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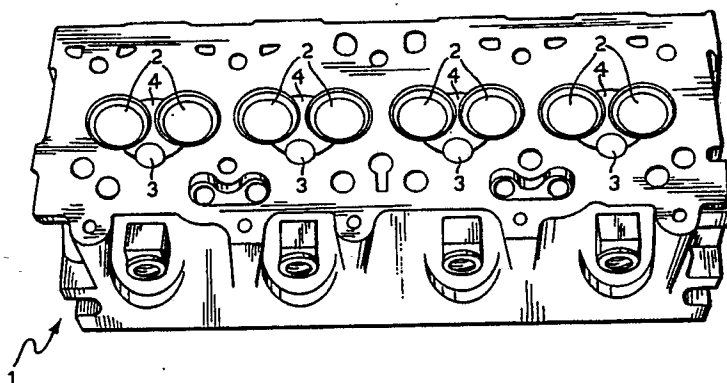
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54 A method of producing so-called flame plates for the heads of internal combustion engines and product obtained thereby.

57 An insert (4) reinforced with ceramic particles or fibres is inserted in the so-called bridge region of the flame plate. The insert (4) is fixed by being positioned in the casting mould and the material forming the head (1) is then cast at a temperature such as to

cause the surface fusion of the insert (4) and the consequent establishment of metallurgical adhesion between the insert (4) and the material forming the head.

FIG. 1



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A method of producing so-called flame plates for the heads of internal combustion engines and product obtained thereby

The present invention relates in general to the so-called flame plates for the heads of internal combustion engines and more specifically concerns a method of producing such flame plates, that is, of the parts of the head which define the so-called tops of the various cylinders of the engine.

It is known that the resistance of these flame plates to thermal fatigue, particularly in heads of light material intended for compression-ignition (diesel) engines, can be improved by inserting an insert of a material with an increased resistance to the thermal stresses generated during the operation of the engine in the bridge region (that is, in the region which separates the holes defining the valve seats and any hole for the insertion of an injector).

A solution of this type is described, for example, in United States Patent 4, 487,175.

Various techniques have hitherto been adopted for locating the insert and ensuring that it is firmly retained in the material forming the head.

According to a solution which can be adopted for inserts made from steel plates or small inserts of alloy material, it is known to locate the insert in the die (mould) for casting the head so that the insert is incorporated in the material of the head and a mechanical anchorage is thus achieved.

According to a possible alternative, seats are provided in the blank casting and are then filled with the material forming the insert. The material is integrated into the seats by fusion, sintering or, if it is preformed, by laser welding or other welding methods.

These solutions cannot be considered wholly satisfactory. In general, the actual characteristics of the material forming the insert, whilst improving its resistance to thermal fatigue, may be critical as regards the location and retention of the insert in the head and may also tend to disturb the propagation of heat through the critical bridge region, perhaps leading to its failure.

The object of the present invention is to provide a method of producing flame plates of the type specified above which does not give rise to the aforementioned problems.

According to the present invention, this object is achieved by virtue of a method which has the characteristics quoted specifically in the following claims.

A further subject of the invention is a product which can be produced by the above method.

By way of summary, the solution according to the invention provides for the use of inserts of a

material which has a low coefficient of expansion (typically an aluminium alloy reinforced with ceramic particles or fibres) and is therefore not very susceptible to the thermal expansion which can cause the failure of the bridge, the inserts being connected to the material forming the head by metallurgical adhesion resulting from the surface fusion of the insert during the manufacture of the head.

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

Figure 1 shows schematically, in a general perspective view, the head of an internal combustion engine produced according to the invention,

Figure 2 is a view from above of a die (mould) usable for carrying out the invention,

Figure 3 is a section taken on the line III-III of Figure 2, and

Figure 4 reproduces a view through a microscope, showing the intimate adhesion at a metallurgical level of two component parts of a head according to the invention.

In Figure 1, the head (cylinder head) of an internal combustion engine, such as a compression-ignition (diesel) engine, is generally indicated 1 and constituted essentially by a shaped body of light material.

The term "light material" as used in the present description and in the following claims is intended generally to mean any material (aluminium, various alloys) currently known as a "light alloy" and used for manufacturing heads for internal combustion engines, this choice of term being intended to leave out of consideration either whether the material is an alloy proper or the composition thereof, which are irrelevant for the purposes of the invention.

The embodiment illustrated is the head 1 of a compression-ignition (diesel) engine including four cylinders with respective top regions defining the so-called flame plates of the head.

In correspondence with each cylinder, the head 1 is provided with two holes 2 for defining the valve-mounting seats. The holes 2, together with a further hole 3 for housing an injector, define the so-called bridge region in which an insert 4 of a material with good resistance to thermal stresses is located.

According to the solution currently considered preferable, the inserts are of aluminium alloy reinforced with fibres (whiskers) or particles of ceramics material.

According to a known solution, the head 1 is

produced by casting in a die (mould), generally indicated 5 in Figures 2 and 3.

In general terms, the die 5 is substantially comparable to a tank with a base wall from which formations (rods) project upwardly for reproducing, in a complementary manner, the shapes of the holes 2 and 3 described above.

More precisely, in correspondence with each cylinder, there are two main rods 6 for defining the holes 2 and a third rod 7 for defining the hole 3.

The inserts 4 are made so that they can be fitted onto the rods 6 and 7 and remain at a certain distance (for example, of the order of 1.5-2.5 mm) from the upper face of the base wall of the die 5.

Ducts, generally indicated 8, are provided in the die 5 for distributing the casting material beneath the base wall, the ducts branching from a main opening 9 situated at the upper end of the die for the introduction of the casting material (light material -as defined above).

The distribution ducts 8 open into the die through respective openings 11, 12 situated on the two opposite sides of the die (see particularly the plan view of Figure 2).

The openings for distributing the casting material over the two walls are arranged in staggered positions.

In the embodiment illustrated, one side of the die has as many openings 11 as there are cylinders of the head 1. There are therefore four openings, each situated in alignment with the axis of one of the cylinders, that is, aligned with the centre line between the main rods 6 and thus oriented axially of the corresponding cylinder.

Five openings 12 are provided on the opposite side, of which the central three are in positions intermediate two adjacent cylinders whilst the two end openings are adjacent the end parts of the die 5. All the openings 12 are thus oriented tangentially of at least one corresponding cylinder of the head 1.

This solution, together with the presence of the above-described space or gap beneath each insert 4, has been shown to be preferable for achieving the best distribution of the casting material.

According to the currently-preferred embodiment of the invention, the die or mould 6 is initially brought to a temperature of not less than 300 °C.

The inserts 4 are then fitted onto the rod 6, 7, care being taken that the space or gap defined with respect to the base of the die has the prescribed dimensions (from 1.5 to 2.5 mm).

Usually, the surface of the insert 4 must be activated appropriately before casting by means of sandblasting or at any rate by treatments for removing the surface layer of alumina which is always present on this type of material.

The die is then closed and the light material

necessary for making the head introduced through the feed opening 9. The material is cast at a temperature of at least 700 °C (preferably about 750 °C) and is propagated within the die 5, particularly over the entire surfaces of the inserts 4. The immediate heating of the entire surfaces of the latter causes the surface fusion of the inserts 4 and their intimate adhesion to the mass of light material forming the head.

The die 5 is then cooled according to known criteria, so as to cool the head which is then removed from the die.

At this point, the head undergoes mechanical working (levelling) with the primary object of removing the mass of light material which is introduced into the gap or space, indicated 13, between the inserts 4 and the base wall of the die. In other words, the working in question causes the inserts 4 to reappear at the outer surface of the head.

The mechanical working of the whole head is then carried out (by known techniques) so as, for example, to bring the holes 2 for forming the valve-mounting seats to the required tolerance.

It has been shown that the casting technique described is decisive for the production of an intimate and firm anchorage between the inserts 4 and the mass of light material forming the head as a whole 1.

Figure 4 shows the microstructural appearance of the interface region between the material of one of the inserts 4 and the mass of light material of the head, generally indicated L.

In the image (magnified 100 times) the presence of a region of surface fusion of the insert, indicated 40, which can give rise to a practically inseparable metallurgical adhesion between the insert 4 and the rest of the head 1, can clearly be recognised.

It has been found that the best results from the qualitative point of view are obtained when the dimensions of the inserts 4 are such that the ratio between their mass and the overall mass of the head is of the order of 1:1000 (for example, 15 grams/mass for the inserts 5 in comparison with 15 kg overall mass of the head 1).

Claims

1. A method of making flame plates for the cylinder heads (1) of internal combustion engines, comprising a mass (L) of light material (as defined above) with at least one incorporated insert (4) of heat-resistant material, in which the at least one insert (4) is set into the light material by casting, characterised in that the light material is cast at a temperature such as to cause surface fusion of the at least one insert (4) so as to achieve metallurgical

adhesion (40) between the at least one insert (4) and the mass of light material (L).

2. A method according to Claim 1, characterised in that the light material is brought to a temperature of at least 700°C.

3. A method according to Claim 2, characterised in that the light material is brought to a temperature of the order of 750°C.

4. A method according to any one of the preceding claims, characterised in that the light material is substantially constituted by aluminium.

5. A method according to Claim 1 or Claim 4, characterised in that the at least one insert (4) is substantially constituted by an aluminium alloy reinforced with ceramics material.

6. A method according to Claim 5, characterised in that the ceramics material is in the form of fibres (whiskers).

7. A method according to Claim 5, characterised in that the ceramics material is in the form of particles.

8. A method according to any one of the preceding claims characterised in that includes the step of providing, for the casting of the light material, a generally tank-shaped die (5) with a base wall, and the step of providing the die (5) with formations (6, 7) for supporting the at least one insert (4) during casting.

9. A method according to Claim 8, characterised in that the formations are made in the form of rods (6, 7) projecting from the base wall of the die (6).

10. A method according to Claim 8 or Claim 9, characterised in that the formations (6, 7) are made so as to define corresponding holes (2, 3) within the resulting flame plate.

11. A method according to any one of claims 8 to 10, characterised in that the formations (6, 7) are made so as to keep the at least one insert (4) at a given distance from the base wall of the die, in order to cause the formation of a respective gap (13) which can be filled by a mass of the light material during casting.

12. A method according to Claim 11, characterised in that the given distance is at least 1.5 mm.

13. A method according to Claim 12, characterised in that the given distance is substantially in the range 1.5 - 2.5 mm.

14. A method according to any one of Claims 8 to 13, characterised in that it includes the step of providing the die (5) with at least one first (11) and one second (12) row of openings for admitting the light material during casting, the openings of the first and second rows (11, 12) being directed axially and tangentially of at least one cylinder of the head (1), respectively.

15. A method according to any one of Claims 8

to 14, characterised in that the die (5) is brought to a temperature of at least 300°C before the casting of the light material.

16. A method according to Claim 15, characterised in that the die (5) is brought to a temperature substantially equal to 350°C before the casting of the light material.

17. A method according to any one of Claims 11 to 13, characterised in that, after the casting of the light material in the die (5), the cylinder head (1) thus formed is cooled and subjected to mechanical working to remove the mass of light material which has been introduced into the respective gap (13).

18. A flame plate for the cylinder head (1) of an internal combustion engine, including at least one insert (4) of heat-resistant material incorporated with metallurgical adhesion (40) in a mass of light material (L).

19. A flame plate according to Claim 18, characterised in that the insert (4) is substantially constituted by an alloy of aluminium reinforced with ceramics material.

20. A flame plate according to Claim 19, characterised in that the ceramics material is in the form of fibres.

21. A flame plate according to Claim 19, characterised in that the ceramics material is in the form of particles.

22. A flame plate for the cylinder head of an internal combustion engine, produced by the method according to any one of Claims 1 to 17.

FIG. 1

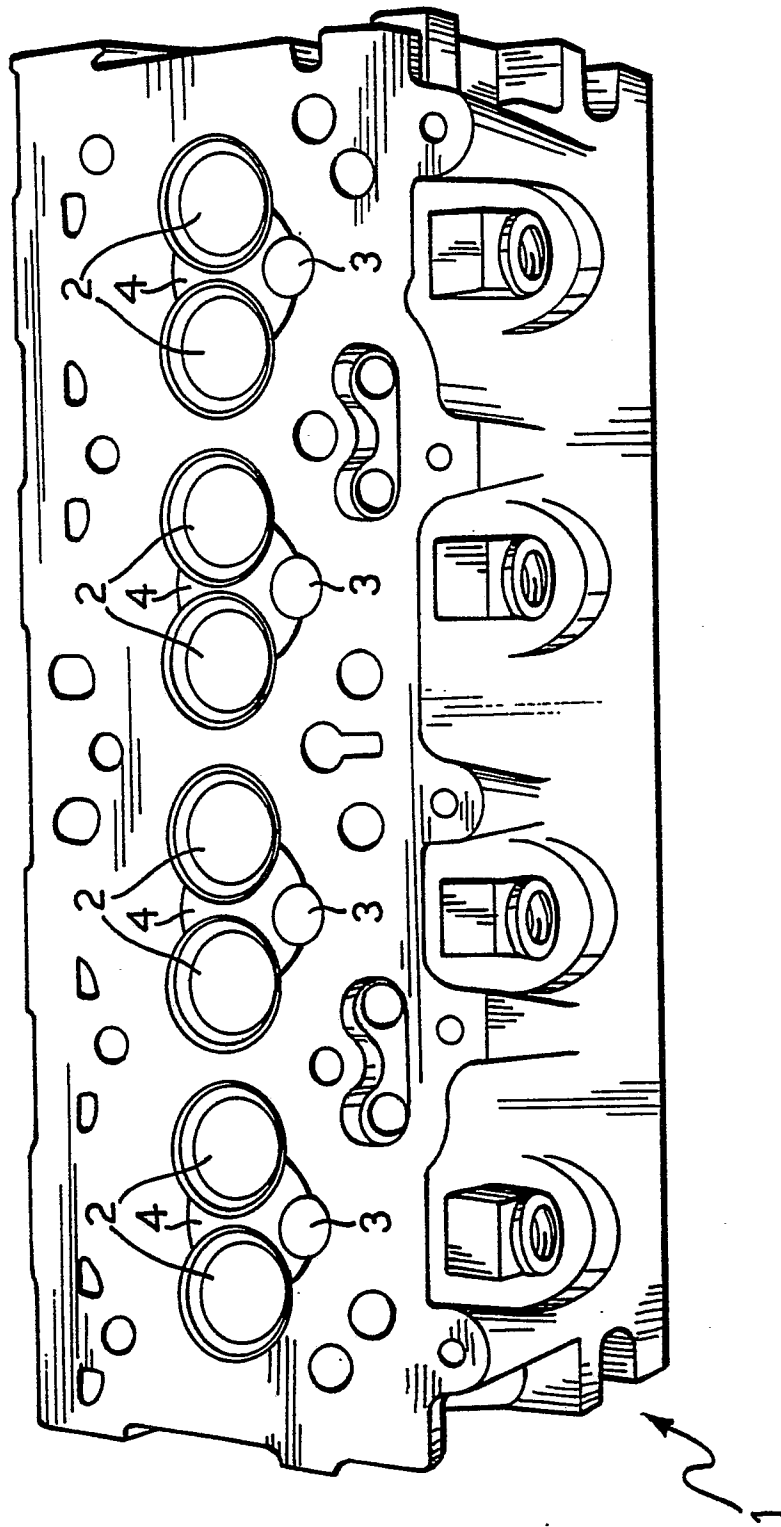


FIG. 2

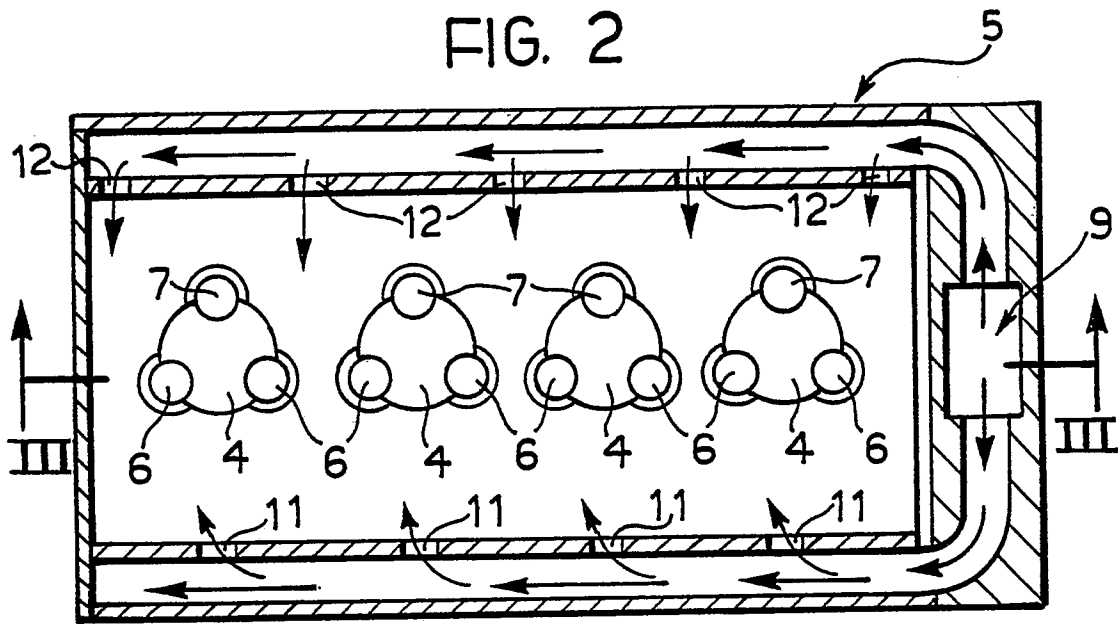


FIG. 3

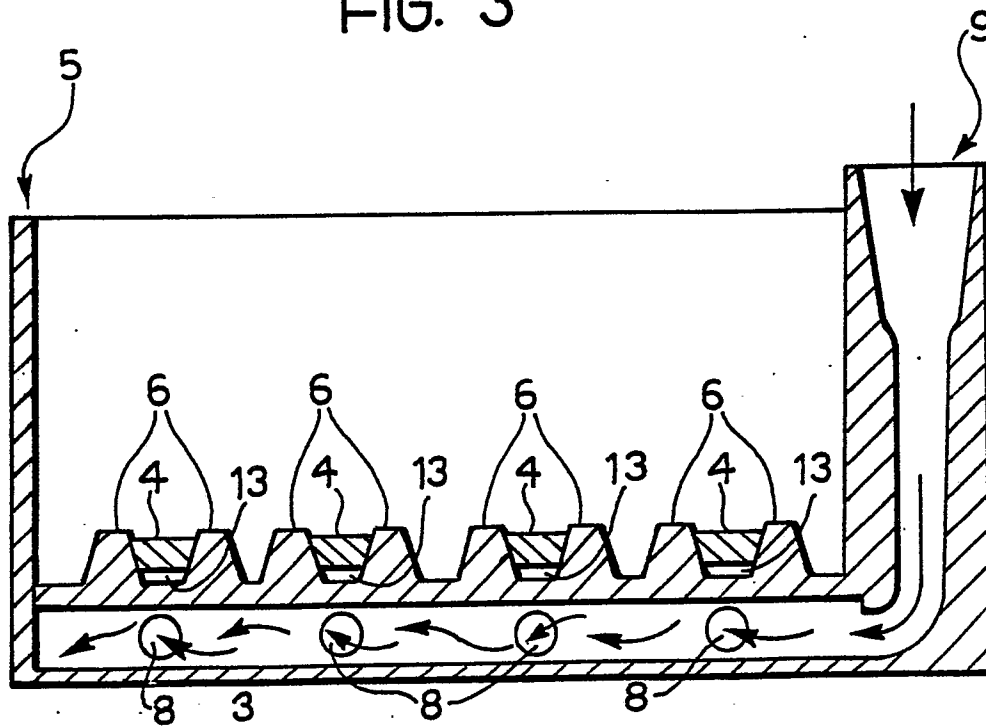
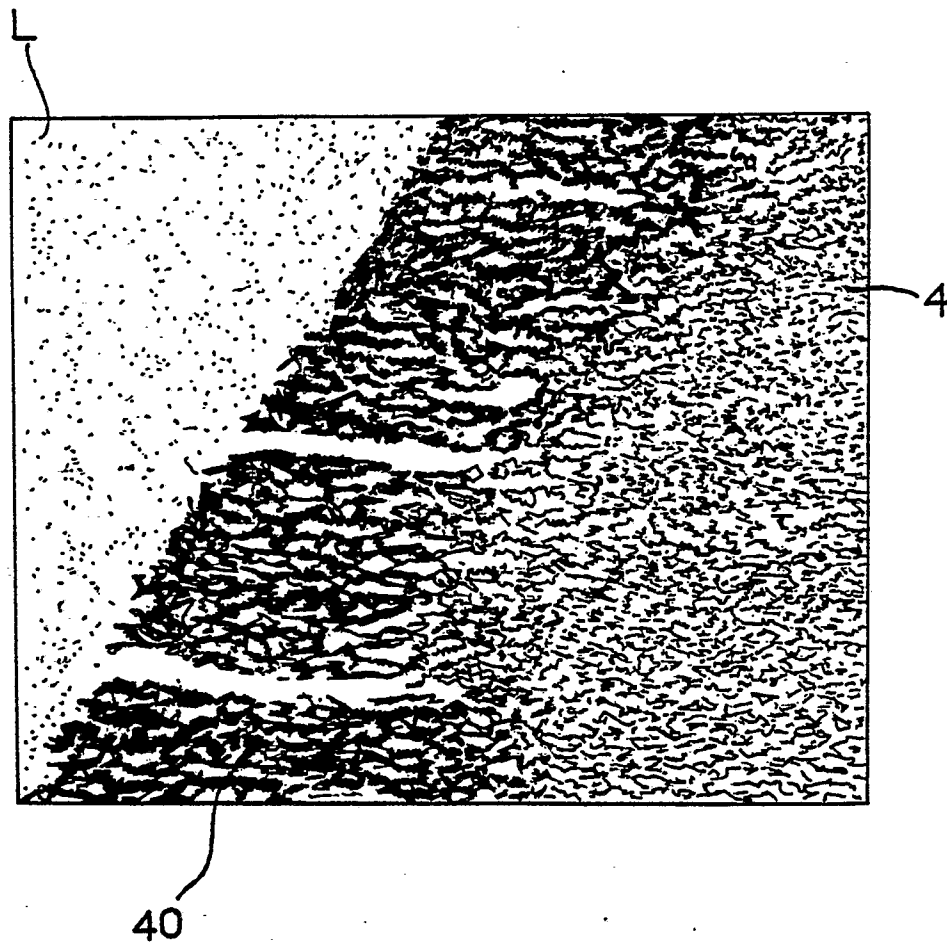


FIG. 4





European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 90 83 0137

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A, D	US-A-4487175 (KLÖCKNER-HUMBOLDT-DEUTZ) * column 3, line 1 - column 3, line 51; figure 2 *	1	F02F1/38 F02F7/00
A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 111 (M-379)(1834) 15 May 1985, & JP-A-59 231163 (YAMAHA HADSUDOKI K.K.) 25 December 1984, * the whole document *	1, 4	
A	US-A-4604779 (NGK SPARK PLUG COMPANY) * column 3, line 1 - column 3, line 67; figure 2 *	1, 6	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F02F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25 JUNE 1990	Examiner WASSENAAR G.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			