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(54) **A method for producing a piston for an internal combustion engine and a piston produced by the method**

Verfahren zur Herstellung eines Kolbens einer Brennkraftmaschine und nach diesem Verfahren hergestellter Kolben

Procédé pour la production d'un piston pour un moteur à combustion interne ainsi que piston produit par ce procédé

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Description

[0001] The present invention relates to a method for producing a piston for an internal combustion (i.c.) engine and a piston produced by the method. In particular, the invention relates to a method for producing a piston of the type having a bowl-in-piston combustion chamber and an air chamber opening into the combustion chamber, said air chamber comprising an insert retained in the piston.

[0002] It is known in a direct injection diesel engine to store a portion of hot compressed air from a compression stroke in an air chamber situated within a piston crown and to release this air into the piston combustion chamber during fuel combustion. This restricts oxygen supply for combustion during the early stages of combustion to limit noise and nitrous oxide emissions but increases oxygen supply towards the end of the combustion event when oxygen shortage would otherwise result in incomplete combustion and, therefore, the production of particulates.

[0003] This is illustrated by SAE paper 952359, published October 1995, pages 147 to 158, in an article entitled "Modelling the Use of Air Injection for Emissions Reduction in a Direct Injected Diesel Engine", which describes the modelling of air injection for emissions reduction in direct injection diesel engines and compares the results for different air chamber configurations. It is concluded in the paper that the provision of an air chamber in a piston which releases air to the combustion chamber during fuel combustion reduces NOx, noise and particulate emissions. It is further concluded in the paper that an air chamber located below the piston combustion chamber having a certain configuration of transfer holes connecting the combustion chamber and the air chamber gives superior results to alternative geometries. However, the mechanical difficulties of providing an air chamber, or an insert comprising an air chamber, adjacent to a combustion chamber in a piston are not addressed.

[0004] Similarly, GB 2184485A discloses a number of alternative constructions of air chamber inserts locatable within a crown of a piston adjacent to a combustion chamber but it does not teach a method of retaining such inserts in the piston crown.

[0005] Such inserts are notoriously difficult to retain in place, the piston material being typically an aluminium alloy having a high coefficient of expansion and the piston, in use, being subjected to large temperature and pressure fluctuations.

[0006] NL 9101258A does describe a method of retaining an insert in a piston crown. The insert is located within the piston crown generally below a piston combustion chamber and encloses an air chamber. One or more small holes in a wall of the insert connects the air chamber with the combustion chamber. Air is taken into and expelled from the air chamber in a manner similar to that of the present invention. The insert is provided with a flange contiguous with a face of the piston crown and is retained in position by bolts. The bolts may extend from the insert down into a cooler portion of the piston and this results in an increase in the mass of a lower part of the piston which affects piston reciprocation. The bolts also weaken the piston structure. Alternatively, the insert does not have a flange but is retained in the piston crown by freeze fitting. Both of these methods do not provide the integrity of assembly necessary to withstand the stresses that the piston will experience in use.

[0007] The prior art mentioned above does not disclose a suitable method for locating and retaining an air chamber insert in a crown of a piston.

[0008] DE 2136594, however, describes a method of retaining a metal alloy insert in a crown of a piston. The alloy of the insert is preferably a copper alloy. The insert locates around the mouth of the piston combustion chamber. The purpose of the insert is to reinforce a rim portion of the combustion chamber and protect it from the thermal stresses associated with fuel combustion. The insert is located as an integral part of the piston by casting the piston around the insert. During casting, the insert becomes welded to the material of the piston. The insert has a portion which projects beyond the piston crown which must be removed after the piston has been cast. The extending portion of the insert is provided as a means of positioning the insert prior to the piston being cast. A disadvantage of this method of insert placement is that it is only suitable where the top of the insert is to extend to the top surface of the piston crown.

[0009] The retention of an apertured air chamber insert within a piston crown presents additional difficulties to those encountered in retaining combustion chamber lip reinforcing inserts. The air chamber insert is likely to be manufactured from a material dissimilar to that of the body of the piston which will present a problem relating to the difference in thermal expansion of the different materials. A further difficulty that will be encountered, in the case where the insert does not extend to the top surface of the piston crown, is the need to accurately position the insert relative to the piston die or mould.

[0010] EP 0295481A discloses means of casting an insert into an aluminium alloy piston, the insert being an insulating crown of an iron-based or nickel-based alloy. However, no means is disclosed for configuring the insert as an air chamber and further, no means is disclosed to enhance the constructional integrity to enhance ability to durably withstand the severe pressure and temperature fluctuations likely to be encountered in a modern high-power-density diesel engine.

[0011] It is an object of the present invention to provide a method for producing a piston for an internal combustion engine of the type having a bowl-in-piston combustion chamber and an air chamber opening thereinto, said air chamber comprising an insert retained in the piston crown.

[0012] According to one aspect of the present invention, there is provided a method for producing a piston

for an internal combustion (i.c.) engine, comprising the steps of: forming an insert; positioning said insert relative to a piston die or mould; and casting said piston in said die or mould; wherein the insert is positioned relative to the piston die or mould such that, when the piston is cast, the insert forms an integral part of the piston so formed, and said insert is formed such that it at least in part defines an air chamber opening into a combustion chamber formed within a crown of the piston.

[0013] The method includes positioning the insert relative to the piston die or mould such that, when the piston is cast, a shoulder is formed which projects into the combustion chamber, said shoulder retaining the insert in the piston crown.

[0014] The method may include forming the shoulder at or near a mouth of the combustion chamber.

[0015] The method includes positioning the insert relative to the piston die or mould such that, when the piston is cast, it is located wholly within the piston crown.

[0016] The method may include forming the insert such that a surface portion thereof forms at least a part of a surface comprising a combustion bowl bounding said combustion chamber.

[0017] The method may include forming at least one aperture in the insert before casting the piston, said aperture intended to afford communication between the air chamber and the combustion chamber.

[0018] Alternatively, the method may include forming the at least one aperture in the insert after the piston has been cast.

[0019] The method may include forming the at least one aperture in the insert such that it opens on the surface portion thereof which forms at least a part of the combustion bowl.

[0020] The method may include positioning the insert relative to the piston die or mould by means of a core of material which, once the piston has been cast, can be easily removed from the insert.

[0021] The method may include contacting the core of material with the insert on the surface portion thereof which forms at least a part of the combustion bowl.

[0022] The method may include attaching the insert to the core of material by placing said insert onto an end portion of said core such that the material of the core conforms to the shape of the surface portion of the insert to which it is attached.

[0023] According to another aspect of the invention, there is provided a piston for an i.c. engine comprising: a piston body; a combustion bowl defining a combustion chamber formed in a crown of the piston body; an air chamber opening into the combustion chamber, said air chamber being bounded by an insert retained in the piston crown, the insert having at least one aperture affording communication between the air chamber and the combustion chamber, wherein the piston is cast such that it is integral with the insert.

[0024] The insert is retained in the piston crown by a cast shoulder projecting into the combustion chamber.

[0025] The shoulder may be located at or near a mouth of the combustion chamber.

[0026] The insert is retained wholly within the piston crown.

[0027] The insert may be shaped and positioned within the piston crown such that the air chamber is situated over a connecting rod small end bearing of the piston.

[0028] The insert may be shaped such that the air chamber locates below the combustion chamber.

[0029] The insert may be shaped such that the air chamber is located centrally with respect to the combustion chamber.

[0030] The insert may be shaped such that an upper surface thereof defines a lower portion of the combustion bowl.

[0031] The insert may include a base wall which, in use, provides a bridge over the connecting rod small end bearing of the piston.

[0032] The insert may be formed from a thermally insulating material such as ceramic.

[0033] Alternatively, the insert may be formed from a ferrous, copper or other metal alloy.

[0034] The insert may be round in plan.

[0035] The upper surface of the insert forming a bottom portion of the combustion bowl may be shaped so as to enhance swirl of air exiting the air chamber.

[0036] The foregoing and further features of the present invention will be more readily understood from the following description of preferred embodiments, by way of example thereof, with reference to the accompanying drawings of which:

Figure 1 is a cross-sectional elevation of a piston air chamber insert in accordance with a first embodiment of the invention;

Figure 2 is a cross-sectional elevation of a piston incorporating the insert of figure 1;

Figure 3 is a cross-sectional elevation of the insert of figure 1 located in a piston, said insert being carried on a core of material for holding said insert in position relative to a piston die or mould thus illustrating the method of the invention;

Figure 4 is a cross-sectional elevation of a piston air chamber insert in accordance with a second embodiment of the invention;

Figure 5 is a cross-sectional elevation of a piston incorporating the insert of figure 4;

Figure 6 is a cross-sectional elevation of the insert of figure 4 located in a piston said insert being carried on a core of material holding said insert in position relative to a piston die or mould thus illustrating the method of the invention; and

[0037] Reference will first be made to figures 1 to 3 of the drawings. Figure 1 is a cross-sectional elevation of a piston air chamber insert 10 to be located within the body of a piston 12 (figure 2). The insert 10 is generally round in plan and comprises a central domed portion 14

surrounded by an upturned flange portion 16. The central domed portion 14 generally encloses an air chamber 18 although, in use, a base of the air chamber 18 will comprise a part of a piston 12 to be cast in situ around the insert 10. The domed portion 14 has a number of apertures 20 located radially around a central axis thereof. In use, the apertures 20 afford communication between the air chamber 18 and a combustion chamber 22 formed in a crown 24 of the piston 12. An upper surface 26 of the insert 10 comprises, in use, a part of a combustion bowl 28 bounding the combustion chamber 22 formed in the piston crown 24.

[0038] The air chamber 18 communicates with the combustion chamber 22 via the apertures 20 which allow compressed air to pass into the chamber 18 during a piston compression stroke. The air in the chamber 18 is released to the combustion chamber 22 during fuel combustion on the engine expansion stroke. In this way the amount of air, and thus oxygen, for fuel combustion is desirably restricted during the early stages of fuel combustion but augmented during the later stages of combustion.

[0039] The insert 10 is retained in the piston crown 24 by means of casting the piston 12 around the insert 10 such that the insert 10 forms an integral part of the piston 12. The insert 10 is retained in place by a cast shoulder 30 which projects into the combustion chamber 22 over the upturned flange part 16 of the insert 10. The insert is wholly contained within the piston crown 24. With the particular arrangement of the first embodiment, an advantage exists in that the air chamber 18 locates generally over a connecting rod small end bearing 32. This provides a degree of thermal insulation to protect said bearing 32 from the high temperatures occurring during fuel combustion. This reduces, and may even eliminate, the need for piston cooling means, such as oil jet cooling, to be included in the i.c. engine.

[0040] The insert may be formed from a metal alloy or ceramic. The material of the insert may diffusion bond with the metal of the piston on its being cast.

[0041] The insert may be formed by the investment casting process or by any other suitable process which may be dictated by the material of the insert. The material of the insert may be chosen to have a lower coefficient of thermal expansion than the alloy of the piston body. The insert will thermally insulate the lower piston body from combustion heat and thus the expansion of the insert itself will be closer to that of the lower part of the piston crown than would be the case if some thermal protection was not provided by the insert.

[0042] Figure 3 illustrates the method of positioning the insert with respect to a piston die or mould (not shown) prior to casting the piston (which is shown as cast) . The insert 10 is positioned by carrying it on a core 34 of material which, in use, forms part of the piston die or mould. The insert is placed onto an end of the core such that the material of the core end conforms to the upper surface 26 of the insert. The remaining surface of the core 34 may be suitably shaped in readiness for piston casting such that said surface can determine part of the combustion chamber shape and reduce, if not eliminate, subsequent machining of the combustion bowl 28.

[0043] In placing the insert 10 on the core 34 of the material, it is necessary to locate some core material 34a in the base of the insert to define the air chamber 18. This core material 34a can be removed from the air chamber 18 via the apertures 20 which may be formed during subsequent machining of the piston crown 24 after the casting process. The material of the core may be any material suitable for casting and which can be easily cleaned from the piston and insert after casting. The material may be a leachable material such as salt which solidifies upon heating but can be dissolved and washed away with water upon completion of the casting process.

[0044] Figures 4 to 6 illustrate a second embodiment of the insert. Like numerals are used to denote like parts. The insert 10 is generally identical to that of the first embodiment but includes a base wall 36 to enclose the air chamber 18. The base wall 36 comprises a bridge over the connecting rod small end bearing 32 to strengthen the base of the piston crown 24 and reduce the thickness of piston material at this point. Thus, the piston 12 so formed is of a similar weight to a conventional piston, but equally as strong.

[0045] When placing the insert 10 on the core 34 for positioning it with respect to the piston die or mould, it is necessary to ensure that the material of the core closes over any apertures 20 in the upper wall of the insert if these have already been formed. Any core material which extends into the air chamber 18 can be easily removed after casting.

[0046] It will be seen that, with an insert configured in the manner illustrated in the embodiments, the air chamber is located centrally to and below the combustion chamber of the piston. It will be appreciated that the insert can be configured to provide other arrangements of air chamber with respect to combustion chamber.

Claims

1. A method for producing a piston (12) for an internal combustion (i.c.) engine, comprising the steps of: forming an insert (10); positioning said insert (10) relative to a piston die or mould; and casting said piston (12) in said die or mould; wherein the insert is positioned relative to the piston die or mould such that, when the piston is cast, the insert forms an integral part of the piston so formed, and said insert is formed such that it at least in part defines an air chamber (18) opening into a combustion chamber (22) formed within a crown (24) of the piston (12), wherein the method includes positioning the insert relative to the piston die or mould such that, when the piston is cast, a shoulder (30) is formed which projects into the combustion chamber (22), the in-

sert (10) is located wholly within the piston crown (24) and is retained therein by said shoulder (30).

2. A method as claimed in claim 1, wherein it includes forming the shoulder (30) at or near a mouth of the combustion chamber (22).

3. A method as claimed in claim 1 or claim 2, wherein it includes forming an insert to comprise a central domed portion (14) surrounded by an upturned flange portion (16).

4. A method as claimed in claim 3 wherein it includes positioning the insert relative to the piston die or mould such that, when the piston is cast, the shoulder (30) projects over the upturned flanged portion (16) of the insert (10).

5. A method as claimed in any preceding claim, wherein it includes forming the insert such that a surface portion (26) thereof forms at least a part of a surface comprising a combustion bowl (28) bounding said combustion chamber (22).

6. A method as claimed in any preceding claim, wherein it includes forming at least one aperture (20) in the insert before casting the piston, said aperture intended to afford communication between the air chamber and the combustion chamber.

7. A method as claimed in any one of claims 1 to 5, wherein it includes forming the at least one aperture (20) in the insert after the piston has been cast.

8. A method as claimed in any preceding claim, wherein it includes forming the at least one aperture in the insert such that it opens on a surface portion thereof (26) which forms at least a part of the combustion bowl (28).

9. A method as claimed in any preceding claim, wherein it includes positioning the insert relative to the piston die or mould by means of a core (34) of material which, once the piston has been cast, can be easily removed from the insert.

10. A method as claimed in claim 9, wherein it includes contracting the core of material with the insert on the surface portion thereof which forms at least a part of the combustion bowl.

11. A method as claimed in claim 9 or 10, wherein it includes attaching the insert to the core of material by placing said insert onto an end portion of said core such that the material of the core conforms to the shape of the surface portion of the insert to which it is attached.

12. A piston (12) for an i.c. engine comprising: a piston body; a combustion bowl (28) defining a combustion chamber (22) formed in a crown (24) of the piston body; an air chamber (18) opening into the combustion chamber, said air chamber being bounded by an insert (10) retained in the piston crown, the insert having at least one aperture (20) affording communication between the air chamber and the combustion chamber, wherein the piston is cast such that it is integral with the insert, and the insert is located wholly within the piston crown, and is retained therein by a cast shoulder (30) projecting into the combustion chamber (22).

13. A piston as claimed in claim 12, wherein the shoulder (30) is located at or near a mouth of the combustion chamber (22).

14. A piston as claimed in claim 12 or claim 13, wherein the insert comprises a central domed portion (14) surrounded by an upturned flanged portion (16).

15. A piston as claimed in claim 14 wherein the shoulder (30) projects over the upturned flanged portion (16) of the insert.

16. A piston as claimed in any one of claims 12 to 15, wherein the insert is configured such that a surface portion (26) thereof forms at least part of a surface comprising a combustion bowl (28) bounding said combustion chamber (22).

17. A piston as claimed in claim 16 wherein the at least one aperture (20) in the insert (10) is formed such that it opens on the surface portion (26) of the insert which forms at least a part of the combustion bowl (28).

18. A piston as claimed in any one of claims 12 to 17, wherein the insert is shaped and positioned within the piston crown such that the air chamber (18) is situated over a connecting rod small end bearing (32) of the piston.

19. A piston as claimed in claim 19, wherein the insert includes a base wall (36) which, in use, provides a bridge over the connecting rod small end bearing (32) of the piston.

Patentansprüche

1. Ein Verfahren zur Herstellung eines Kolbens (12) für eine Verbrennungsmaschine, bestehend aus folgenden Schritten: Formen eines Einsatzes (10); Positionieren des Einsatzes (10) bezüglich einer Kolbenmatrize oder -form; und Gießen des Kolbens (12) in die Matrize oder Form; wobei der Einsatz be-

züglich der Kolbenmatrize oder -form so positioniert wird, daß der Einsatz beim Gießen des Kolbens einen integralen Teil des so geformten Kolbens bildet, und der Einsatz so geformt wird, daß er zumindest teilweise eine Luftkammer (18) festlegt, die sich nach einer Brennkammer (22), welche in einem Boden (24) des Kolbens (12) geformt ist, öffnet, wobei das Verfahren das Positionieren des Einsatzes bezüglich der Kolbenmatrize oder -form beinhaltet, so daß beim Gießen des Kolbens eine Schulter (30) gebildet wird, die in die Brennkammer (22) hineinragt, wobei der Einsatz (10) vollständig innerhalb des Kolbenbodens (24) angeordnet ist und von der Schulter (30) dort gehalten wird.

2. Verfahren gemäß Anspruch 1, wobei die Schulter (30) an oder in der Nähe einer Öffnung der Brennkammer (22) geformt wird.

3. Verfahren gemäß Anspruch 1 oder Anspruch 2, wobei ein Einsatz geformt wird, um einen zentralen, gewölbten Abschnitt (14) einzuschließen, der von einem nach oben gerichteten Flanschabschnitt (16) umgeben ist.

4. Verfahren gemäß Anspruch 3, wobei der Einsatz bezüglich der Kolbenmatrize oder -form positioniert wird, so daß beim Gießen des Kolbens die Schulter (30) über den nach oben gerichteten Flanschabschnitt (16) des Einsatzes (10) ragt.

5. Verfahren gemäß einem der vorhergehenden Ansprüche, wobei der Einsatz so geformt wird, daß ein Oberflächenabschnitt (26) des Einsatzes zumindest einen Teil einer Oberfläche bildet, die eine die Brennkammer (22) begrenzende Verbrennungsmulde (28) umfaßt.

6. Verfahren gemäß einem der vorhergehenden Ansprüche, wobei vor dem Gießen des Kolbens zumindest eine Öffnung (20) im Einsatz geformt wird, wobei diese Öffnung dazu dienen soll, den Austausch zwischen der Luftkammer und der Brennkammer zu gewährleisten.

7. Verfahren gemäß einem der Ansprüche 1 bis 5, wobei die zumindest eine Öffnung (20) im Einsatz geformt wird, nachdem der Kolben gegossen worden ist.

8. Verfahren gemäß einem der vorhergehenden Ansprüche, wobei die eine Öffnung im Einsatz geformt wird, so daß sie sich auf dessen Oberflächenabschnitt (26), der zumindest einen Teil der Verbrennungsmulde (28) bildet, öffnet.

9. Verfahren gemäß einem der vorhergehenden Ansprüche, wobei der Einsatz bezüglich der Kolbenmatrize oder -form mittels eines Materialkerns (34), welcher leicht vom Einsatz zu entfernen ist, sobald der Kolben gegossen ist, positioniert wird.

10. Verfahren gemäß Anspruch 9, wobei der Materialkern sich mit dem Einsatz an dessen Oberflächenabschnitt, der zumindest einen Teil der Verbrennungsmulde bildet, zusammenzieht.

11. Verfahren gemäß Anspruch 9 oder 10, wobei der Einsatz am Materialkern befestigt wird, indem der Einsatz an einen Endabschnitt des Kerns angeordnet wird, so daß das Material des Kerns mit der Form des Oberflächenabschnitts des Einsatzes, mit dem es verbunden ist, übereinstimmt.

12. Ein Kolben (12) für eine Verbrennungsmaschine, bestehend aus: einem Kolbenkörper; einer Verbrennungsmulde (28), die eine Brennkammer (22) festlegt, welche in einem Boden (24) des Kolbenkörpers gebildet ist; einer Luftkammer (18), die sich nach der Brennkammer hin öffnet, wobei diese Luftkammer durch einen im Kolbenboden befindlichen Einsatz (10) begrenzt ist, wobei der Einsatz zumindest eine Öffnung (20) aufweist, die eine Verbindung zwischen der Luftkammer und der Brennkammer, worin der Kolben gegossen ist, so daß er mit dem Einsatz eine Einheit bildet, ermöglicht und der Einsatz sich ganz im Inneren des Kolbenkranzes befindet und dort von einer gegossenen Schulter (30), welche in die Brennkammer (22) ragt, gehalten wird.

13. Kolben gemäß Anspruch 12, wobei die Schulter (30) an oder in der Nähe der Öffnung der Brennkammer (22) angeordnet ist.

14. Kolben gemäß Anspruch 12 oder Anspruch 13, wobei der Einsatz einen zentralen, gewölbten Abschnitt (14) umfaßt, der von einem nach oben gerichteten Flanschabschnitt (16) umgeben ist.

15. Kolben gemäß Anspruch 14, wobei die Schulter (30) über den nach oben gerichteten Flanschabschnitt (16) des Einsatzes ragt.

16. Kolben gemäß einem der Ansprüche 12 bis 15, wobei der Einsatz so konzipiert ist, daß ein Oberflächenabschnitt (26) davon zumindest einen Teil einer Fläche bildet, die eine die Brennkammer (22) eingrenzende Verbrennungsmulde (28) enthält.

17. Kolben gemäß Anspruch 16, wobei die zumindest eine Öffnung (20) im Einsatz (10) geformt wird, so daß sie sich auf dem Oberflächenabschnitt (26) des Einsatzes, der zumindest einen Teil der Verbrennungsmulde (28) bildet, öffnet.

18. Kolben gemäß einem der Ansprüche 12 bis 17, wobei der Einsatz im Kolbenboden so geformt und angeordnet ist, daß sich die Luftkammer (18) über einem Pleuelstangenkopflager (32) des Kolbens befindet.

19. Kolben gemäß Anspruch 19, wobei der Einsatz eine Grundwand (36) umfaßt, die bei Gebrauch eine Brücke über das Pleuelstangenkopflager (32) des Einsatzes bereitstellt.

Revendications

1. Un procédé de production d'un piston (12) pour un moteur à combustion interne (i.c.), comprenant les étapes : de formation d'un insert (10) ; de positionnement dudit insert (10) par rapport à une matrice ou à un moule de piston ; et de coulage dudit piston (12) dans ladite matrice ou ledit moule ; dans lequel l'insert est positionné par rapport à la matrice ou au moule de piston de telle sorte que, lorsque le piston est coulé, l'insert forme une pièce solidaire du piston ainsi formé, et ledit insert est formé de telle sorte qu'il définit au moins en partie une chambre d'air (18) débouchant dans une chambre de combustion (22) formée à l'intérieur d'une couronne (24) du piston (12), dans lequel le procédé comporte le positionnement de l'insert par rapport à la matrice ou au moule de piston de telle sorte que, lorsque le piston est coulé, un épaulement (30) est formé, lequel s'avance en saillie dans la chambre de combustion (22), l'insert (10) est entièrement situé à l'intérieur de la couronne de piston (24) et est retenu dans celle-ci par ledit épaulement (30).

2. Un procédé tel que revendiqué dans la revendication 1, lequel comporte la formation de l'épaulement (30) au niveau d'une entrée de la chambre de combustion (22) ou à proximité de celle-ci.

3. Un procédé tel que revendiqué dans la revendication 1 ou la revendication 2, lequel comporte la formation d'un insert afin qu'il comprenne une portion centrale bombée (14) entourée par une portion à bride retroussée (16).

4. Un procédé tel que revendiqué dans la revendication 3, lequel comporte le positionnement de l'insert par rapport à la matrice ou au moule de piston de telle sorte que, lorsque le piston est coulé, l'épaulement (30) s'avance en saillie par-dessus la portion à bride retroussée (16) de l'insert (10).

5. Un procédé tel que revendiqué dans n'importe quelle revendication précédente, lequel comporte la formation de l'insert de telle sorte qu'une portion de surface (26) de celui-ci forme au moins une partie d'une surface comprenant un bol de combustion (28) délimitant ladite chambre de combustion (22).

6. Un procédé tel que revendiqué dans n'importe quelle revendication précédente, lequel comporte la formation d'au moins un orifice (20) dans l'insert avant de couler le piston, ledit orifice étant destiné à permettre la communication entre la chambre d'air et la chambre de combustion.

7. Un procédé tel que revendiqué dans une quelconque des revendications 1 à 5, lequel comporte la formation dudit orifice au moins (20) dans l'insert après avoir coulé le piston.

8. Un procédé tel que revendiqué dans n'importe quelle revendication précédente, lequel comporte la formation dudit orifice au moins dans l'insert de telle sorte qu'il ouvre sur une portion de surface de celui-ci (26), laquelle forme au moins une partie du bol de combustion (28).

9. Un procédé tel que revendiqué dans n'importe quelle revendication précédente, lequel comporte le positionnement de l'insert par rapport à la matrice ou au moule de piston au moyen d'un noyau (34) de matériau, lequel peut être facilement retiré de l'insert une fois le piston coulé.

10. Un procédé tel que revendiqué dans la revendication 9, lequel comporte la mise en contact du noyau de matériau avec l'insert sur la portion de surface de celui-ci qui forme au moins une partie du bol de combustion.

11. Un procédé tel que revendiqué dans la revendication 9 ou 10, lequel comporte la fixation de l'insert au noyau de matériau en plaçant ledit insert sur une portion d'extrémité dudit noyau de telle sorte que le matériau du noyau épouse la configuration de la portion de surface de l'insert auquel il est fixé.

12. Un piston (12) pour un moteur i.c. comprenant : un corps de piston ; un bol de combustion (28) définissant une chambre de combustion (22) formée dans une couronne (24) du corps de piston ; une chambre d'air (18) débouchant dans la chambre de combustion, ladite chambre d'air étant délimitée par un insert (10) retenu dans la couronne de piston, l'insert ayant au moins un orifice (20) permettant la communication entre la chambre d'air et la chambre de combustion, dans lequel le piston est coulé de telle sorte qu'il est solidaire à l'insert, et l'insert est entièrement situé à l'intérieur de la couronne de piston et est retenu dans celle-ci par un épaulement coulé (30) s'avançant en saillie dans la chambre de combustion (22).

13. Un piston tel que revendiqué dans la revendication 12, dans lequel l'épaulement (30) est situé au niveau d'une entrée de la chambre de combustion (22) ou à proximité de celle-ci.

14. Un piston tel que revendiqué dans la revendication 12 ou la revendication 13, dans lequel l'insert comprend une portion centrale bombée (14) entourée par une portion à bride retroussée (16).

15. Un piston tel que revendiqué dans la revendication 14 dans lequel l'épaulement (30) s'avance en saillie par-dessus la portion à bride retroussée (16) de l'insert.

16. Un piston tel que revendiqué dans une quelconque des revendications 12 à 15, dans lequel l'insert est conformé de telle sorte qu'une portion de surface (26) de celui-ci forme au moins une partie d'une surface comprenant un bol de combustion (28) délimitant ladite chambre de combustion (22).

17. Un piston tel que revendiqué dans la revendication 16 dans lequel cet orifice au moins (20) dans l'insert (10) est formé de telle sorte qu'il ouvre sur la portion de surface (26) de l'insert, laquelle forme au moins une partie du bol de combustion (28).

18. Un piston tel que revendiqué dans une quelconque des revendications 12 à 17, dans lequel l'insert est configuré et positionné à l'intérieur de la couronne de piston de telle sorte que la chambre d'air (18) se trouve par-dessus un coussinet de pied de bielle (32) du piston.

19. Un piston tel que revendiqué dans la revendication 19, dans lequel l'insert comporte une paroi de base (36) laquelle fournit, lors de l'utilisation, un pont par-dessus le coussinet de pied de bielle (32) du piston.

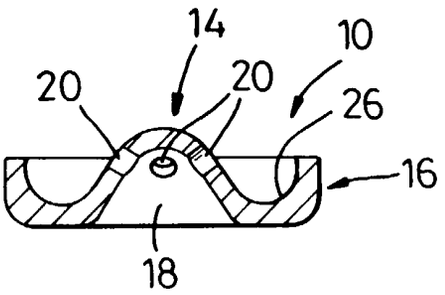

Fig. 1

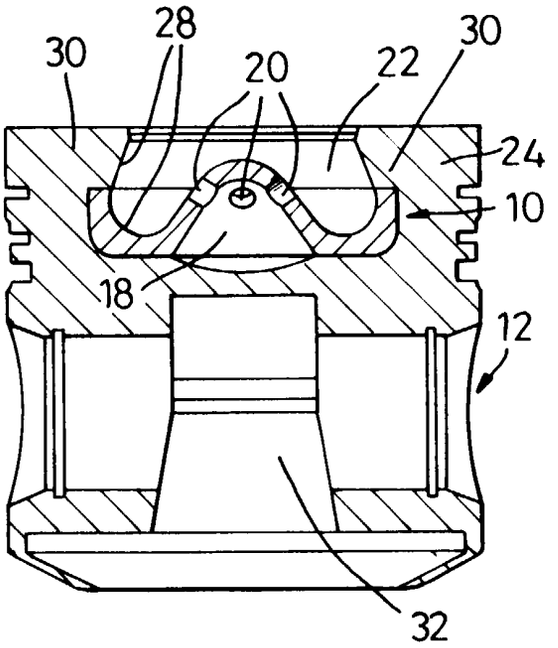

Fig. 2

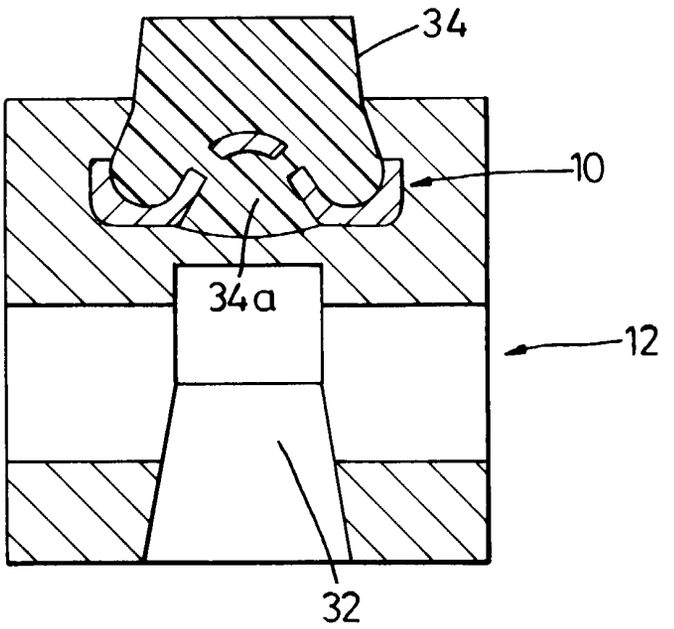

Fig. 3

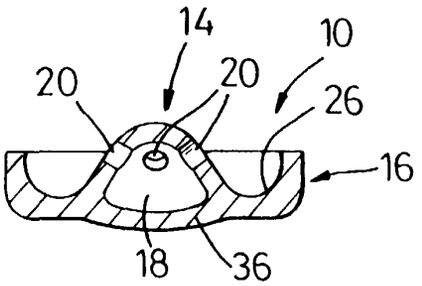

Fig. 4

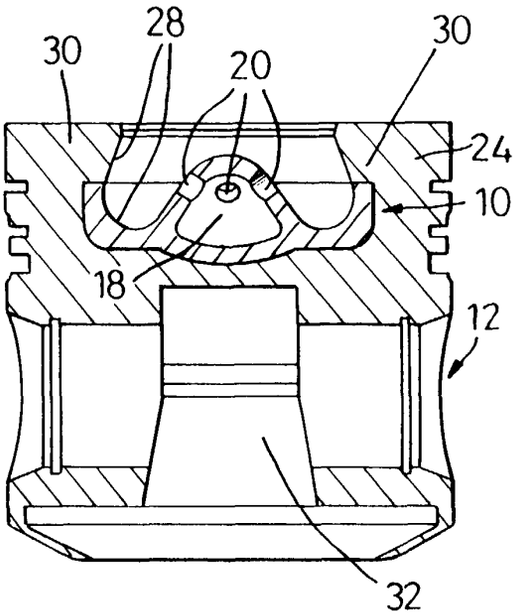

Fig. 5

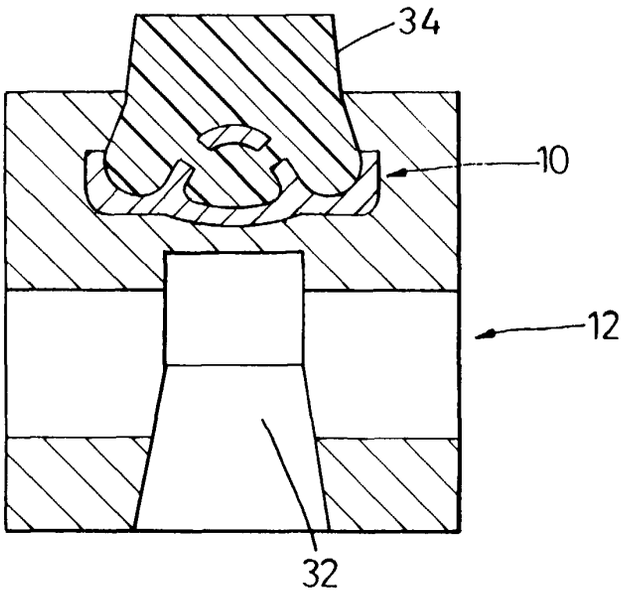

Fig. 6

[drawing(s) deleted]