4. A head according to any one of Claims 1 to 3 characterised in that the sintered steel insert (9) has at least one aperture for the formation of a precombusion chamber (5), and in that a profiled part (10) which at least partly delimits the precombusion chamber (5) is incorporated in this aperture.

5. A head according to Claim 4, characterised in that the profiled part (10) is driven into the aperture.

6. A head according to Claim 4, characterised in that the profiled part (10) is itself formed of sintered material and is fixed in the aperture upon sintering of the material (co-sintering).

7. A method for producing a head for an internal combustion engine of Claim 1 including at least one part (9) which is intended to define the top of a respective cylinder of the engine, with at least one aperture (2, 3) defining a respective valve seat, characterised in that it includes the steps of :

producing the at least one part (9) in the form of a sintered steel body,

producing at least one further annular body (11) intended to define the at least one aperture from sintered maraging steel,

incorporating the at least one further body (11) of

sintered maraging steel in the sintered steel body (9), and

producing the head (1) in a mass of light material, incorporating the sintered steel body (9), which in turn incorporates the at least one further body (11) of sintered maraging steel, in the mass of light alloy by fusion.

8. A method according to Claim 7, characterised in that it includes the steps of :

forming the at least one further body (11) of maraging steel in a state suitable for sintering,

producing the steel body (9) in a state suitable for sintering,

combining the at least one further body (11) with the said body (9), and

subjecting the steel body (9) combined with the at least one further body (11) of maraging steel to sintering to produce a single element of sintered material, and

incorporating the single element of sintered material in the mass of light material (1) by fusion.

Patentansprüche

1. Zylinderkopf für eine Brennkraftmaschine, mit wenigstens einem zur Begrenzung der Oberseite eines entsprechenden Zylinders der Maschine bestimmten Teils (9), das wenigstens eine Öffnung (2, 3) aufweist, die einen Sitz für ein entsprechendes Ventil begrenzt, wobei der Zylinder als Ganzes aus einer Leichtwerkstoffmasse (1) besteht, dadurch gekennzeichnet,

daß der wenigstens eine Teil (9) aus einem Einsatz aus gesintertem Stahl besteht,

und daß die wenigstens eine Öffnung (2, 3) von einem weiteren Einsatz (11) aus gesintertem Maraging-Stahl begrenzt ist.

2. Zylinderkopf nach Anspruch 1, dadurch gekennzeichnet, daß der Einsatz (9) aus gesintertem Stahl durch Schmelzen mit der Leichtwerkstoffmasse (1) verbunden ist.

3. Zylinderkopf nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der weitere Einsatz (11) aus gesintertem Maraging-Stahl in den Einsatz (9) aus gesintertem Stahl eingebettet ist.

4. Zylinderkopf nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß der Einsatz (9) aus gesintertem Stahl wenigstens eine Öffnung für die Bildung einer Vorbrennkammer (5) besitzt und daß in diese Öffnung ein profiliertes Teil (10) eingesetzt ist, das die Vorbrennkammer (5) wenigstens teilweise begrenzt.

5. Zylinderkopf nach Anspruch 4, dadurch gekennzeichnet, daß das profilierte Teil (10) in die Öffnung eingetrieben ist.

6. Zylinderkopf nach Anspruch 4, dadurch gekennzeichnet, daß das profilierte Teil (10) selbst aus gesintertem Material hergestellt und beim Sintern des Materials in der Öffnung befestigt wird (Zusammensintern).

7. Verfahren zur Herstellung eines Zylinderkopfs für eine Brennkraftmaschine nach Anspruch 1 mit wenigstens einem zur Begrenzung der Oberseite eines entsprechenden Zylinders der Maschine bestimmten Teils (9) mit wenigstens einer Öffnung (2, 3) aufweist, die einen Sitz für ein entsprechendes Ventil begrenzt, gekennzeichnet durch folgende Verfahrensschritte :

Herstellen des wenigstens einen Teils (9) in Form eines Körpers aus gesintertem Stahl,

Herstellen wenigstens eines weiteren ringförmigen Körpers (11) aus gesintertem Maraging-Stahl zur Begrenzung der wenigstens einen Öffnung,

Einsetzen des wenigstens einen weiteren Körpers (11) aus gesintertem Maraging-Stahl in den Körper (9) aus gesintertem Stahl und

Herstellen des Zylinderkopfes (1) aus einer Leichtwerkstoffmasse, wobei der Körper (9) aus gesintertem Stahl, der seinerseits den wenigstens einen weiteren Körper (11) aus gesintertem Maraging-Stahl enthält, in die Leichtwerkstoffmasse durch Schmelzen eingesetzt wird.

8. Verfahren nach Anspruch 7, gekennzeichnet durch die Verfahrensschritte :

Ausbilden des wenigstens einen weiteren Körpers (11) aus Maraging-Stahl in einem für das Sintern geeigneten Zustand,

Herstellen des Stahlkörpers (9) in einem für das Sintern geeignetem Zustand,

Kombinieren des wenigstens einen weiteren Körpers (11) mit dem einen Körper (9),

Sintern des mit dem wenigstens einen weiteren Körper (11) aus Maraging-Stahl kombinierten Stahlkörpers (9), um ein einstückiges Element aus gesintertem Material herzustellen, und

Verbinden des einstückigen Elements aus gesintertem Material mit der Leichtwerkstoffmasse (1) durch Schmelzen.

Revendications

1. Culasse pour moteurs à combustion interne, comprenant au moins une partie (9) qui est destinée à définir le haut d'un cylindre respectif du moteur, avec au moins une ouverture (2, 3) qui définit un siège pour une soupape respective, dans lequel la culasse dans son ensemble est constituée par une masse (1) d'un matériau léger, caractérisée en ce que :

ladite au moins une partie (9) est constituée par un insert en acier fritté, et

ladite au moins une ouverture (2, 3) est définie par un autre insert (11) en acier autotrempant fritté.

2. Culasse selon la revendication 1, caractérisée en ce que l'insert en acier fritté (9) est incorporé dans la masse de métal léger (1) par fusion.

3. Culasse selon la revendication 1 ou la revendication 2, caractérisée en ce que l'autre insert (11) en acier autotrempant fritté est incorporé dans l'insert en acier fritté (9).

4. Culasse selon une quelconque des revendications 1 à 3, caractérisé en ce que l'insert en acier fritté (9) possède au moins une ouverture pour la formation d'une chambre de précombustion (5) et en ce qu'une partie profilée (10) qui délimite au moins en partie la chambre de précombustion (5) est incorporée dans cette ouverture.

5. Culasse selon la revendication 4, caractérisée en ce que la partie profilée (10) est encastrée dans l'ouverture.

6. Culasse selon la revendication 4, caractérisée en ce que la partie profilée (10) est elle-même formée d'un matériau fritté et est fixée dans l'ouverture par suite du frittage du matériau (co-frittage).

7. Procédé de fabrication d'une culasse pour un moteur à combustion interne selon la revendication 1, comprenant au moins une partie (9) qui est destinée à définir la partie haute d'un cylindre respectif du moteur, avec au moins une ouverture (2, 3) définissant un siège de soupape respectif, caractérisé en ce qu'il comprend les phases consistant à :

produire ladite au moins une partie (9) sous la forme d'un corps en acier fritté,

produire en acier autotrempant fritté au moins un autre corps annulaire (11) destiné à définir ladite au moins une ouverture,

incorporer ledit au moins un autre corps (11) en acier autotrempant fritté dans le corps (9) en acier fritté, et

produire la culasse (1) en une masse de matériau léger, incorporer le corps (9) en acier fritté, dans lequel ledit au moins un autre corps (11) en acier autotrempant fritté est à son tour incorporé, dans la masse d'alliage léger par fusion.

8. Procédé selon la revendication 7, caractérisé en ce qu'il comprend les phases consistant à :

former ledit au moins un autre corps (11) en acier autotrempant dans un état approprié pour le frittage ;

produire le corps en acier (9) dans un état approprié pour le frittage ;

combiner ledit au moins un autre corps (11) audit corps (9) ; et

soumettre le corps en acier (9) combiné audit au moins un autre corps (11) en acier autotrempant à un frittage pour produire un unique élément en matériau fritté, et

incorporer un élément unique en matériau fritté dans la masse de matériau léger (1) par fusion.

FIG. 1

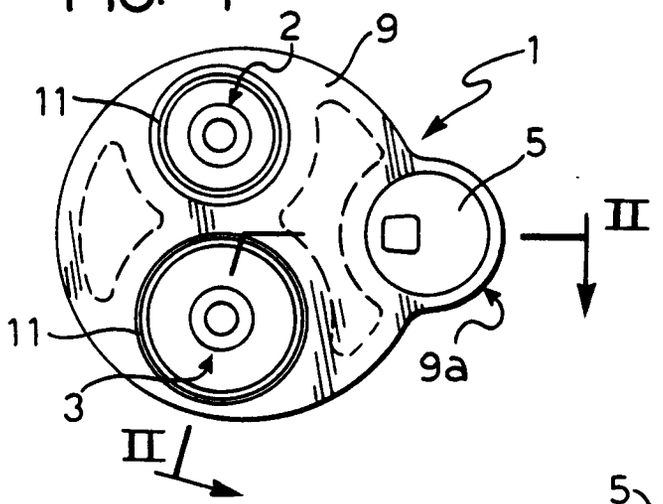

FIG. 2

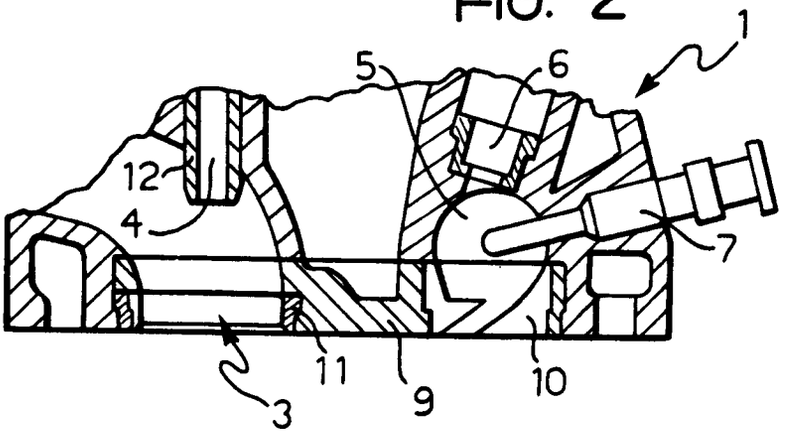

FIG. 3

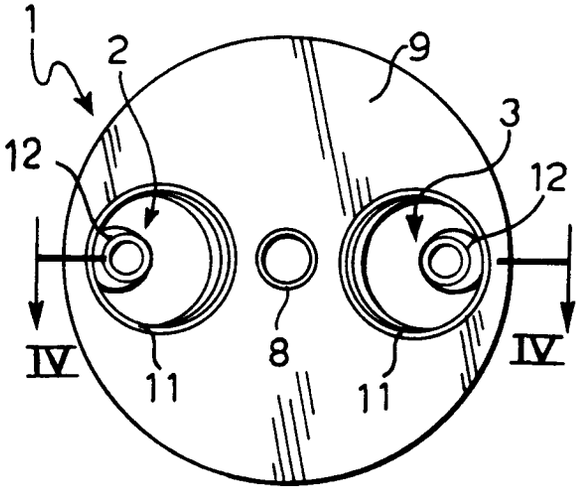

FIG. 4