(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 250 806 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
23.03.2022 Bulletin 2022/12

(21) Application number: **16706278.5**

(22) Date of filing: **01.02.2016**

(51) International Patent Classification (IPC):
F02F 3/18 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F02F 3/18

(86) International application number:
PCT/US2016/015906

(87) International publication number:
WO 2016/123601 (04.08.2016 Gazette 2016/31)

(54) PISTON WITH SEALED COOLING GALLERY AND METHOD OF CONSTRUCTION THEREOF

KOLBEN MIT ABGEDICHTETEM KÜHLKANAL UND VERFAHREN ZUR KONSTRUKTION DAVON

PISTON COMPRENANT UNE GALERIE DE REFROIDISSEMENT ÉTANCHE ET PROCÉDÉ DE CONSTRUCTION ASSOCIÉ

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **30.01.2015 US 201562110191 P**

(43) Date of publication of application:
06.12.2017 Bulletin 2017/49

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EP 3 250 806 B1

Description

CROSS-REFERENCE TO RELATED APPLICATION

BACKGROUND OF THE INVENTION

1. Technical Field

[0001] This invention relates generally to internal combustion engines, and more particularly to pistons and their method of construction.

2. Related Art

[0002] Engine manufacturers are encountering increasing demands to improve engine efficiencies and performance, including, but not limited to, improving fuel economy, improving fuel combustion, reducing oil consumption, and increasing the exhaust temperature for subsequent use of the heat within the vehicle. In order to achieve these goals, the engine running temperature in the combustion chamber needs to be increased. However, while desirable to increase the temperature within the combustion chamber, it remains necessary to maintain the piston at a workable temperature. As such, it is known to incorporate outer and inner cooling galleries, both open and closed, within the piston head through which engine oil is circulated to reduce the operating temperature of the piston head. The outer cooling galleries typically circulate about an upper land of the piston including a ring groove region while the inner cooling gallery is typically beneath an upper combustion surface of the piston head, commonly referred to as undercrown, which commonly includes a recessed combustion bowl. As such, both the ring belt region and the combustion surface benefit from cooling action of the circulated oil. Wherein a closed cooling gallery is provided, it is known to cast closed cooling galleries; however, the manufacturing process tends to be costly.

[0003] Further, JP S61 187 944 U discloses a piston of an internal combustion engine having a sealing cavity formed therein between a combustion chamber side wall and a piston outer wall, said cavity enclosing oil and an active gas. The sealing cavity is formed by core molding, wherein an opening is sealed with a drain bolt via a gasket. However, JP S61187944 U does not disclose a piston body with an upper and a lower part constructed as separate pieces, wherein the lower part provides a floor of an annular cooling gallery and a floor has a through opening.

[0004] US 2014/0123930 A1 discloses a piston for an internal combustion engine comprises a sealed cooling gallery extending circumferentially around a center axis beneath a bowl rim of an upper crown. A metal-containing composition having a high thermal conductivity fills a portion of the sealed cooling gallery to dissipate heat. The metal-containing composition includes a base material having a melting temperature less than 181°C. and a plurality of metal particles having a thermal conductivity greater than the thermal conductivity of the base material. For example, the metal-containing composition can comprise copper particles dispersed in silicone oil, or copper particles dispersed in a mixture of alkali metals. During high temperature operation, as the piston reciprocates in the cylinder bore, the base material is liquid and flows throughout the cooling gallery to dissipate heat away from the upper and lower crowns.

[0005] A similar piston assembly is also disclosed in FR 647 110 A.

[0006] A piston constructed in accordance with this invention overcomes the aforementioned disadvantages associated with pistons having a closed cooling gallery.

SUMMARY OF THE INVENTION

[0007] A piston for an internal combustion engine according to the present invention is defined by claim 1. Dependent claims relate to preferred embodiments. A method of constructing a piston for an internal combustion engine according to the present invention is defined by claim 4. Claim 5 relates to preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] These and other aspects, features and advantages of the invention will become more readily appreciated when considered in connection with the following detailed description of presently preferred embodiments and best mode, appended claims and accompanying drawings, in which:

Figure 1 is a bottom view of an embodiment of a piston;
Figure 2 is a cross-sectional view taken generally along line 2-2 of the piston of Figure 1;
Figure 3 is an enlarged view of the encircled area 3 of Figure 2;
Figure 4A is an elevation view of a seal plug from the piston of Figure 1;
Figure 4B is top view of the seal plug of Figure 4A;
Figure 5A is a view of an embodiment of a seal plug shown in a preassembled state;
Figure 5B is a view similar to Figure 5A showing the seal plug in a fully assembled state;
Figure 6A is an elevation view of the seal plug from the piston of Figures 5A and 5B;
Figure 6B is top view of the seal plug of Figure 6A;
Figure 7A is a cross-sectional elevation view of an assembly with a sealing member (not covered by the appended claims) shown in a partially installed state;
Figure 7B is a cross-sectional elevation view of the sealing member of Figure 7A shown in a fully installed state;
Figure 8A is a cross-sectional elevation view of an assembly with a sealing member (not covered by the appended claims) shown in an uninstalled state;

Figure 8B is a cross-sectional elevation view of the sealing member of Figure 8A shown in an installed state;

Figure 9A is a cross-sectional elevation view of an assembly with a sealing member (not covered by the appended claims) in an uninstalled state; and

Figure 9B is a cross-sectional elevation view of the sealing member of Figure 9A shown in an installed state.

DETAILED DESCRIPTION

[0009] Referring in more detail to the drawings, Figures 1 and 2 illustrate a piston assembly, referred to hereafter simply as piston 10, constructed according to one presently preferred embodiment of the invention, for reciprocating movement in a cylinder bore or chamber of an internal combustion engine (not shown), such as light vehicle diesel, midrange diesel, heavy duty and large bore diesel engines, and gas engines, for example. The piston 10 has a piston body 12 extending along a central longitudinal axis 14 along which the piston 10 reciprocates in the cylinder bore. The body 12 is formed including an upper combustion wall having on one side an upper combustion surface 16 configured for direct exposure to combustion gases within a cylinder bore and on an opposite side an undercrown surface 18 located directly and axially beneath the upper combustion surface 16. The piston body 12 is also formed having a ring belt region 20 depending from the upper combustion surface 16 adjacent the upper combustion surface 16 wherein the ring belt region 20 is configured for receipt of at least one piston ring (not shown), as is known. Further, the piston body 12 is constructed having an annular, closed and sealed cooling gallery 22 with a coolant medium 24 sealed therein for the life of the piston 10. The cooling gallery 22 is shown as being toroid-shaped and configured radially inwardly and in substantial radial alignment with the ring belt region 20, by way of example and without limitation. Upon disposing the coolant medium 24 within the cooling gallery 22, the cooling gallery 22 is sealed off and maintained as a hermetically sealed cooling gallery by a sealing member 26, thereby assuring the coolant medium 24 is contained within the cooling gallery 22 and prevented from leaking outwardly therefrom past the sealing member 26.

[0010] The piston body 12 is shown having a steel upper part 28 and a steel lower part 30 constructed from separate pieces of steel material and subsequently fixed to one another via a welding process, such as induction welding, resistance welding, charge carrier rays, electron beam welding, laser welding, stir welding, brazing, soldering, hot or cold diffusion, and shown as a friction welding process, though other joining processes are contemplated to be within the scope of the invention. In the embodiment shown, a first bond joint 32 joins a pair of annular inner ribs 34, 36 to one another, and in addition, a second bond joint 38 extends through an outer wall within the ring belt region 20 to join a pair of annular outer ribs 40, 42 to one another.

[0011] The lower part 30 depends along the central axis 14 from the upper part 28 to provide a pair of pin bosses 44 having laterally spaced pin bores 46 coaxially aligned along a pin bore axis 48 that extends generally transverse to the central longitudinal axis 14. The pin bosses 44 are joined to laterally spaced skirt portions 50 via strut portions 52. The skirt portions 50 are diametrically spaced from one another across opposite sides the pin bore axis 48 and have convex outer surfaces contoured for sliding cooperation within the cylinder bore to maintain the piston 10 in a desired orientation as it reciprocates along the axis 14 through the cylinder bore.

[0012] The upper combustion surface 16 is represented as having a recessed combustion bowl 54 to provide a desired gas flow with the cylinder bore. At least in part due to the combustion bowl 54, relatively thin regions of piston body material are formed between the upper combustion surface 16, the annular cooling gallery 22 and the undercrown surface 18. As such, in use, these regions need to be properly cooled via oil flowing through the cooling gallery 22. The necessary cooling for this region is provided, at least in part, via coolant medium 24 contained within the cooling gallery 22.

[0013] To facilitate disposing the coolant medium 24 into the cooling gallery 22 upon joining the upper part 28 to the lower part 30, the lower part 30 has a through opening 56 formed in a floor 58 of the cooling gallery 22, such as via a drilling process, by way of example and without limitation. The through opening 56 can be formed having a suitable diameter, and in accordance with one example, the diameter was formed between about 8-10mm, without limitation, and formed as non-threaded through opening. The through opening 56 is shown as being located radially inwardly from a central portion of one of the skirts 50, generally centrally between the pin bores 46, on a non-thrust side of the piston 10, thereby being in a region of reduced stress. To facilitate forming the through opening 56 in the precise, desired location, an identifying feature can be formed in a surface of the floor 58, such as an embossed or coined depression, by way of example and without limitation, while forging or otherwise constructing the lower part 30. Then, upon disposing the desired type and amount of coolant medium 24 through the through opening 56 and into the cooling gallery 22, the cooling gallery 22 is completely closed and sealed off via the sealing member 26 and confined within the cooling gallery 22.

[0014] Figures 4A-B depict an embodiment, wherein the sealing member 26 is provided as a non-threaded, steel plug. The plug 26 has a generally cylindrical stud or shank 60 extending along a central axis 61 and an enlarged head, also referred to as end cap 62. The shank 60 is preferably sized having an outer diameter (d) that is less than the diameter of the through opening 56 in the floor 58 of the cooling gallery 22, and thus, the shank 60, being void of any external male threads, has a clearance fit within the through opening 56 upon being disposed therethrough. As such, there is no need to control tight tolerances between the outer diameter of the shank 60 and the outer periphery of the through opening 56, as there is no interference fit therebetween, and thus, manufacturing efficiencies can be realized. To facilitate locating and centering the shank 60 within the through opening 56, the shank 60 can be formed having a chamfered end 64. The end cap 62 is formed having a planar or substantially planar, annular joining surface 66 extending generally transversely to the axis 61 outwardly from the shank 60. The joining surface 66 extends radially outwardly beyond the through opening 56, thereby presenting the end cap 62 with a diameter that is larger than the diameter of the through opening 56. The joining surface is the portion of the sealing member 26 that is responsible for and directly forms a fixed bond joint with the lower part 30.

[0015] Prior to disposing the sealing member 26 in the through opening 56 to be closed and sealed off, as best shown in Figure 3, a bonding surface 70 on the underside of the floor 58, to which the joining surface 66 of the sealing member 26 is to be fixed, can be machined flat and planar, such as in a spot facing operation, by way of example and without limitation. As such, a good, reliable, gas/fluid leak-proof bond is able to be reliably established between the joining surface 66 and the bonding surface 70. Then, upon forming the smooth, planar bonding surface 70, the shank 60 of the sealing member 26 is disposed within the through opening 56 in a clearance fit therewith, and the sealing member 26 is rotatably driven at a sufficiently high rotational speed to form the bond joint 68 via a friction weld, whereupon flashing 71 is formed to extend radially outwardly from the respective steel joining and bonding surfaces 66, 70 and axially inwardly into the through opening 56, which is accommodated by the clearance fit of the shank 60 within the through opening 56. Accordingly, the flashing 71, being freely permitted to flow into the through opening 56 between the outer periphery of the through opening 56 and the outer surface of the shank 60, automatically facilitates forming the gas/liquid tight seal to hermetically seal off the through opening 56, and thus, no additional bonding agents are needed, thereby further providing manufacturing efficiencies, thus, reducing cost. To facilitate rotatably driving the sealing member 26 at the rotational speed needed to form a friction weld joint, the end cap 62 can be provided with a drive feature 72, shown as a non-circular, hexagonal recessed pocket, by way of example and without limitation, for receipt of a similarly shaped drive tool. It should be recognized that the pocket 72 could take a different; non-circular shaped, as desired, and further, could be formed as a male protrusion, if desired.

[0016] Figures 5A-5B and 6A-6B depict an embodiment, wherein a sealing member 26' for closing and sealing off a through opening 56 extending into a cooling gallery 22 of a piston (portion of piston 10 illustrated), wherein the same reference numerals, offset by a prime symbol ('), are used to identify like features of the sealing member.

[0017] The sealing member 26' is provided as a non-threaded, steel plug. The plug 26' has an annular tapered nose 60' extending radially inwardly toward a central axis 61' to a free end 64', wherein the free end 64' is shown to be slightly flattened, by way of example and without limitation. The tapered nose 60' extends radially outwardly away from the central axis 61' to a generally cylindrical sidewall 63, wherein the sidewall 63 extends to an opposite free end 62'. To facilitate rotatably driving the sealing member 26' at the rotational speed needed to form a friction weld joint, the free end 62' can be provided with a drive feature 72', shown as a serrated face, by way of example and without limitation, for receipt of a similarly serrated drive tool 73. To facilitate locating the driving tool 73, a central recessed pocket 75 can be formed in the free end 62' to receive a similarly shaped male protrusion 77 on the driving tool 73. The tapered nose 60' provides a conical joining surface 66' that extends radially outwardly beyond the through opening 56, thereby presenting the sidewall 63 and joining surface 66' with a diameter that is larger than the diameter of the through opening 56. The joining surface 66' is the portion of the sealing member 26' that is responsible for abutting and directly forming a fixed friction welded bond joint 68' with the lower part 30.

[0018] In assembly, the tapered nose 60' of the sealing member 26' is disposed within the through opening 56, wherein the conical or frustroconical form of the nose taper facilitates locating and centering the sealing member 26' in the through opening 56. Then, the serrated tool 73 is brought into mating engagement with the serrated drive feature 72', and the sealing member 26' is rotatably driven at a sufficiently high rotational speed to form the bond joint 68' via a friction weld, whereupon the sealing member 26' is caused to sink into the material of the floor 58 as a result of melting material of the floor 58, wherein molten, solidified and hardened flashing 71' is formed to extend radially outwardly from the respective steel joining and bonding surfaces 66', 70 and axially inwardly into the through opening 56, which facilitates forming the strong, gas/liquid tight seal to hermetically seal off the through opening 56, and thus, no additional bonding agents are needed, thereby further providing manufacturing efficiencies, thus, reducing cost. It should be recognized that both the material of the floor 58 and the sealing member 26' can be caused to melt, thereby forming an alloy of molten, solidified material that results in the strong, hardened bond joint.

[0019] Figures 7A and 7B depict an assembly with a sealing member 126 for closing and sealing off a through opening 156 extending into a cooling gallery 122 of a piston (portion of piston 110 illustrated) that is not covered by the appended claims. This assembly is included for explanatory purposes, wherein the same reference numerals, offset by a factor of 100, are used to identify like features. The piston body 112 is constructed substantially the same as discussed above for the body 12, and thus, repetition in describing the piston body 112 is believed unnecessary.

[0020] The sealing member 126 is provided as a rivet-style member, having a rivet body 74 and a rivet actuation member, also referred to as rivet mandrel 76. The rivet-style sealing member 126 is thus actuated to move from a first pre-installed state (Figure 7A) to an expanded, plastically deformed second installed state (Figure 7B) in the same manner as a common rivet. During installation, a shank 78 of the rivet body 74 is inserted through the non-threaded through opening 156 in a slight clearance fit, whereupon a portion of the shank 78 is extended upwardly into the cooling gallery 122 and an enlarged cap or head 79, having a larger diameter than the through opening 156, is brought into abutment with an underside of the floor 158, and then, a suitable rivet actuation tool (not shown) grasps the exposed, free end of the rivet mandrel 76 depending from the floor 158 to pull the rivet mandrel 76 relative to the rivet body 74, as is known in deploying rivets, thereby plastically deforming and expanding a portion of the shank 78 of the rivet body 74 into a permanent interference fit with an outer periphery of the through opening 156 an upper surface of the floor 158 to sealingly close off the through opening 156. It is contemplated, if desired, to facilitate forming a gas/fluid tight seal upon plastically deforming the shank 78 to its expanded form, a high temperature anaerobic sealant material 82 could be disposed about the shank 78 of the rivet body 74 prior to disposing the rivet body 74 into the through opening 156.

[0021] Figures 8A and 8B depict an assembly with a sealing member 226 for closing off a through opening 256 extending into a cooling gallery 222 of a piston (portion of piston 210 illustrated) that is not covered by the appended claims. The assembly is included for explanatory purposes, wherein the same reference numerals, offset by a factor of 200, are used to identify like features. The piston body 212 is constructed substantially the same as discussed above for the body 12, and thus, repetition in describing the piston body is believed unnecessary.

[0022] The sealing member 226 is provided as a cup-shaped plug. During installation, a closed end of the plug 226 is pressed into the through opening 256 in an interference fit with a suitable installation tool 80 received in and pressing against an open end of the plug 226 to sealingly close off the through opening 256. Preferably, to facilitate forming a gas/fluid tight seal, a high temperature anaerobic sealant material 282 is first disposed about an outer periphery 84 of the plug 226 prior to disposing the plug 226 into the through opening 256. The plug 226 can be formed having any suitable diameter to provide the desired interference fit within the through opening 256, taking into account the material and wall thickness (t) of the plug 226.

[0023] Figures 9A and 9B depict an assembly with a tapered sealing member 326 for closing and sealing off a through opening 356 extending into a cooling gallery 322 of a piston (portion of piston 310 illustrated) that is not covered by the appended claims The assembly is included for explanatory purposes, wherein the same reference numerals, offset by a factor of 300, are used to identify like features. The piston body 312 is constructed substantially the same as discussed above for the body 12, and thus, repetition in describing the piston body 312 is believed unnecessary.

[0024] The tapered sealing member 326 is provided as a tapered threaded member, having a tapered male threaded shank 360. During installation, the tapered threaded shank 360 is threaded into a matching tapered female threaded through opening 356 to sealingly close off the tapered threaded through opening 356. The matching inclination of the tapers of the threaded shank 360 and the threaded opening 356 automatically cause the sealing member 326 to be driven to a set depth, and prevent the sealing member 326 from being over driven completely through the through opening 356. Preferably, to facilitate forming a gas/fluid tight seal, a high temperature anaerobic sealant material 382 is first disposed about an outer periphery of the threaded shank 360 prior to threading the threaded shank 360 into the threaded through opening 356. To facilitate rotatably driving the sealing member 326 into the threaded through opening 356, an end 362 of the member 326 can be provided with a drive feature 372, shown as a non-circular, hexagonal recessed pocket, by way of example and without limitation, for receipt of a similarly shaped drive tool. It should be recognized, as discussed above, that the pocket 372 could take a different; non-circular shaped, as desired, and further, could be formed as a male protrusion, if desired. In accordance with one aspect of the invention, the tapered threaded shank 360 is threaded into the tapered threaded through opening 356 to a torque between about 18-22 Nm, which has been found, in combination with the anaerobic sealant material 382, to optimally close off and seal the through opening 356 for the intended life of the piston 310.

[0025] It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

Claims

1. A piston for an internal combustion engine, comprising:

a piston body (12) including an upper part (28) and a lower part (30) bounding an annular cooling gallery (22), wherein said upper part (28) and said lower part (30) are constructed from separate pieces and are fixed to one another via a welding process, said upper part (28) having an upper combustion surface (16) configured for direct exposure to combustion gases within a cylinder bore and an undercrown surface (18) beneath said upper combustion surface (16) and having a ring belt region (20) radially outwardly from said annular cooling gallery (22), said lower part (30) providing a floor (58) of said annular cooling gallery (22) and a pair of pin bosses (44) depending from said floor (58), said pin bosses (44) having axially aligned pin bores (46) and said floor (58) having a through opening (56);

a coolant medium (24) disposed in said annular cooling gallery (22); and

a sealing member (26) sealing off said through opening (56) and sealing said coolant medium (24) in said coolant gallery (22);

wherein said sealing member (26) is fixed to said floor (58) via a friction weld joint, the sealing member (26) comprising a tapered nose (60') disposed within the through opening (56), a joining surface (66') fixed to a bonding surface (70) on an underside of the floor (58), and hardened flashing extended radially outwardly from the joining and bonding surfaces (66', 70) and axially inwardly into the through opening (56).

2. The piston of claim 1 wherein said through opening (56) is formed on a non-thrust side of said piston body (12).

3. The piston of claim 2 wherein said through opening (56) is formed generally between said piston bosses (44).

4. A method of constructing a piston for an internal combustion engine, comprising:

forming a piston body (12) including an upper part (28) and a lower part (30) constructed from separate pieces, the upper part (26) having an upper combustion surface (16) configured for direct exposure to combustion gases within a cylinder bore and an undercrown surface (18) beneath the upper combustion surface (16);

forming a ring belt region (20) configured for receipt of at least one piston ring adjacent the upper combustion surface (16);

forming an annular cooling gallery (22) radially inwardly from the ring belt region (20), said annular cooling gallery (22) having a floor (58), the lower part (30) providing the floor (58);

forming a through opening (56) in said floor (58) of the cooling gallery (22);

fixing the upper part (28) and the lower part (30) to one another via a welding process;

disposing a coolant medium (24) in the cooling gallery (22) through the through opening (56);

disposing a sealing member comprising a tapered nose (60') and a joining surface (66') in the through opening (56) to seal the coolant medium in the cooling gallery (22); and

friction welding the sealing member (26) to an underside of said floor (58) of the cooling gallery (22), wherein the joining surface (66') is fixed to a bonding surface (70') on the underside of said floor (58), and wherein the sealing member (26) is caused to sink into material of the floor (58), causing material of the floor (58) and the sealing member (26) to melt, thereby forming an alloy of molten, solidified material, and wherein molten, solidified and hardened flashing (71') is formed to extend radially outwardly from the respective steel joining and bonding surfaces (66', 70) and axially inwardly into the through opening (56).

5. The method of claim 4 further including forming the through opening (56) on a non-thrust side said piston body (12).

Patentansprüche

1. Kolben für einen Verbrennungsmotor, umfassend:

einen Kolbenkörper (12), der ein oberes Teil (28) und ein unteres Teil (30) beinhaltet, die eine ringförmige Kühlgalerie (22) begrenzen, wobei das obere Teil (28) und das untere Teil (30) aus separaten Stücken konstruiert sind und durch einen Schweißprozess aneinander befestigt werden, das obere Teil (28) eine obere Verbrennungsfläche (16), die für eine direkte Einwirkung von Verbrennungsgasen ausgelegt ist, innerhalb einer Zylinderbohrung und eine Unterbodenfläche (18) unterhalb der oberen Verbrennungsfläche (16) aufweist und einen Ringbandbereich (20) radial außerhalb der ringförmigen Kühlgalerie (22) aufweist, wobei das untere Teil (30) einen Boden (58) der ringförmigen Kühlgalerie (22) und ein Paar von Kolbenbolzenaugen (44), die von dem Boden (58) herabhängen, bereitstellt, wobei die Kolbenbolzenaugen (44) radial ausgerichtete Kolbenbolzenbohrungen (46) aufweisen und der Boden (58) eine Durchgangsöffnung (56) hat;

ein Kühlmedium (24), das in der ringförmigen Kühlgalerie (22) angeordnet ist; und

ein Dichtungselement (26), das die Durchgangsöffnung (56) abdichtet und das Kühlmedium (24) in der Kühlgalerie (22) abdichtet;

wobei das Dichtungselement (26) an dem Boden (58) durch eine Reibschweißverbindung befestigt ist, das Dichtungselement (26) eine sich konisch verjüngende Nase (60'), die in der Durchgangsöffnung (56) angeordnet ist, eine Verbindungsfläche (66'), die an einer Bindungsfläche (70) an einer Unterseite des Bodens (58) befestigt ist, und gehärtete Verblechung, die sich von der Verbindungs- und Bindungsfläche (66', 70) radial nach außen und axial nach innen in die Durchgangsöffnung (56) erstreckt, aufweist.

2. Kolben nach Anspruch 1, wobei die Durchgangsöffnung (56) an einer Nicht-Schubseite des Kolbenkörpers (12) gebildet ist.

3. Kolben nach Anspruch 2, wobei die Durchgangsöffnung (56) im Allgemeinen zwischen den Kolbenbolzenaugen (44) gebildet ist.

4. Verfahren zum Konstruieren eines Kolbens für einen Verbrennungsmotor, umfassend:

Bilden eines Kolbenkörpers (12), der ein oberes Teil (28) und ein unteres Teil (30) beinhaltet, die aus separaten Stücken konstruiert sind, wobei das obere Teil (26) eine obere Verbrennungsfläche (16), die für eine direkte Einwirkung von Verbrennungsgasen ausgelegt ist, innerhalb einer Zylinderbohrung und eine Unterbodenfläche (18) unterhalb der oberen Verbrennungsfläche (16) aufweist;
Bilden eines Ringbandbereichs (20), der zum Aufnehmen mindestens eines Kolbenrings neben der oberen Verbrennungsfläche (16) ausgelegt ist;
Bilden einer ringförmigen Kühlgalerie (22) radial einwärts von dem Ringbandbereich (20), wobei die ringförmige Kühlgalerie (22) einen Boden (58) aufweist, wobei das untere Teil (30) den Boden (58) bereitstellt;
Bilden einer Durchgangsöffnung (56) in dem Boden (58) der Kühlgalerie (22);
Befestigen des oberen Teils (28) an dem unteren Teil (30) durch einen Schweißprozess;
Anordnen eines Kühlmediums (24) in der Kühlgalerie (22) durch die Durchgangsöffnung (56);
Anordnen eines Dichtungselements, das eine sich konisch verjüngende Nase (60') umfasst, und einer Verbindungsfläche (66') in der Durchgangsöffnung (56), um das Kühlmedium in der Kühlgalerie (22) abzudichten; und
Reibschweißen des Dichtungselements (26) an eine Unterseite des Bodens (58) der Kühlgalerie (22), wobei die Verbindungsfläche (66') an einer Bindungsfläche (70') an der Unterseite des Bodens (58) befestigt wird und wobei das Dichtungselement (26) veranlasst wird, in Material des Bodens (58) einzusinken, Schmelzenlassen von Material des Bodens (58) und des Dichtungselements (26), wodurch eine Legierung aus geschmolzenem, verfestigten Material gebildet wird, und wobei eine geschmolzene, verfestigte und gehärtete Verblechung (71') gebildet wird, die sich radial von den entsprechenden Stahlverbindungs- und Bindungsflächen (66', 70) nach außen und axial nach innen in die Durchgangsöffnung (56) erstreckt.

5. Verfahren nach Anspruch 4, weiter beinhaltend Bilden der Durchgangsöffnung (56) an einer Nicht-Schubseite des Kolbenkörpers (12).

Revendications

1. Piston pour un moteur à combustion interne, comprenant :

un corps de piston (12) comportant une partie supérieure (28) et une partie inférieure (30) délimitant une galerie de refroidissement annulaire (22), dans lequel ladite partie supérieure (28) et ladite partie inférieure (30) sont construites à partir de pièces distinctes et sont fixées l'une à l'autre via un processus de soudage, ladite partie supérieure (28) comportant une surface de combustion supérieure (16) configurée pour une exposition directe à des gaz de combustion à l'intérieur d'un alésage de cylindre et une surface de sous-couronne (18) au-dessous de ladite surface de combustion supérieure (16) et comportant une région de courroie annulaire (20) radialement vers l'extérieur à partir de ladite galerie de refroidissement annulaire (22), ladite partie inférieure (30) fournissant un plancher (58) de ladite galerie de refroidissement annulaire (22) et une paire de bossages d'axe (44) dépendant dudit plancher (58), lesdits bossages d'axe (44) comportant des alésages d'axe (46) alignés axialement et ledit plancher (58) comportant une ouverture traversante (56) ;
un fluide de refroidissement (24) disposé dans ladite galerie de refroidissement annulaire (22) ; et
un élément d'étanchéité (26) scellant ladite ouverture traversante (56) et scellant ledit fluide de refroidissement (24) dans ladite galerie de refroidissement (22) ;
dans lequel ledit élément d'étanchéité (26) est fixé audit plancher (58) via une liaison par soudage par friction, l'élément d'étanchéité (26) comprenant un nez effilé (60') disposé à l'intérieur de l'ouverture traversante (56), une surface de jonction (66') fixée à une surface de liaison (70) sur un dessous du plancher (58), et un solin durci s'étendant radialement vers l'extérieur depuis les surfaces de jonction et de liaison (66', 70) et axialement vers l'intérieur dans l'ouverture traversante (56).

2. Piston selon la revendication 1, dans lequel ladite ouverture traversante (56) est formée sur un côté sans poussée dudit corps de piston (12).

3. Piston selon la revendication 2, dans lequel ladite ouverture traversante (56) est formée généralement entre lesdits bossages de piston (44).

4. Procédé de construction d'un piston pour un moteur à combustion interne, comprenant:

la formation d'un corps de piston (12) comportant une partie supérieure (28) et une partie inférieure (30) construites à partir de pièces distinctes, la partie supérieure (26) comportant une surface de combustion supérieure (16) configurée pour une exposition directe à des gaz de combustion à l'intérieur d'un alésage de cylindre et une surface de sous-couronne (18) au-dessous de ladite surface de combustion supérieure (16) ;
la formation d'une région de courroie annulaire (20) configurée pour recevoir au moins un segment adjacent à la surface de combustion supérieure (16) ;
la formation d'une galerie de refroidissement annulaire (22) radialement vers l'intérieur à partir de la région de courroie annulaire (20), ladite galerie de refroidissement annulaire (22) comportant un plancher (58), la partie inférieure (30) fournissant le plancher (58) ;
la formation d'une ouverture traversante (56) dans ledit plancher (58) de la galerie de refroidissement (22) ;
la fixation de la partie supérieure (28) et de la partie inférieure (30) l'une à l'autre via un processus de soudage ;
la disposition d'un fluide de refroidissement (24) dans la galerie de refroidissement (22) à travers l'ouverture traversante (56) ;
la disposition d'un élément d'étanchéité comprenant un nez effilé (60') et une surface de jonction (66') dans l'ouverture traversante (56) pour sceller le fluide de refroidissement dans la galerie de refroidissement (22) ; et
le soudage par friction de l'élément d'étanchéité (26) à un dessous dudit plancher (58) de la galerie de refroidissement (22), dans lequel la surface de jonction (66') est fixée à une surface de liaison (70') sur le dessous dudit plancher (58), et dans lequel l'élément d'étanchéité (26) est amené à s'enfoncer dans un matériau du plancher (58), en amenant le matériau du plancher (58) et l'élément d'étanchéité (26) à fondre, en formant de ce fait un alliage de matériau solidifié en fusion, et dans lequel un solin fondu, solidifié et durci (71') est formé pour s'étendre radialement vers l'extérieur depuis les surfaces de jonction et de liaison (66', 70) en acier respectives et axialement vers l'intérieur dans l'ouverture traversante (56).

5. Procédé selon la revendication 4, comprenant en outre la formation de l'ouverture traversante (56) sur un côté sans poussée dudit corps de piston (12).

FIG. 1

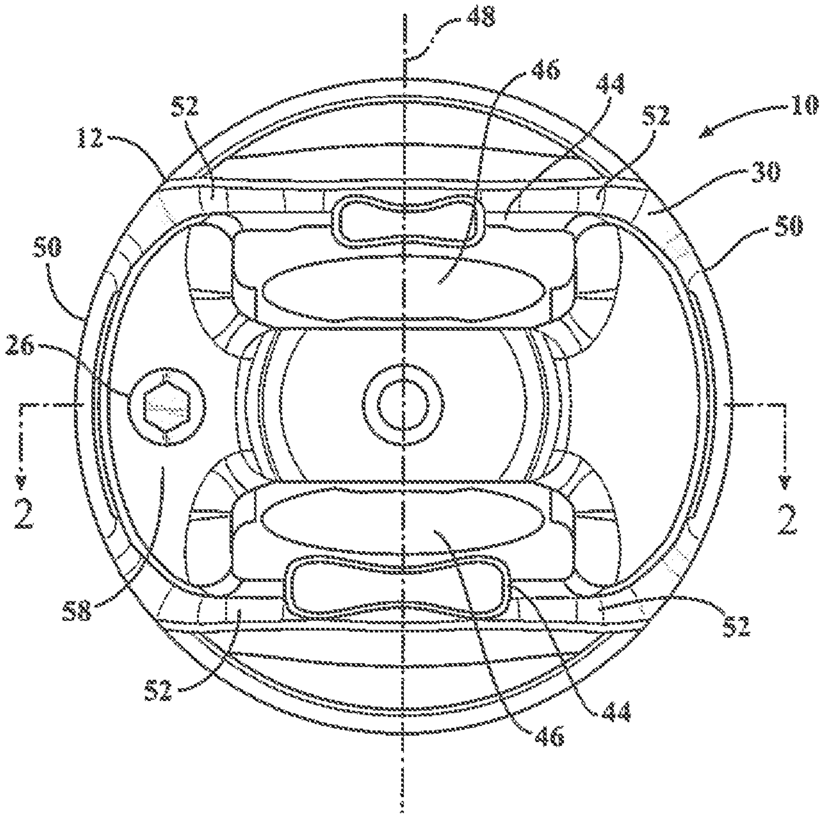
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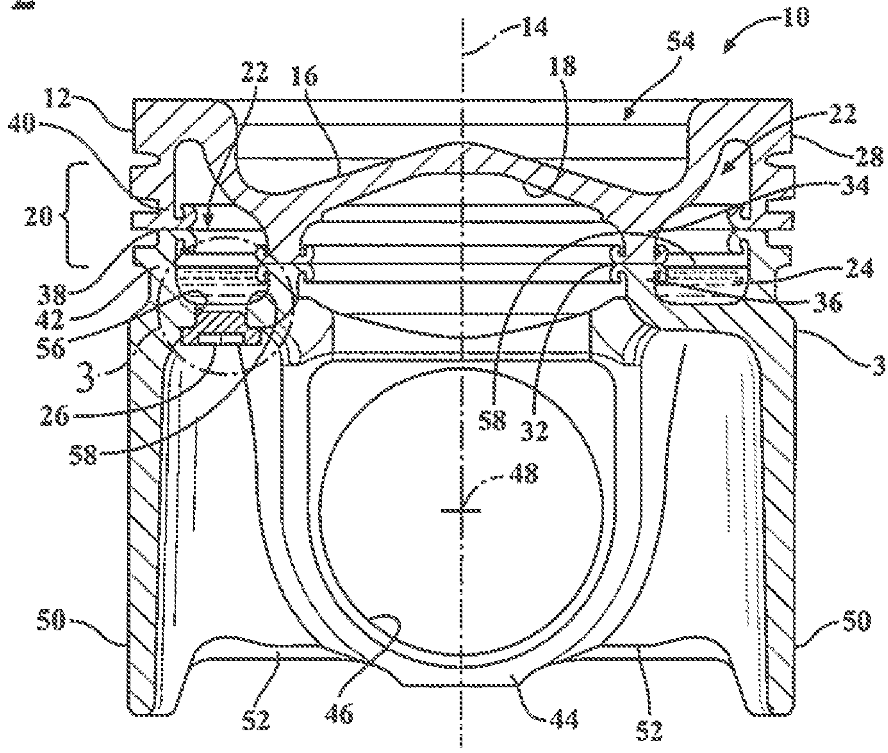
FIG. 2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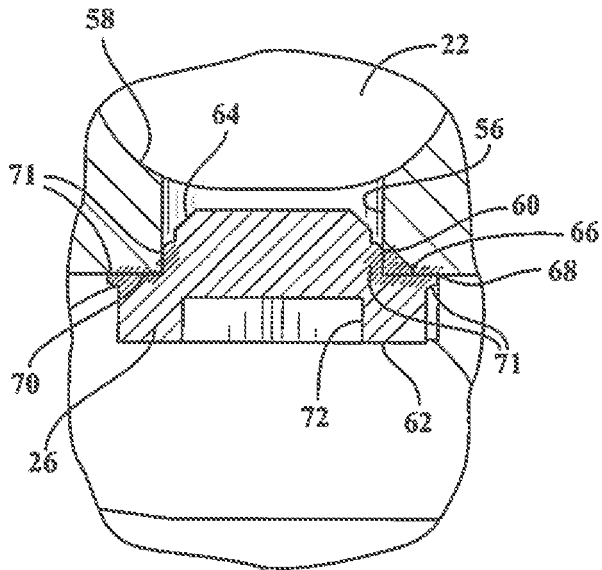

FIG. 3

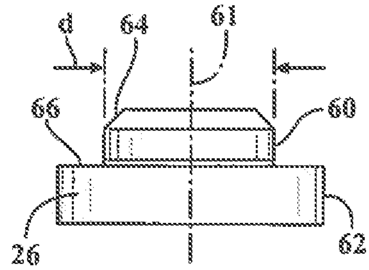

FIG. 4A

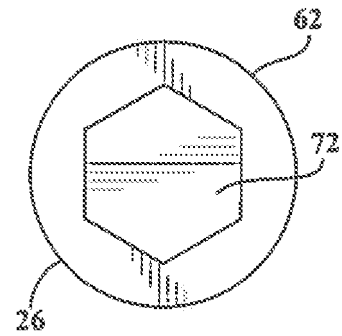

FIG. 4B

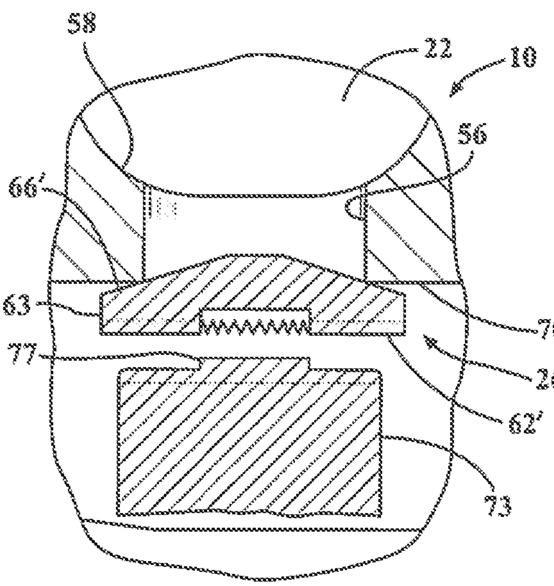

FIG. 5A

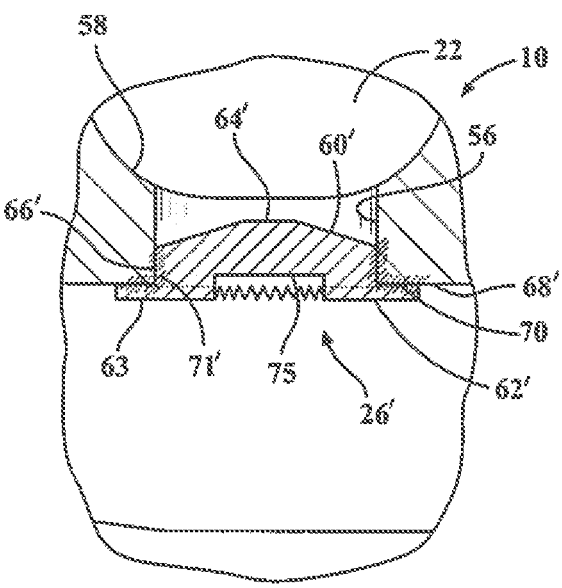

FIG. 5B

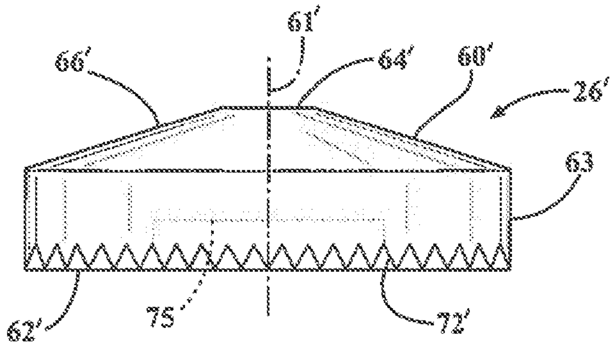

FIG. 6A

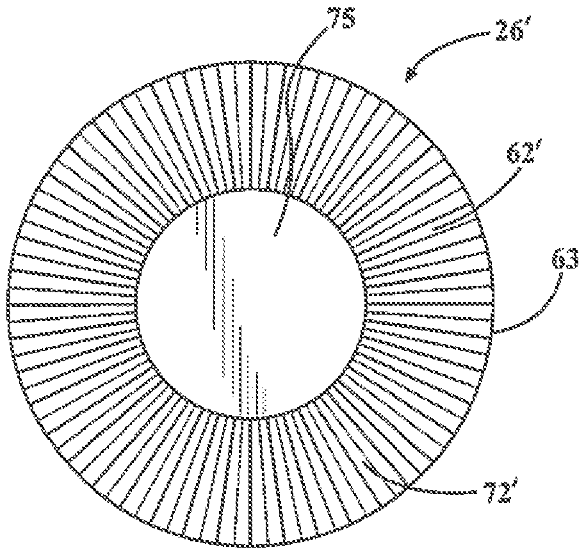

FIG. 6B

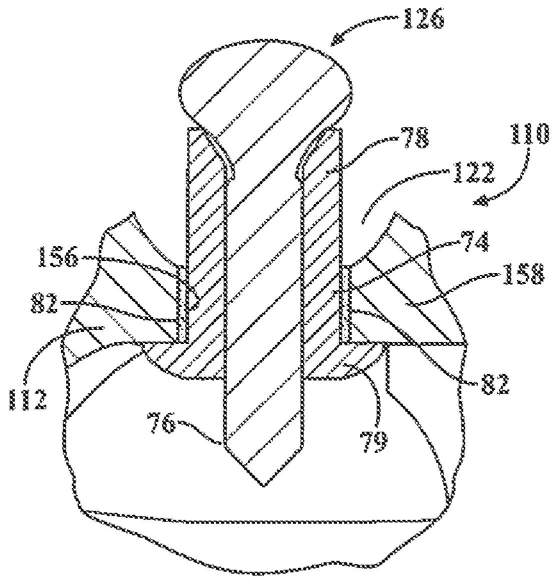

FIG. 7A

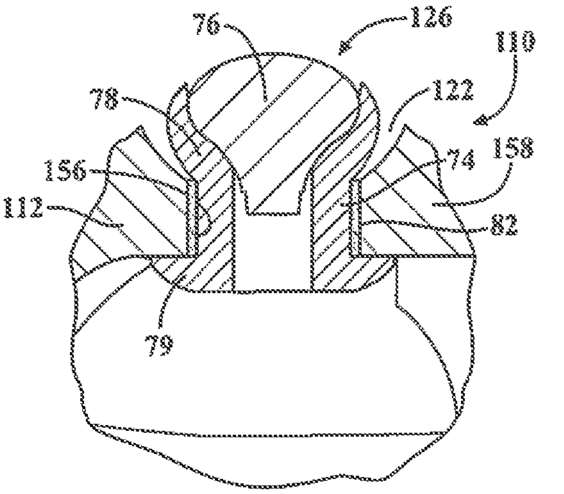

FIG. 7B

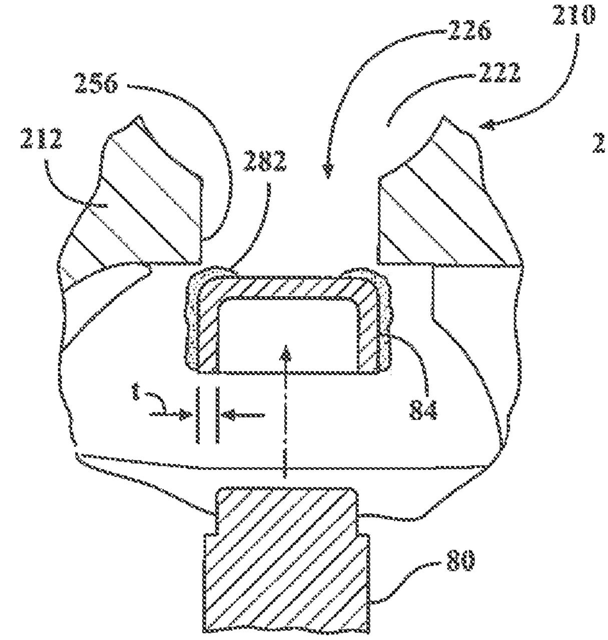

FIG. 8A

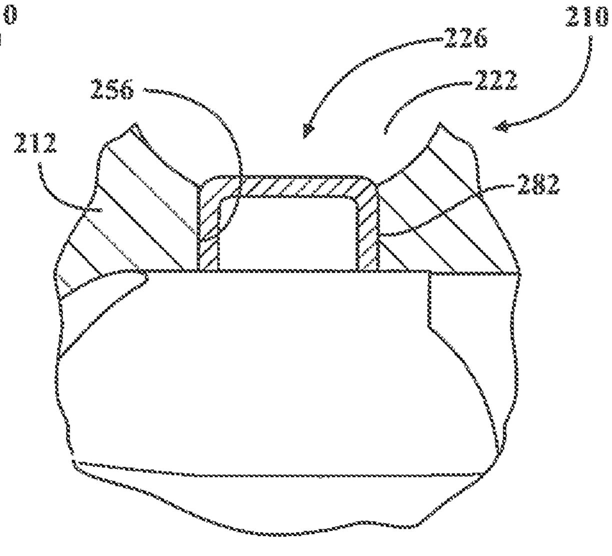

FIG. 8B

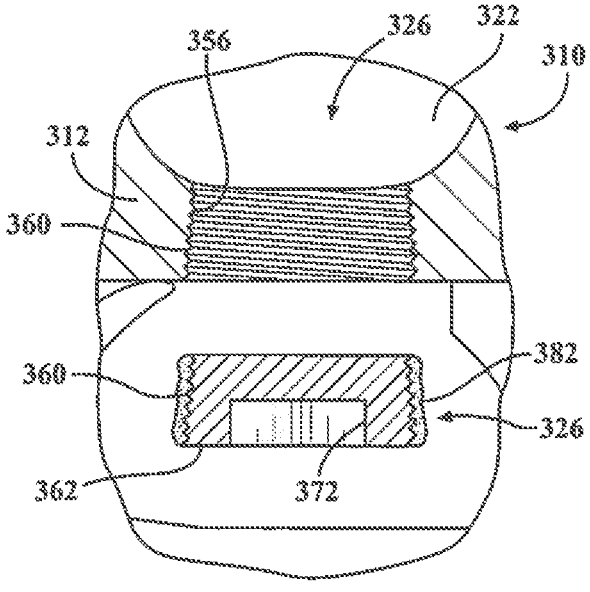

FIG. 9A

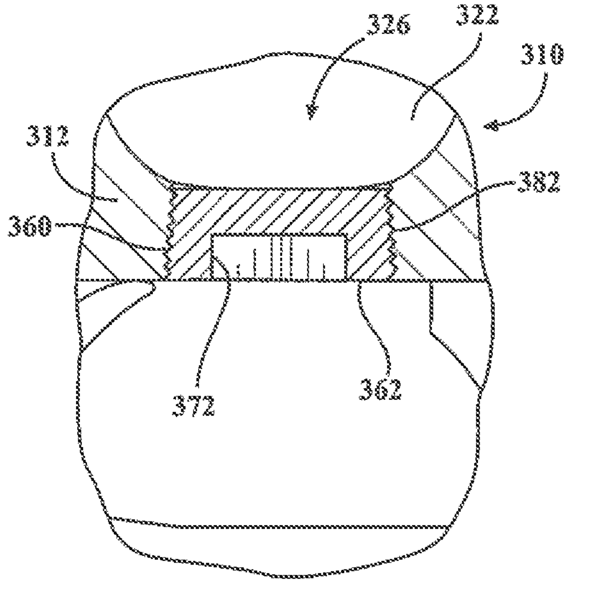

FIG. 9B

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- US 20140123930 A1 **[0004]**
- FR 647110 A **[0005]**