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(54) **Cylinder head structure for an engine and engine provided therewith**

Zylinderkopfaufbau für einen Motor und der damit ausgestattete Motor

Structure d'une culasse pour un Moteur et Moteur associée

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- **PATENT ABSTRACTS OF JAPAN vol. 2003, no. 12, 5 December 2003 (2003-12-05) -& JP 2004 218593 A (MITSUBISHI MOTORS CORP; MITSUBISHI AUTOMOB ENG CO LTD), 5 August 2004 (2004-08-05)**
- **PATENT ABSTRACTS OF JAPAN vol. 2003, no. 12, 5 December 2003 (2003-12-05) -& JP 2004 239126 A (NISSAN MOTOR CO LTD), 26 August 2004 (2004-08-26)**

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Description

[0001] The present invention relates to a cylinder head structure for an engine, particularly to a cylinder head of an engine that can improve the engine cooling function, and to an engine provided therewith.

[0002] An engine valve drive mechanism comprising two intake valves and two exhaust valves provided for each cylinder has been recently adopted to improve an intake and exhaust efficiency of the engine.

[0003] The engine equipped with such a valve drive mechanism has been also desired to have a higher power as well as compactness of its engine body. Accordingly, some measures against a severe heat load due to the higher power have been required.

[0004] In particular, it is advantageous to improve the cooling function substantially around or close to the combustion chamber and the exhaust ports, and therefore some technologies for those have been proposed.

[0005] For example, Japanese Patent Laid-Open Publication 2003-314357 discloses a structure that the cross section area of the plug tower portion (the cylindrical ignition-plug hole wall) of the cylinder head is configured to be gradually enlarged from the combustion-chamber side to the upper-deck side (from below to above) to increase the coolant flow speed at the combustion-chamber side in the water jacket compared with that at the upper-deck side, thereby improving the cooling function of the engine.

[0006] Japanese Patent Laid-Open Publication 2004-218593 discloses a structure comprising a rib protruding in the direction of the upstream of a circulating water flow achieving a preferential cooling water flow in one of two cooling water ways.

[0007] Meanwhile, since the total flow volume of the engine coolant is determined based on the function of the water pump etc., the efficiency of the cooling function rests upon how to make the coolant flow.

[0008] Also, the engine generally has different cooling requirements, namely, the exhaust-side portion requires more cooling than the intake-side portion does. The art disclosed in the above-described publication, however, just attempts to increase the coolant flow speed at the combustion-chamber side entirely in the water jacket, and so would not provide more appropriate cooling function for respective portions.

[0009] Further, it is necessary to reduce properly the temperature around the ignition plug, but the art in the publication would not consider the cooling function of the ignition-plug hole wall itself either.

[0010] In addition, a drill hole is generally formed to make the coolant passage for introducing the coolant from the cylinder block into the portion between the exhaust ports so as to cool this portion properly. However, any measures for properly cooling the portion are not disclosed in the above-described art.

[0011] The present invention has been devised in view of the above-described problems, and an object of the

present invention is to provide the cylinder head structure of an engine that can improve the cooling function of the exhaust-side portion efficiently as well as the intake-side portion, substantially providing the proper cooling function of the ignition-plug hole wall.

[0012] This object is solved by the cylinder head structure of an engine according to the present invention of claim 1 and by an engine according to claim 8. Preferred embodiments of the present invention are subject to the dependent claims.

[0013] According to the present invention, there is provided a cylinder head structure for an engine, in which the engine has a multiple cylinders, there is provided for each cylinder a valve unit comprising one or more intake valves and one or more exhaust valves and an ignition plug located at the cylinder, and there are provided a main coolant jacket to allow part of a coolant to flow substantially around each ignition-plug hole wall substantially in a cylinder-row direction and an exhaust-side sub coolant jacket to allow part of the coolant to flow substantially around each exhaust port wall substantially in the cylinder-row direction, the both coolant jackets being connected to each other, the cylinder structure comprising:

a first vertical bead or projection or restriction portion that is formed at a portion of the ignition-plug hole wall that is substantially opposed to the exhaust port wall, the first vertical bead portion providing a smallest cross section of a passage between the ignition-plug hole wall and the exhaust port wall in said main coolant jacket;

a second vertical bead or projection or restriction portion that is formed at a portion of the ignition-plug hole wall that is substantially opposed to an intake port wall, the second vertical bead portion providing a smallest cross section of a passage between the ignition-plug hole wall and the intake port wall in said main coolant jacket; and

wherein said smallest cross section provided by the first vertical bead portion is configured so as to be greater than said smallest cross section provided by the second vertical bead portion, and said first vertical bead portion' formed at the ignition-plug hole wall is configured so as to be substantially opposed to the exhaust port wall that is located at an upstream side of the flow direction of the coolant, and,

and the first vertical bead portion is configured so as to be longer in the vertical direction than the second vertical bead portion.

[0014] Accordingly, since the smallest cross section at the exhaust-side portion of the main coolant jacket is configured to be greater than that at the intake-side portion of the main coolant jacket by the first and second vertical bead portions, the coolant flow volume at the exhaust-side portion in the jacket can be made greater than that at the intake-side portion, particularly suppressing the

total coolant flow volume of the main coolant jacket properly.

[0015] According to a preferred embodiment of the present invention, a coolant passage that is provided close to the one or more, preferably between a pair of exhaust port walls of the cylinder, one end of the coolant passage opening at a cylinder-head lower face and the other thereof opening at a location that is substantially opposed to the ignition plug hole wall,

[0016] According to a further preferred embodiment of the present invention, there is provided a cylinder head structure of an engine, in which the engine has multiple cylinders, there is provided for each cylinder a valve unit comprising two intake valves and two exhaust valves and an ignition plug located at a substantially central portion of the cylinder, and there are provided a main water jacket to allow part of a coolant to flow around each ignition-plug hole wall in a cylinder-row direction and an exhaust-side sub water jacket to allow part of the coolant to flow around each exhaust port wall in the cylinder-row direction, the both water jackets being connected to each other, the cylinder structure comprising a first vertical bead portion that is formed at a portion of the ignition-plug hole wall that is opposed to the exhaust port wall, the first vertical bead portion providing a smallest cross section of a passage between the ignition-plug hole wall and the exhaust port wall in said main water jacket, a second vertical bead portion that is formed at a portion of the ignition-plug hole wall that is opposed to an intake port wall, the second vertical bead portion providing a smallest cross section of a passage between the ignition-plug hole wall and the intake port wall in the main water jacket, and a coolant passage that is provided between a pair of exhaust port walls of the cylinder, one end of the coolant passage opening at a cylinder-head lower face and the other thereof opening at a location that is opposed to the ignition plug hole wall, wherein the smallest cross section provided by the first vertical bead portion is configured so as to be greater than the smallest cross section provided by the second vertical bead portion, and the first vertical bead portion formed at the ignition-plug hole wall is configured so as to be opposed to the exhaust port wall that is located at an upstream side of the flow direction of the coolant.

[0017] Accordingly, since the smallest cross section at the exhaust-side portion of the main water jacket is configured to be greater than that at the intake-side portion of the main water jacket by the first and second vertical bead portions, the coolant flow volume at the exhaust-side portion in the jacket can be made greater than that at the intake-side portion, suppressing the total coolant flow volume of the main water jacket properly.

[0018] Also, since the first and second vertical bead portions are exposed on the coolant flowing, the cooling function of the ignition-plug hole wall can be also improved.

[0019] Further, since the first vertical bead portion formed at the ignition-plug hole wall is configured so as

to be opposed to the exhaust port wall that is located at the upstream side of the coolant passage, the flow of the coolant is narrowed upstream of the portion where the above-described the coolant passage opens. Thereby, the flow speed of the coolant at the portion where the coolant passage opens is increased, so the coolant in the coolant passage can be properly sucked in the portion due to the Venturi effect. As a result, more coolant is provided around the exhaust-side portion and the cooling function around there can be improved.

[0020] Herein, shapes of the first and second vertical bead portions should not be limited to a particular shape, but preferably a smoother configuration may be appropriate to increase the flow speed of the coolant.

[0021] Also, as long as it can narrow or restrict the flow of the coolant at its location being opposed to the intake port wall, the second vertical bead portion may be provided so as to be substantially opposed to any one of a pair of intake ports.

[0022] According to an embodiment of the present invention, an exhaust-side passage portion restricted by the first vertical bead portion is configured so as to be higher in a vertical direction than an intake-side passage portion restricted by the second vertical bead portion.

[0023] Accordingly, the area where the coolant speed increases by the exhaust-side passage portion can be made wider over the vertical direction from a lower position to an upper position.

[0024] Thereby, the suction of the coolant via the portion from the cylinder block side to the portion between a pair of exhaust portions (from below to above obliquely) can be promoted by advantageously enlarging the area where the Venturi effect prevails.

[0025] As a result, the cooling function by the coolant passage between the exhaust ports can be increased and thereby the cooling function can be improved effectively.

[0026] According to another embodiment, the exhaust-side passage portion restricted by the first vertical bead portion has a substantially constant width over a height thereof.

[0027] Accordingly, the increase of the flow speed of the coolant by the first vertical bead portion can be provided uniformly over the whole area at the exhaust-side portion.

[0028] Thus, the coolant is properly moved even at the combustion side (lower side), so the cooling function at the combustion side can be improved.

[0029] As a result, the cooling function at the combustion side that may receive severe heat load can be improved.

[0030] According to another embodiment of the present invention, the second vertical bead portion formed at the ignition-plug hole wall is configured so as to be substantially opposed to the intake port wall that is located at a downstream side of the flow direction of the coolant.

[0031] Thus, since the second vertical bead portion is

formed at the portion that is opposed to the intake port wall located at the downstream side, the coolant flowing in the area between a pair of intake ports would not be affected improperly by the second vertical bead portion.

[0032] Thus, since the coolant streams down smoothly through the area between the intake ports without stagnating, the proper cooling function at the intake-side portion can be obtained.

[0033] Namely, in the case where no coolant passage is formed at the area between the intake ports unlike the area between the exhaust ports described above, the stagnation of the coolant would be promoted in this area. According to the above-described embodiment, however, second vertical bead portion is located at the downstream side, so the occurrence of the stagnation could be prevented appropriately.

[0034] According to another embodiment of the present invention, there is provided an intake-side sub water or coolant jacket that is located below the intake ports of each cylinder to connect with the main water or coolant jacket, a fuel-injector hole wall to accommodate a fuel injector is formed at a portion that is between a pair of intake ports and below the intake ports, and the fuel-injector hole wall is located in the intake-side sub water or coolant jacket.

[0035] Accordingly, since the intake-side sub water or coolant jacket is provided below the intake ports and the fuel-injector hole wall is located in the intake-side sub water or coolant jacket, the fuel injector can be cooled properly with the coolant in the intake-side sub water or coolant jacket. Thus, the heat load to the fuel injector can be reduced.

[0036] Particularly, since the flow volume in the main water or coolant jacket is narrowed by the first and second vertical bead portions and the coolant volume flowing into the intake-side sub water or coolant jacket is increased instead, the cooling of the fuel injector can be improved surely.

[0037] As a result, the cooling of the inside of the cylinder head with a limited volume of coolant can be attained efficiently.

[0038] According to the invention, there is further provided an engine comprising:

a cylinder head structure according to the invention or a preferred embodiment thereof which is to be assembled on a cylinder block via a gasket,

wherein the cylinder block comprises a plurality of cylinders and respective coolant jackets being provided substantially around the respective cylinders for cooling, wherein:

a plurality of peripheral openings are formed at peripheral portions at least partly around and/or close to the cylinders at a top deck of the cylinder block, and at both sides of the top deck are provided one or more intake-side and/or exhaust-side coolant-intro-

duction openings, the gasket has one or more connection holes substantially corresponding to the coolant-introduction openings,

the connection holes are formed such that an exhaust-side connection hole has a larger hole area than an intake-side connection hole, and/or one or more connection holes being formed substantially corresponding to the peripheral openings have an opening area which is configured to be smaller than that of the connection hole(s), so that a greater volume of the coolant flowing into the cylinder head from the cylinder block passes through the connection holes.

[0039] Other features, aspects, and advantages of the present invention will become apparent from the following description which refers to the accompanying drawings. It should be understood that even though embodiments are separately described, single features thereof may be combined to additional embodiments.

FIG. 1 is a schematic diagram of a coolant path of an engine with a cylinder head according to the present invention.

FIG. 2 is a plan view of the partially-cut-out cylinder head.

FIG. 3 is a sectional view taken along line A-A of FIG. 2.

FIG. 4 is a sectional view taken along line B-B of FIG. 2.

FIG. 5 is a sectional view taken along line C-C of FIG. 2.

FIG. 6 is a bottom face view of the cylinder head.

FIG. 7A is a plan view of the cylinder block, and FIG. 7B is a plan view of a gasket.

FIG. 8 is a sectional view taken along line D-D of FIG. 2.

FIG. 9 is a plan view of part of a main water or coolant jacket located around an ignition-plug hole wall.

FIG. 10 is perspective view showing around the ignition-plug hole wall, when viewed from the exhaust side.

FIG. 11 is perspective view showing around the ignition-plug hole wall, when viewed from the intake side.

FIG. 12 is a sectional view taken along line F-F of FIG. 3.

[0040] Hereinafter, a preferred embodiment of the present invention will be described referring to the accompanied drawings. FIG. 1 is a schematic diagram of a coolant path X of an engine E with a cylinder head according to the present invention.

[0041] The coolant path X of the engine E comprises a coolant circulation path that includes a radiator 1 to cool heated coolant, a thermostat 2 to control particularly the flow volume and/or speed of the coolant, a water or coolant pump or circulating means 3 to supply or trans-

port or circulate the coolant in the path, a cylinder block 4 to be cooled by the coolant, and a cylinder head 5 to be cooled by the coolant likewise. The engine E is cooled by the coolant that is circulated in this path X. Herein, at least one cooling fan 6 preferably is provided to cool the radiator 1.

[0042] The flow volume of the coolant in the coolant path X is adjusted or controlled to a specified (predetermined or predeterminable) volume particularly by the water or coolant pump 3 and others. Thus, the cooling function of the engine E depends on how to control distribution of the coolant in the path.

[0043] According to the present embodiment, a proper structure is provided to the cylinder head 5 of the engine E, thereby increasing the efficient flow of the coolant and improving the cooling function of the engine E.

[0044] FIG. 2 is a plan view of the partially-cut-out cylinder head 5. FIG. 3 is a sectional view taken along line A-A of FIG. 2 (sectional view between ports). FIG. 4 is a sectional view taken along line B-B of FIG. 2 (sectional view between ports). FIG. 5 is a sectional view taken along line C-C of FIG. 2 (sectional view between cylinders). FIG. 6 is a bottom face view of the cylinder head 5. FIG. 7A is a plan view of the cylinder block 4, and FIG. 7B is a plan view of a gasket 7.

[0045] The cylinder head 5 of the present embodiment is exemplarily the one of the 4-cylinder inline engine E. It is to be understood, however, that the cylinder head may be applied to other engine configurations, e.g. to a 6- or 8-cylinder engine such as in V- or line-configuration. The cylinder head 5 is to be assembled on the cylinder block 4 via the gasket 7.

[0046] Hereinafter, a longitudinal direction, namely a cylinder-row direction of the cylinder head 5 is referred to as the engine longitudinal direction, an output end side of a crank shaft (upper side in FIG. 2) is referred to as the engine rear side, its opposite side (lower side in FIG. 2) is referred to as the engine front side, a left side when viewed from the back (right side in FIG. 2) is referred to as the engine intake side, and its opposite side (left side in FIG. 2) is referred to as the engine exhaust side. Likewise, respective sides of the engine E are defined by these in FIGS. 6 and 7.

[0047] At a bottom deck 5a of the cylinder head 5 is formed a combustion-chamber ceiling portion 11 that at least partly closes a cylinder 10 (see FIG. 7) of the cylinder block 4 from above, as shown in FIGS. 3 and 4.

[0048] The combustion-chamber ceiling portion 11, which is formed substantially in a so-called pent-roof shape as shown in FIG. 3 preferably being substantially conic or trunco-conic in shape, preferably has at the center thereof a plug hole 12 to accommodate an ignition plug (not illustrated) to be inserted substantially vertically along an axis of the cylinder.

[0049] Also, there are provided two or more intake ports 13 at the intake side and two or more exhaust ports 14 at the exhaust side respectively so as to open at slat portions of the combustion-chamber ceiling portion 11 of

each cylinder substantially enclosing the center plug hole 12, as shown in FIG. 2. Intake and exhaust valves 15a, 15b (shown in two-dotted broken lines in FIG. 4) are respectively disposed at or in their ports 13, 14.

[0050] The intake ports 13, 13 preferably are provided so as to extend substantially straight and/or substantially upward obliquely from the combustion chamber and to open at the intake-side portion of the cylinder head 5 independently as shown in FIG. 4. Meanwhile, the exhaust ports 14, 14 are provided so as to preferably merge with each other at a specified point and/or extend substantially horizontally and to open at the exhaust-side portion of the cylinder head 5.

[0051] At the intake side of the bottom deck 5a is formed a nozzle hole 16 for at least partly accommodating a fuel injector (not illustrated) to inject fuel preferably substantially directly into the combustion chamber as shown in FIG. 3.

[0052] As shown in FIG. 6, respective cylinders 10 are located so close to each other that respective portions 17... of the bottom deck 5a that are located between the cylinders are thin (narrow) in the respective cylinder-row direction.

[0053] The cylinder head 5, as shown in FIG. 3, has a intermediate or middle deck 5b at an intermediate position (preferably at a substantially middle position) thereof in the vertical direction. Above the intermediate/middle deck 5b are provided intake and exhaust camshafts (not illustrated), while below the intermediate/middle deck 5b are provided a head-side water or coolant jacket 20 that is partitioned by the bottom deck 5a, jacket side walls 18 and the like.

[0054] Also, at the intermediate/middle deck 5b are provided valve holes 19a, 19b for the intake and/or exhaust valves 15a, 15b of each cylinder at both sides of the plug hole 12. Also, head-bolt through holes 22 and bolt boss portions 21 for head bolts (not illustrated) to assemble the cylinder head 5 on the cylinder block 4 are formed substantially around the cylinder.

[0055] The intake and exhaust camshafts (not illustrated) to drive respective intake and exhaust valves 15a, 15b are disposed above the intermediate/middle deck 5b so as to preferably extend substantially in parallel in the engine longitudinal direction at respective portions just above the valve holes 19a, 19b.

[0056] The cylinder head 5 further has journal portions 23, 24 that are located at both or substantially opposite sides of the plug hole 12 of each cylinder, which are supports of the respective camshafts.

[0057] The above-described head-side water or coolant jacket 20, which is provided at an intermediate position (preferably substantially at the central portion) in the engine width direction substantially above the bottom deck 5a and the intake and exhaust ports 13, 14 as shown in FIG. 4 and others, includes a main water or coolant jacket 31 that extends substantially in the cylinder-row direction substantially from a foremost (first) combustion-chamber ceiling portion 11 to a rearmost (fourth) combustion-

chamber ceiling portion 11, an intake-side sub water or coolant jacket 32 that extends substantially in the cylinder-row direction between the intake ports 13... and the bottom deck 5a, and an exhaust-side sub water or coolant jacket 33 that extends substantially in the cylinder-row direction substantially between the exhaust ports 14... and the bottom deck 5a. The water or coolant jackets 31 and 32 are connected with each other via branch passages 34... etc.. Likewise, the water or coolant jackets 31 and 33 are connected with each other.

[0058] The main water or coolant jacket 31 is partitioned by the intermediate/middle deck 5b at its upper portion and by the bottom deck 5a at its lower portion as shown in FIG. 4. Further, the sides of the main water or coolant jacket 31 are partitioned by an intake port wall 25 forming the intake ports 13... , an exhaust port wall 26 forming the exhaust ports 14..., respective bolt bosses 21 and the like. At the intermediate portion (preferably substantially at the central portion) of the main water or coolant jacket 31 in the engine width direction is provided a plug hole wall 27 forming the plug hole 12 that stands substantially vertically.

[0059] Accordingly, the coolant flows or circulates down in the main water or coolant jacket 31 substantially from the engine front towards or to the rear in the cylinder-row direction, along the respective intake port walls 25, exhaust port walls 26, and plug hole walls 27.

[0060] The above-described intake-side sub water or coolant jacket 32 is formed, as shown in FIG. 3, between the intake port wall 25 and a nozzle hole wall 28 forming the nozzle hole 16 of the injector, and extends substantially in the cylinder-row direction substantially between the front and rear of the engine E. Like the main water or coolant jacket 31, the coolant flows down in this water or coolant jacket 32 substantially from the engine front towards or to the rear in the cylinder-row direction along the respective intake port walls 25 and the nozzle hole walls 28.

[0061] The above-described exhaust-side sub water or coolant jacket 33 is formed, as shown in FIG. 4, between the intake port wall 26 and the bottom deck 5a, and extends substantially in the cylinder-row direction substantially between the engine front and the rear. Like the other water or coolant jackets, the coolant flows down in this water or coolant jacket 33 from the engine front to the rear in the cylinder-row direction along the respective exhaust port walls 26.

[0062] Also, as shown in FIG. 3, there is provided substantially between a pair of exhaust ports 14, 14 a coolant passage 35 preferably made of a drill hole to interconnect a water or coolant jacket of the cylinder block 4 and the head-side water or coolant jacket 20 for introducing the coolant from the cylinder block 4 into the portion substantially between the exhaust ports 14, 14.

[0063] Thus, by the coolant passage 35 actively introducing the coolant from the cylinder block 4 into the portion between the exhaust ports 14, 14, the cooling function of the portion between the exhaust port walls 26 that

are exposed to burned gas with a high temperature can be improved.

[0064] The e.g. four cylinders 10... are formed at the cylinder block 4 in the cylinder-row direction as shown in FIG. 7A, and water or coolant jackets, not illustrated, are provided substantially around the respective cylinders for cooling. Also, a plurality of peripheral openings 41... are formed at peripheral portions at least partly around and/or close to the cylinders at the top deck. At both sides of the front end of the top deck are provided intake-side and exhaust-side coolant-introduction openings 42, 43, respectively.

[0065] Herein, there are provided one or more pins 45 between each cylinder at the engine intake and/or exhaust sides, which function as positioning means for the cylinder head 5 along with bolt holes 44 fastened.

[0066] Meanwhile, as shown in FIG. 7B, the gasket 7 has a corresponding number (e.g. four) cylinder holes 71 corresponding to the respective number of cylinders, and through holes 72 for the head bolts passing through. Also, it has one or more connection holes 73, 74 substantially corresponding to the above-described coolant-introduction openings 42, 43 at the engine front side.

[0067] These connection holes 73, 74 are formed such that the exhaust-side connection hole 74 preferably has a larger hole area than the intake-side connection hole 73 does, which is apparent from FIG. 7B. Thereby, the coolant flow volume at the exhaust side is increased.

[0068] Also, the gasket 7 includes connection holes 75... which are formed substantially corresponding to the peripheral openings 41. The opening area of the connection hole 75 preferably is configured to be considerably smaller (e.g. having an opening area more than about two times smaller, preferably more than about three times smaller, more preferably more than about five times smaller) than that of the connection holes 73, 74, so most of the coolant flowing into the cylinder head 5 from the cylinder block 4 passes through the connection holes 73, 74.

[0069] Further, the opening area of the exhaust-side connection hole 75 preferably is configured to be greater than that of the intake-side connection hole 75. This is because the coolant should preferably be introduced via the above-described coolant passage 35 at the exhaust side.

[0070] Thereby, the flow position and flow volume of the coolant flowing into the cylinder head 5 from the cylinder block 4 is determined or controlled.

[0071] Meanwhile, the water or coolant jacket at the side of the cylinder head 5 receiving the coolant from the openings 73, 74 and 75 of the gasket 7 includes intake-side and exhaust-side openings 51, 52 formed at the engine front and a plurality of peripheral openings 53... formed at peripheral portions of the cylinders, as shown in FIG. 6.

[0072] Herein, the openings 51, 52 receive the coolant from the cylinder block 4 mainly, and the coolant received via these openings flows into the main water or coolant

jacket 31, and then the exhaust-side sub water or coolant jacket 33 and the intake-side sub water or coolant jacket 32. Although some coolant flows in from the peripheral openings 53... through the connection openings 75... of the gasket 7, the amount of this flow is very little. Thereby, the coolant flowing in the cylinder head 5 flows surely from the engine front to the rear.

[0073] According to the cylinder head 5 of the present embodiment, the flow volume and speed of the coolant in the main water or coolant jacket 31 is adjusted properly. This will be described referring to FIGS. 8 - 11. FIG. 8 is a sectional view taken along line D-D of FIG. 2, showing the cross section of the plug hole wall 27. FIG. 9 is a plan view of part of the main water or coolant jacket 31 located around the plug hole wall 27. FIG. 10 is perspective view showing the area around the plug hole wall 27, when viewed from the exhaust side. FIG. 11 is perspective view showing the area around the plug hole wall 27, when viewed from the intake side. In these figures, each arrow shows a flow direction of the coolant.

[0074] As shown in FIG. 9 and others, a first flow-restriction vertical bead or projection 81 is formed at a portion 27a of the plug hole wall 27 that is substantially opposed to the exhaust port wall 26 located at the engine front side (the coolant-flow upstream side), and/or a second flow-restriction vertical bead or projection 82 is formed at a portion 27b of the plug hole wall 27 that is substantially opposed to the intake port wall 25 located at the engine rear side (the coolant-flow downstream side) (see FIG. 11).

[0075] The first flow-restriction vertical bead 81 is formed so as to extend relatively long vertically from a lower position to a higher position at the plug hole wall 27 as shown in FIG. 8, and its cross section preferably substantially has an arc shape with a gentle curvature so that a coolant passage 31 a is narrowed gradually between this bead 81 and the substantially circular-shaped exhaust port wall 26.

[0076] Meanwhile, the second flow-restriction vertical bead 82 is formed so as to extend relatively short vertically compared to the first flow-restriction vertical bead 81 as shown in FIG. 8, and likewise its cross section preferably substantially has the arc shape with the gentle curvature so that a coolant passage 31 b is narrowed gradually between this bead 82 and the substantially circular-shaped intake port wall 26.

[0077] Thus, since the total flow volume of the coolant in the main water or coolant jacket 31 is restricted (narrowed) by these first and/or second flow-restriction vertical beads 81, 82, the volume of the coolant flowing out from the branch passages 34 into the intake-side and exhaust-side sub water or coolant jackets 32, 33 can be increased. Also, since these beads 81, 82 preferably are formed at or on the plug hole walls 27, the cooling function of the plug hole walls 27 can be improved.

[0078] Further, as apparent from FIG. 8, a smallest passage cross area S1 of the exhaust-side coolant passage 31 a preferably is set to be greater than a smallest

passage cross area S2 of the intake-side coolant passage 31 b.

[0079] Thus, the coolant flow volume of the exhaust-side coolant passage 31 a can be made greater than that of the intake-side coolant passage 31 b, and thereby the coolant flow volume in the exhaust-side sub water or coolant jacket 33 can be made greater than that in the intake-side sub water or coolant jacket 32, suppressing or reducing the total coolant flow volume in the main water or coolant jacket 31. Accordingly, the cooling function at the exhaust side can be improved.

[0080] Particularly, the cooling function can be further improved by preferably providing the first flow-restriction vertical bead 81 at this portion for the following reason.

[0081] Namely, as shown in FIG. 9, since the first flow-restriction vertical bead 81 is provided at or close to this location, the flow of the coolant (or the cross-sectional area for the coolant) is narrowed and thereby the flow speed of the coolant at this portion is increased. Since the coolant passage 35 opens at a flow-in area 31 c between the exhaust ports 14, 14 as described above, the coolant in the coolant passage 35 can be properly sucked in this area due to the Venturi effect. Thereby, the cooling function at the exhaust side can be improved.

[0082] Also, since the first flow-restriction vertical bead 81 preferably is formed so as to extend widely (long) in the vertical direction as described above, the Venturi effect can be created over the wide (long) range and thereby the coolant suction function of the coolant passage 35 from the cylinder block 4 can be further improved.

[0083] Further, since the exhaust-side coolant passage 31 a restricted by the first flow-restriction vertical bead 81 formed vertically long preferably is configured so as to have a substantially constant width w1 over its height, the coolant flow can be created at the combustion-chamber side (lower side) as well. Accordingly, the proper coolant flow can be surely generated and thereby the cooling function at the combustion-chamber side can be improved.

[0084] Meanwhile, the second flow-restriction vertical bead 82 preferably is formed at or on the portion 27b of the plug hole wall 27 that is substantially opposed to the intake port wall 25 located at the engine rear side (the coolant-flow downstream side) as described above. Accordingly, the cooling function at the intake side can be improved for the following reason.

[0085] In the case where the second flow-restriction vertical bead 82 is formed at a or on portion of the plug hole wall 27 that is substantially opposed to the intake port wall 25 located at the engine front side, the coolant flow speed would increase partially at a flow-in area 31d between the intake ports 13, 13. And, in the case where no coolant passage 35 is provided between the intake ports 13, 13, unlike between the exhaust ports 14, 14, the cooling would not be done properly at this area.

[0086] Namely, this partial flow speed increasing may generate "vortex" in the flow-in area 31 d as shown by a broken line in FIG. 9, so that stagnation of the coolant

would occur in this area.

[0087] According to the above-described embodiment, however, the second flow-restriction vertical bead 82 preferably is formed at the portion that is substantially opposed to the intake port wall 25 located at the engine rear side, thereby not changing the flow speed of the coolant in this flow-in area 31 d. Thus, the proper and substantially uniform coolant flow can be obtained and thereby the proper cooling function can be provided.

[0088] Further, as shown in FIG. 8, the intake-side coolant passage 31 b restricted by the second flow-restriction vertical bead 82 preferably is configured so as to have a substantially constant width w2 over its height. Thereby, the proper coolant flow can be surely generated and the cooling function at the combustion-chamber side can be improved.

[0089] Further, since the coolant flow volume in the main water or coolant jacket 31 is narrowed by the first and/or second flow-restriction vertical beads 81, 82 and thereby the coolant volume flowing into the intake-side sub water or coolant jacket 32 is increased, the cooling of the nozzle hole wall 28 located in the intake-side sub water or coolant jacket 32 can be improved surely.

[0090] Namely, as shown in FIG. 12, a sectional view taken along line F-F of FIG. 3, the intake-side sub water or coolant jacket 32 is formed so as to at least partly, preferably substantially fully surround the nozzle hole wall 28 for the fuel injector. The fuel injector can be cooled properly by increasing the coolant flow volume to the intake-side sub water or coolant jacket 32.

[0091] Thus, according to the present embodiment, since the first and/or second flow-restriction vertical beads 81, 82 are provided respectively at or on or close to appropriate portions of the plug hole walls 27, the cooling function of the cylinder head 5 can be improved properly and efficiently with the restricted volume of the coolant.

[0092] Particularly, since the first flow-restriction vertical bead 81 is formed at or on or close to the portion substantially opposed to the exhaust port wall 26 located at the engine front side (the coolant flow upstream side), the proper suction of the coolant from the coolant passage 35 can be obtained, thereby improving the cooling function at the exhaust side.

[0093] The present invention should not be limited to the above-described embodiment. For example, the second flow-restriction vertical bead 82 may be formed at or on or close to a portion of the plug hole wall 27 that is substantially opposed to the intake port wall 25 located at the engine front side (the coolant flow upstream side). Although there may occur some stagnation of the coolant in the flow-in area 31 d in this case, a sufficient flow volume of the coolant may reduce this stagnation. As a result, the cooling function by such a location of the second flow-restriction vertical bead 82 would not deteriorate improperly with the sufficient flow volume of the coolant.

[0094] Also, the shape or length of these beads 81, 82 may be modified properly according to factors such as

the flow volume and/or speed of the coolant.

[0095] In the correspondence between the structure of the present invention and the above-described embodiment, the first vertical bead portion preferably corresponds to the first flow-restriction vertical bead 81, the second vertical bead portion preferably corresponds to the second flow-restriction vertical bead 82, the ignition-plug hole wall preferably corresponds to the plug hole wall 27, the exhaust-side passage portion preferably corresponds to the exhaust-side coolant passage 31 a, the intake-side passage portion preferably corresponds to the intake-side coolant passage 31 b, the fuel-injector hole wall preferably corresponds to the nozzle hole wall 28.

[0096] According to the above, the first flow-restriction vertical bead 81 narrowing the coolant flow is provided to increase the flow speed at this portion. The coolant passage 35 opens at the flow-in area 31c between the exhaust ports 14, 14. Thereby, the flow speed of the coolant at this area is increased, so the coolant in the coolant passage 35 can be properly sucked due to the Venturi effect. As a result, the cooling function can be improved.

[0097] The present invention can be applied to a cylinder head structure of any types of engines.

Claims

1. A cylinder head structure for an engine (E), in which the engine (E) has a multiple cylinders (10), there is provided for each cylinder (10) a valve unit comprising one or more intake valves (15a) and one or more exhaust valves (15b) and an ignition plug located at the cylinder (10), and there are provided a main coolant jacket (31) to allow part of a coolant to flow substantially around each ignition-plug hole wall (27) substantially in a cylinder-row direction and an exhaust-side sub coolant jacket (33) to allow part of the coolant to flow substantially around each exhaust port wall (26) substantially in the cylinder-row direction, the both coolant jackets (31, 33) being connected to each other, the cylinder structure comprising:

a first vertical bead portion (81) that is formed at a portion (27a) of the ignition-plug hole wall (27) that is substantially opposed to the exhaust port wall (26), the first vertical bead portion (81) providing a smallest cross section (S1) of a passage (31 a) between the ignition-plug hole wall (27) and the exhaust port wall (26) in said main coolant jacket (31);

a second vertical bead portion (82) that is formed at a portion (27b) of the ignition-plug hole wall (27) that is substantially opposed to an intake port wall (25), the second vertical bead portion (82) providing a smallest cross section (S2) of a passage (31b) between the ignition-plug hole wall (27) and the intake port wall (25) in said

main coolant jacket (31);

wherein said smallest cross section (81) provided by the first vertical bead portion (81) is configured so as to be greater than said smallest cross section (S2) provided by the second vertical bead portion (82), and said first vertical bead portion (81) formed at the ignition-plug hole wall (27) is configured so as to be substantially opposed to the exhaust port wall (26) that is located at an upstream side of the flow direction of the coolant; and wherein said first vertical bead portion (81) is configured so as to be longer in the vertical direction than said second vertical bead portion (82).

2. The cylinder head structure of an engine (E) of claim 1, wherein a coolant passage (35) that is provided close to the one or more (26), preferably between a pair of exhaust port walls (26) of the cylinder (10), one end of the coolant passage (35) opening at a cylinder-head lower face and the other thereof opening at a location substantially opposed to the ignition plug hole wall (27).
3. The cylinder head structure of an engine (E) of one of the preceding claims, wherein an exhaust-side passage portion (31a) restricted by said first vertical bead portion (81) is configured so as to be higher in a vertical direction than an intake-side passage portion (31b) restricted by said second vertical bead portion (82).
4. The cylinder head structure of an engine (E) of one of the preceding claims, wherein said exhaust-side passage portion (31a) restricted by the first vertical bead portion (81) has a substantially constant width over a height thereof.
5. The cylinder head structure of an engine (E) of one of the preceding claims, wherein said second vertical bead portion (82) formed at the ignition-plug hole wall (27) is configured so as to be substantially opposed to the intake port wall (25) that is located at a downstream side of the flow direction of the coolant.
6. The cylinder head structure of an engine (E) of one of the preceding claims, wherein there is provided an intake-side sub coolant jacket (32) that is located below the intake ports (13) of each cylinder (10) to connect with said main coolant jacket (31), a fuel-injector hole wall (28) to accommodate a fuel injector is formed at a portion that is between a pair of intake ports (13) and below the intake ports (13), and said fuel-injector hole wall (28) is located in said intake-side sub coolant jacket (32):
7. An engine (E) comprising:

a cylinder head structure according to one of the preceding claims which is to be assembled on a cylinder block (4) via a gasket (7);

wherein the cylinder block (4) comprises a plurality of cylinders (10) and respective coolant jackets being provided substantially around the respective cylinders (10) for cooling, wherein:

a plurality of peripheral openings (41) are formed at peripheral portions at least partly around and/or close to the cylinders (10) at a top deck of the cylinder block (4), and at both sides of the top deck are provided one or more intake-side and/or exhaust-side coolant-introduction openings (42, 43); wherein the gasket (7) has one or more connection holes (73, 74) substantially corresponding to the coolant-introduction openings (42, 43);

wherein the connection holes (73, 74) are formed such that an exhaust-side connection hole (74) has a larger hole area than an intake-side connection hole (73), and/or

wherein one or more connection holes (75) being formed substantially corresponding to the peripheral openings (41) have an opening area which is configured to be smaller than that of the connection hole (s) (73, 74), so that a greater volume of the coolant flowing into the cylinder head (5) from the cylinder block (4) passes through the connection holes (73, 74).

Patentansprüche

1. Zylinderkopfstruktur für einen Motor (E), bei dem der Motor (E) eine Mehrzahl von Zylindern (10) aufweist, wobei für jeden Zylinder (10) eine Ventileinheit vorgesehen ist, die ein oder mehrere Einlassventile (15a) und ein oder mehrere Auslassventile (15b) sowie eine Zündkerze umfasst, die an dem Zylinder (10) angeordnet ist, und wobei ein Hauptkühlmittelmantel (31), der erlaubt, dass ein Teil eines Kühlmittels im Wesentlichen um jede Zündkerzenlochwand (27) herum im Wesentlichen in einer Zylinderreihenrichtung fließt, und ein auslassseitigen Teil- bzw. Unterkühlmittelmantel (33), der erlaubt, dass ein Teil des Kühlmittels im Wesentlichen um jede Auslassport- bzw. -öffnungswand (26) im Wesentlichen in der Zylinderreihenrichtung fließt, vorgesehen sind, wobei beide Kühlmittelmäntel (31, 33) miteinander verbunden sind, wobei die Zylinderstruktur umfasst:

einen ersten vertikalen Wulstabschnitt (81), der an einem Abschnitt (27a) der Zündkerzenlochwand (27) gebildet ist, der im Wesentlichen entgegengesetzt bzw. gegenüberliegend zu der

Auslassöffnungswand (26) ist, wobei der erste vertikale Wulstabschnitt (81) einen kleinsten Querschnitt (S1) eines Durchgangs (31 a) zwischen der Zündkerzenlochwand (27) und der Auslassöffnungswand (26) in dem Hauptkühl-

mittelmantel (31) bereitstellt; einen zweiten vertikalen Wulstabschnitt (82), der an einem Abschnitt (27b) der Zündkerzenlochwand (27) gebildet ist, der im Wesentlichen entgegengesetzt bzw. gegenüberliegend zu einer Einlassport- bzw. -öffnungswand (25) ist, wobei der zweite vertikale Wulstabschnitt (82) einen kleinsten Querschnitt (S2) eines Durchgangs (31 b) zwischen der Zündkerzenlochwand (27) und der Einlassöffnungswand (25) in dem Hauptkühlmittelmantel (31) bereitstellt;

wobei der kleinste Querschnitt (S1), der durch den ersten vertikalen Wulstabschnitt (81) bereitgestellt wird, konfiguriert ist, um größer zu sein als der kleinste Querschnitt (S2), der durch den zweiten vertikalen Wulstabschnitt (82) bereitgestellt wird, und der erste vertikale Wulstabschnitt (81), der an der Zündkerzenlochwand (27) gebildet ist, konfiguriert ist, um im Wesentlichen entgegengesetzt bzw. gegenüberliegend zu der Auslassöffnungswand (26) zu sein, die an einer Stromaufwärts-Seite der Flussrichtung des Kühlmittels angeordnet ist; und

wobei der erste vertikale Wulstabschnitt (81) konfiguriert ist, um in der vertikalen Richtung länger zu sein als der zweite vertikale Wulstabschnitt (82).

2. Zylinderkopfstruktur eines Motors (E) nach Anspruch 1, wobei ein Kühlmitteldurchgang (35) nahe der einen oder mehreren (26), vorzugsweise zwischen einem Paar Auslassport- bzw. -öffnungswänden (26) des Zylinders (10) vorgesehen ist, wobei sich ein Ende des Kühlmitteldurchgangs (35) an einer unteren Fläche bzw. Seite des Zylinderkopfs öffnet und das andere sich an einer Position bzw. Stelle öffnet, die im Wesentlichen entgegengesetzt bzw. gegenüberliegend zu der Zündkerzenlochwand (27) ist.

3. Zylinderkopfstruktur eines Motors (E) nach einem der vorhergehenden Ansprüche, wobei ein auslassseitiger Durchgangsabschnitt (31 a), der durch den ersten vertikalen Wulstabschnitt (81) begrenzt ist, konfiguriert ist, um in einer vertikalen Richtung höher zu sein als ein einlassseitiger Durchgangsabschnitt (31 b), der durch den zweiten vertikalen Wulstabschnitt (82) begrenzt ist.

4. Zylinderkopfstruktur eines Motors (E) nach einem der vorhergehenden Ansprüche, wobei der auslassseitige Durchgangsabschnitt (31 a), der durch den ersten vertikalen Wulstabschnitt (81) begrenzt ist, eine im Wesentlichen konstante Breite über eine Hö-

he davon aufweist.

5. Zylinderkopfstruktur eines Motors (E) nach einem der vorhergehenden Ansprüche, wobei der zweite vertikale Wulstabschnitt (82), der an der Zündkerzenlochwand (27) gebildet ist, konfiguriert ist, um im Wesentlichen entgegengesetzt bzw. gegenüberliegend zu der Einlassöffnungswand (25) zu sein, die an einer Stromabwärts-Seite der Flussrichtung des Kühlmittels angeordnet ist.

6. Zylinderkopfstruktur eines Motors (E) nach einem der vorhergehenden Ansprüche, wobei ein einlassseitiger Teil- bzw. Unterkühlmittelmantel (32) vorgesehen ist, der unterhalb der Einlassöffnungen (13) jedes Zylinders (10) zur Verbindung mit dem Hauptkühlmittelmantel (31) angeordnet ist, wobei eine Kraftstoffeinspritzlochwand (28) zum Aufnehmen eines Kraftstoffeinspritzers an einem Abschnitt gebildet ist, der sich zwischen einem Paar Einlassöffnungen (13) und unterhalb der Einlassöffnungen (13) befindet, und wobei die Kraftstoffeinspritzlochwand (28) in dem einlassseitigen Unterkühlmittelmantel (32) angeordnet ist.

7. Motor (E), umfassend:

eine Zylinderkopfstruktur nach einem der vorhergehenden Ansprüche, die über einen Dichtungsring (7) an bzw. auf einem Zylinderblock (4) zu montieren ist,

wobei der Zylinderblock (4) eine Mehrzahl von Zylindern (10) und jeweilige Kühlmittelmäntel umfasst, die im Wesentlichen um die jeweiligen Zylinder (10) herum zur Kühlung vorgesehen sind, wobei:

eine Mehrzahl von Umfangsöffnungen (41) an Umfangsabschnitten zumindest teilweise um die Zylinder (10) herum und/oder nahe dieser an einer oberen Fläche des Zylinderblocks (4) gebildet ist, und an beiden Seiten der oberen Fläche eine oder mehrere einlassseitige und/oder auslassseitige Kühlmittleinbringungsöffnung(en) (42, 43) vorgesehen ist bzw. sind; wobei der Dichtungsring (7) ein oder mehrere Verbindungslöcher (73, 74) im Wesentlichen entsprechend der Kühlmittleinbringungsöffnungen (42, 43) aufweist;

wobei die Verbindungslöcher (73, 74) so gebildet sind, dass ein auslassseitiges Verbindungsloch (74) einen größeren Lochbereich aufweist als ein einlassseitiges Verbindungsloch (73), und/oder wobei ein oder mehrere Verbindungslöcher (75), die im Wesentlichen entsprechend der Umfangsöffnungen (41) gebildet sind, einen Öffnungsbereich aufweisen, der konfiguriert ist, um kleiner zu sein als

derjenige des/der Verbindungslochs/Verbindungs-
löcher (73, 74), so dass eine größere Menge an Kühl-
mittel, das von dem Zylinderblock (4) in den Zylind-
derkopf (5) fließt, durch die Verbindungs-
löcher (73, 74) tritt.

Revendications

1. Structure de culasse de cylindre pour un moteur (E), dans laquelle le moteur (E) a des cylindres multiples (10), dans laquelle une unité de soupape qui comprend une ou plusieurs soupapes d'admission (15a) et une ou plusieurs soupapes d'échappement (15b) et une bougie d'allumage placée sur le cylindre (10) est prévue pour chaque cylindre (10), et dans laquelle sont prévues une chemise principale d'agent refroidissant (31) pour permettre à une partie d'un agent refroidissant de s'écouler sensiblement autour de chaque paroi à trous des bougies d'allumage (27) sensiblement dans une direction des rangées de cylindres et une chemise secondaire d'agent refroidissant du côté de l'évacuation (33) pour permettre à une partie de l'agent refroidissant de s'écouler sensiblement autour de chaque paroi à trous des ports d'évacuation (26) sensiblement dans la direction des rangées de cylindres, les deux chemises d'agent refroidissant (31, 33) étant reliées l'une à l'autre, la structure de cylindre comprenant :

une première portion verticale à nervure (81) qui est formée sur une portion (27a) de la paroi à trous des bougies d'allumage (27) qui est sensiblement opposée à la paroi des ports d'évacuation (26), la première portion verticale à nervure (81) fournissant une section transversale la plus petite (S1) d'un passage (31a) entre la paroi à trous des bougies d'allumage (27) et la paroi des ports d'évacuation (26) dans ladite chemise principale d'agent refroidissant (31) ;
une seconde portion verticale à nervure (82) qui est formée sur une portion (27b) de la paroi à trous des bougies d'allumage (27) qui est sensiblement opposée à une paroi des ports d'admission (25), la seconde portion verticale à nervure (82) fournissant une section transversale la plus petite (S2) d'un passage (31b) entre la paroi à trous des bougies d'allumage (27) et la paroi des ports d'admission (25) dans ladite chemise principale d'agent refroidissant (31) ;

dans laquelle ladite section transversale la plus petite (S1) fournie par la première portion verticale à nervure (81) est configurée de manière à être plus grande que ladite section transversale la plus petite (S2) fournie par la seconde portion verticale à nervure (82), et dans laquelle ladite première portion verticale à nervure (81) formée sur la paroi à trous

des bougies d'allumage (27) est configurée de manière à être sensiblement opposée à la paroi des ports d'évacuation (26) qui est placée sur un côté en amont de la direction de flux de l'agent refroidissant ;
et
dans laquelle ladite première portion verticale à nervure (81) est configurée de manière à être plus longue dans la direction verticale que ladite seconde portion verticale à nervure (82).

2. Structure de culasse de cylindre pour un moteur (E) selon la revendication 1, dans laquelle un passage d'agent refroidissant (35) qui est prévu à proximité de la une paroi ou des plusieurs parois (26), de préférence entre une paire de parois de port d'évacuation (26) du cylindre (10), une extrémité du passage d'agent refroidissant (35) s'ouvrant sur un côté inférieur de la culasse de cylindre et l'autre extrémité de celui-ci s'ouvrant sur un emplacement sensiblement opposé à la paroi à trous des bougies d'allumage (27).
3. Structure de culasse de cylindre pour un moteur (E) selon l'une des revendications précédentes, dans laquelle une portion du passage du côté de l'évacuation (31a) restreinte par ladite première portion verticale à nervure (81) est configurée de manière à être plus haute dans une direction verticale qu'une portion de passage du côté de l'admission (31b) restreinte par ladite seconde portion verticale à nervure (82).
4. Structure de culasse de cylindre pour un moteur (E) selon l'une des revendications précédentes, dans laquelle ladite portion du passage du côté de l'évacuation (31a) restreinte par la première portion verticale à nervure (81) a une largeur sensiblement constante sur une hauteur de celle-ci.
5. Structure de culasse de cylindre pour un moteur (E) selon l'une des revendications précédentes, dans laquelle ladite seconde portion verticale à nervure (82) formée sur la paroi à trous des bougies d'allumage (27) est configurée de manière à être sensiblement opposée à la paroi des ports d'admission (25) qui est placée sur un côté en aval de la direction de flux de l'agent refroidissant.
6. Structure de culasse de cylindre pour un moteur (E) selon l'une des revendications précédentes, dans laquelle est prévue une chemise secondaire d'agent refroidissant sur le côté de l'admission (32) qui est placée en dessous des ports d'admission (13) de chaque cylindre (10) pour la liaison avec ladite chemise principale d'agent refroidissant (31), dans laquelle une paroi à trous d'injecteur de carburant (28) pour adapter un injecteur de carburant est formée sur une portion qui est entre une paire de ports d'ad-

mission (13) et en dessous des ports d'admission (13), et dans laquelle ladite paroi à trous d'injecteur de carburant (28) est placée dans ladite chemise secondaire d'agent refroidissant sur le côté de l'admission (32).

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7. Moteur (E) comprenant :

une structure de culasse de cylindre conformément à l'une des revendications précédentes, laquelle doit être assemblée sur un bloc de cylindres (4) au moyen d'une garniture d'étanchéité (7),

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dans lequel le bloc de cylindres (4) comprend une pluralité de cylindres (10) et des chemises respectives d'agent refroidissant qui sont prévues sensiblement autour des cylindres respectifs (10) pour le refroidissement, et dans lequel :

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une pluralité d'ouvertures périphériques (41) est formée sur des portions périphériques se trouvant au moins en partie autour et/ou à proximité des cylindres (10) sur une plateforme supérieure du bloc de cylindres (4), et
une ouverture d'introduction d'agent refroidissant est prévue ou plusieurs ouvertures d'introduction d'agent refroidissant (42 ; 43) sont prévues du côté de l'admission et/ou du côté de l'évacuation sur les deux côtés de la plateforme supérieure ; dans lequel la garniture d'étanchéité (7) a un trou de liaison qui correspond ou plusieurs trous de liaison (73, 74) qui correspondent sensiblement aux ouvertures d'introduction d'agent refroidissant (42 ; 43) ;

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dans lequel les trous de liaison (73, 74) sont formés de telle sorte qu'un trou de liaison du côté de l'évacuation (74) a une plus grande zone de trou qu'un trou de liaison du côté de l'admission (73), et/ou dans lequel un trou de liaison qui est formé ou plusieurs trous de liaison (75) qui sont formés sensiblement en correspondance aux ouvertures périphériques (41) a (ont) une zone d'ouverture qui est configurée de manière à être plus petite que celle du (des) trou(s) de liaison (73, 74), de telle sorte qu'un plus grand volume d'agent refroidissant qui s'écoule dans la culasse de cylindre (5) depuis le bloc de cylindres (4) passe à travers les trous de liaison (73, 74).

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FIG. 1

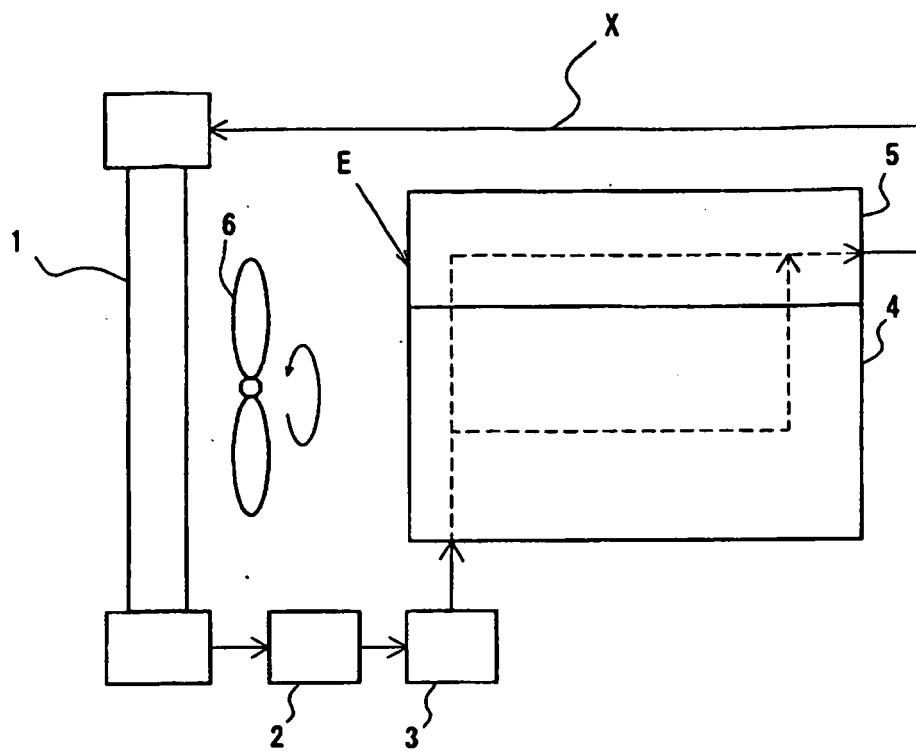


FIG. 2

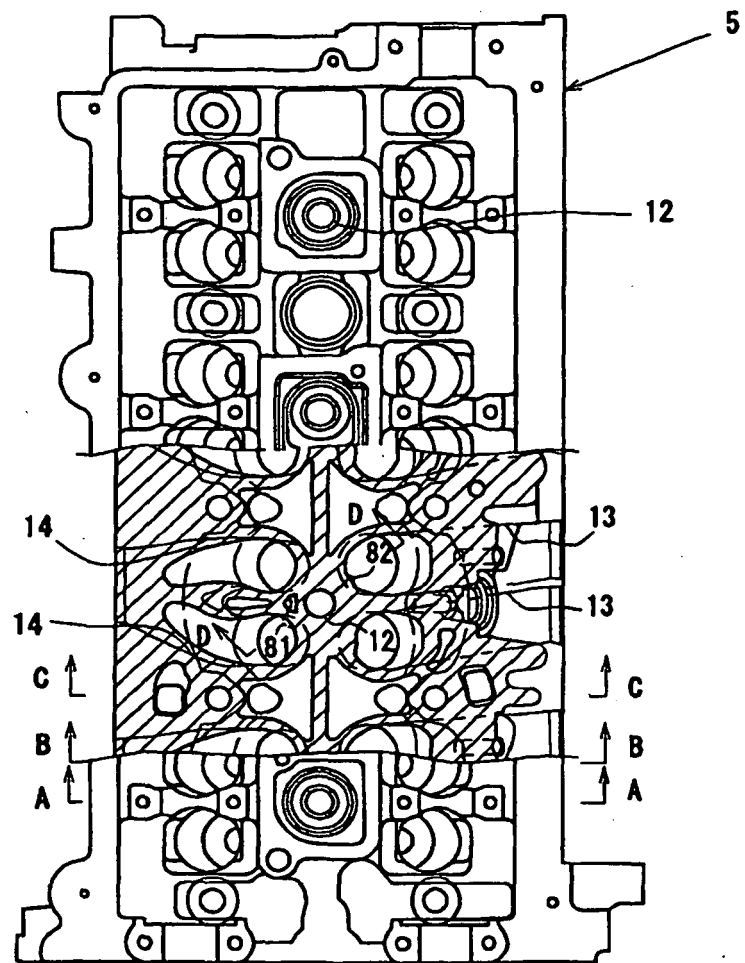


FIG. 3

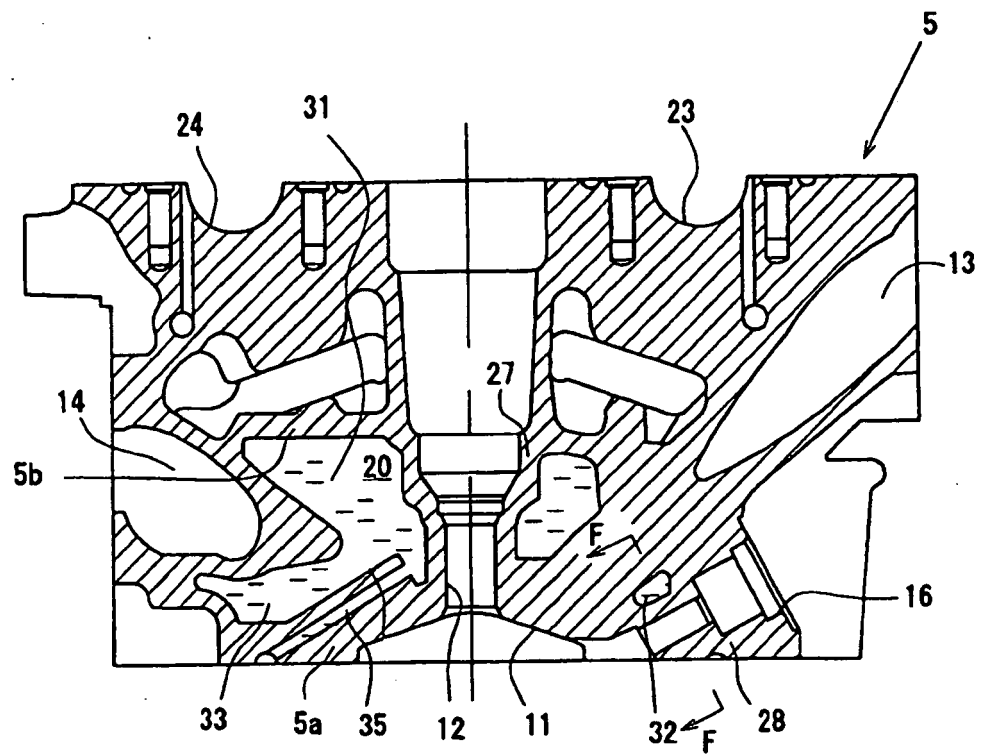


FIG. 4

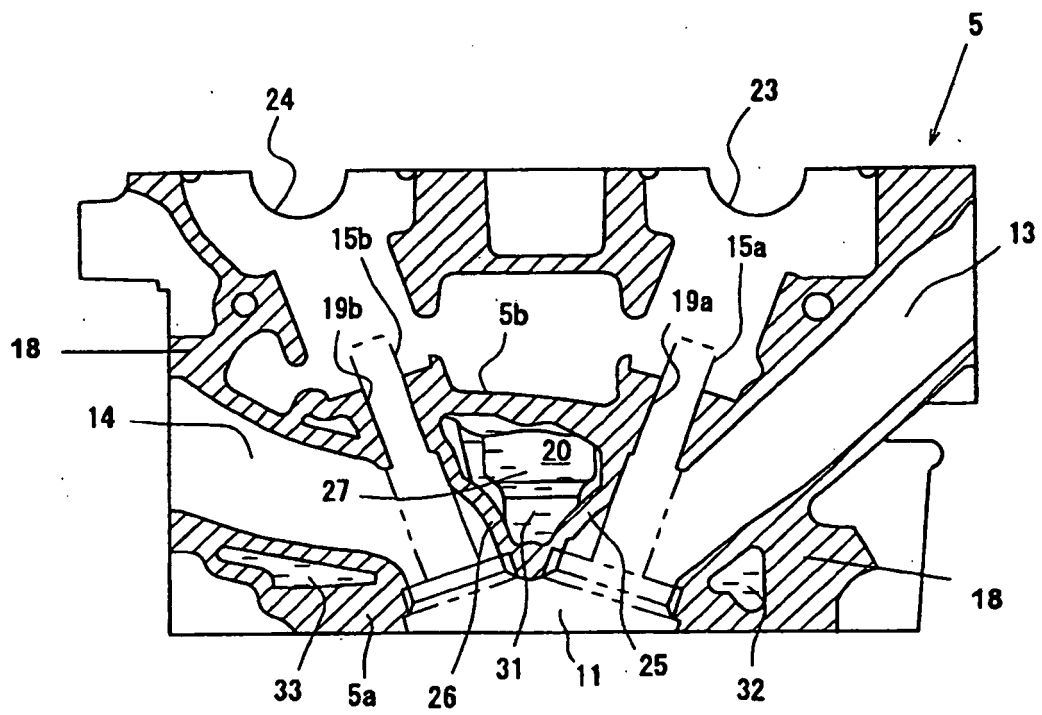


FIG. 5

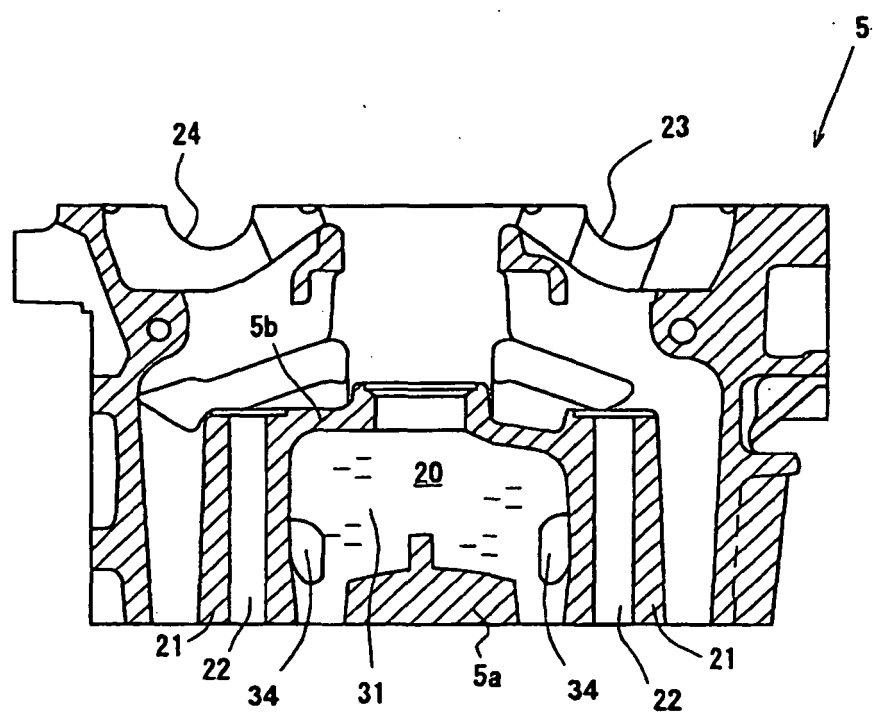
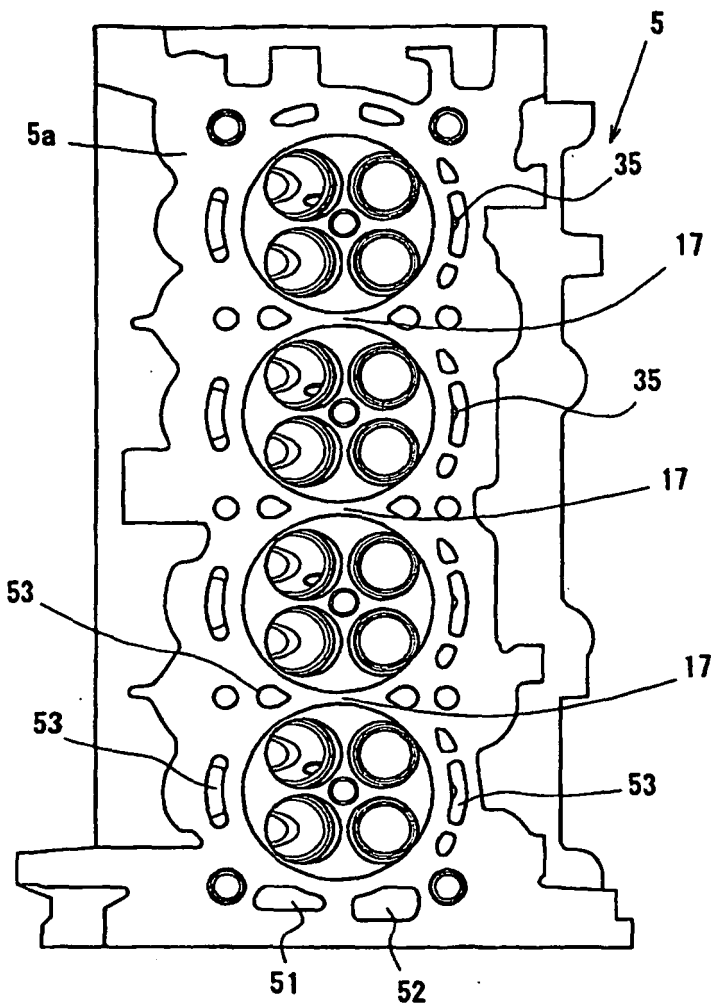


FIG. 6



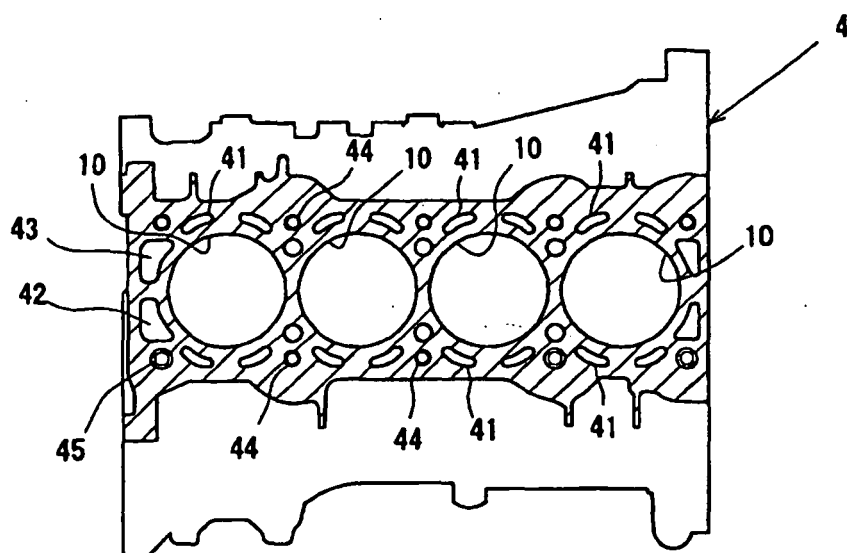


FIG. 7A

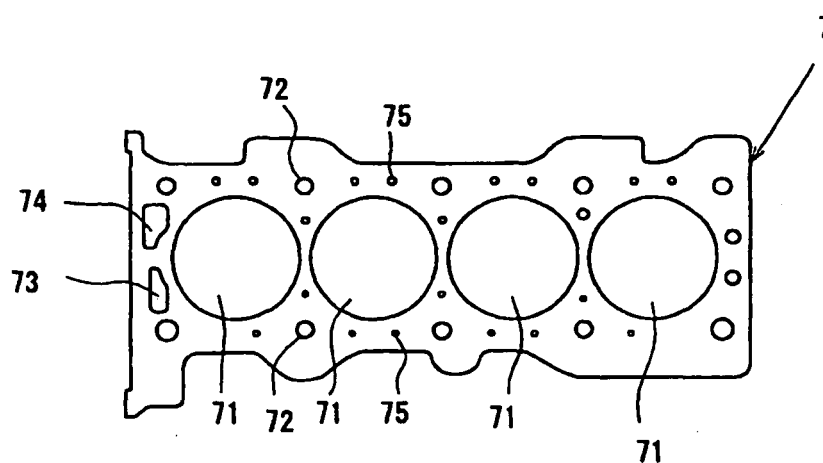


FIG. 7B

FIG. 8

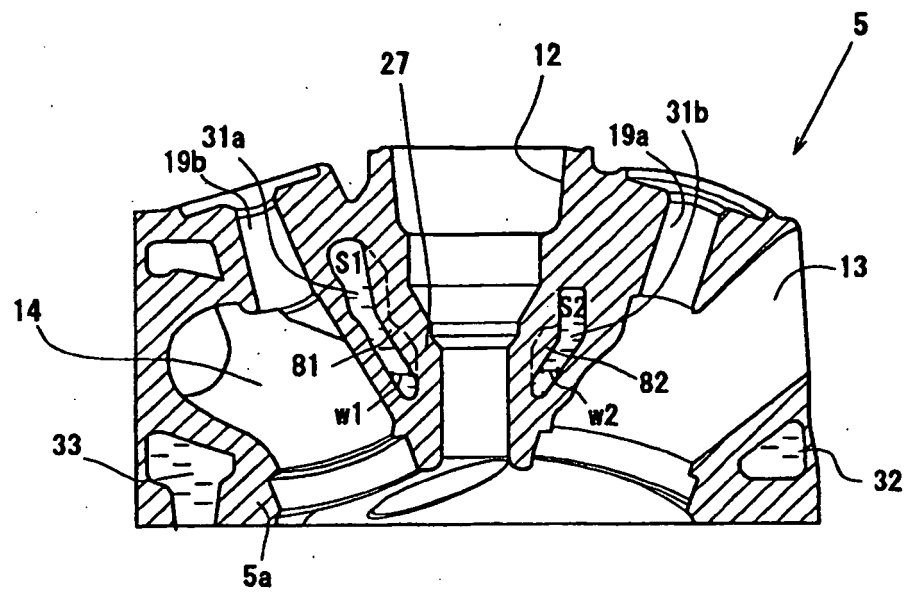


FIG. 9

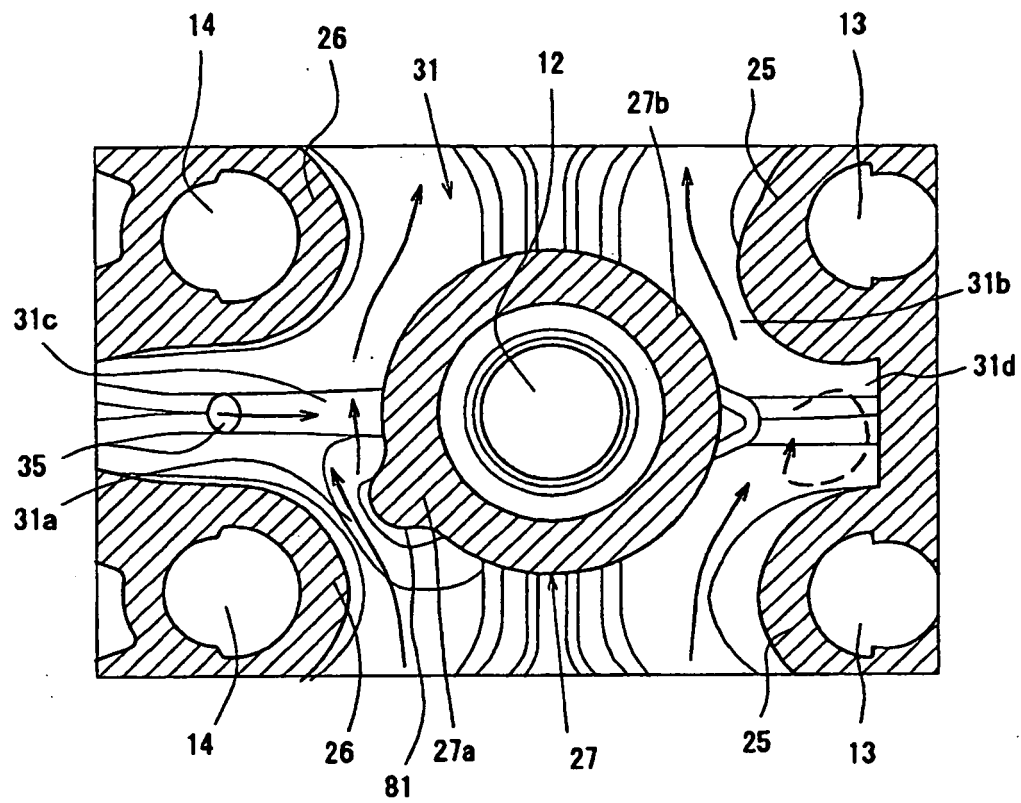


FIG. 10

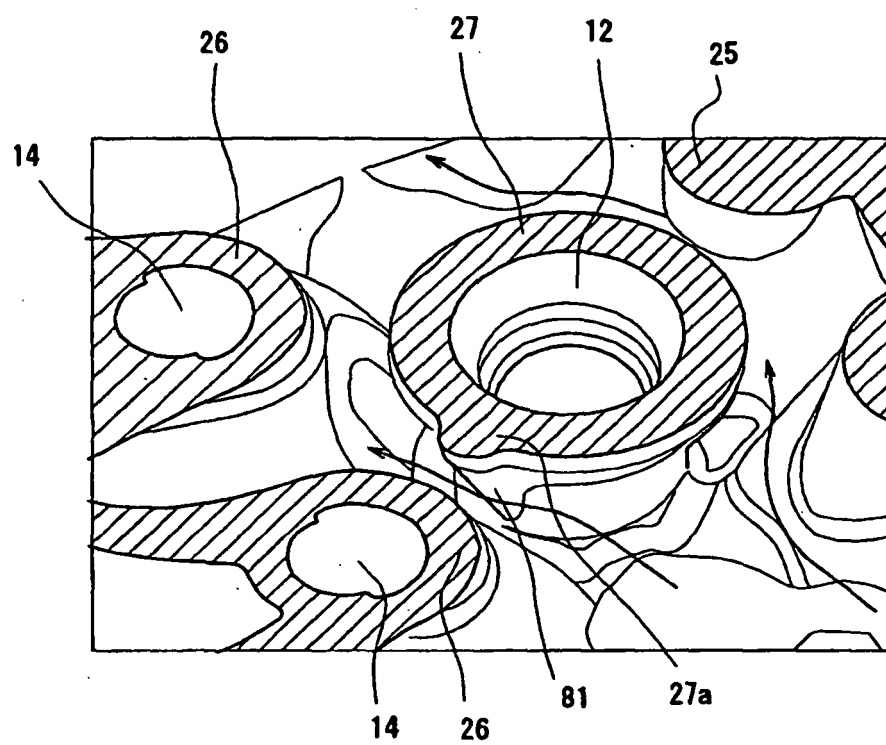


FIG. 11

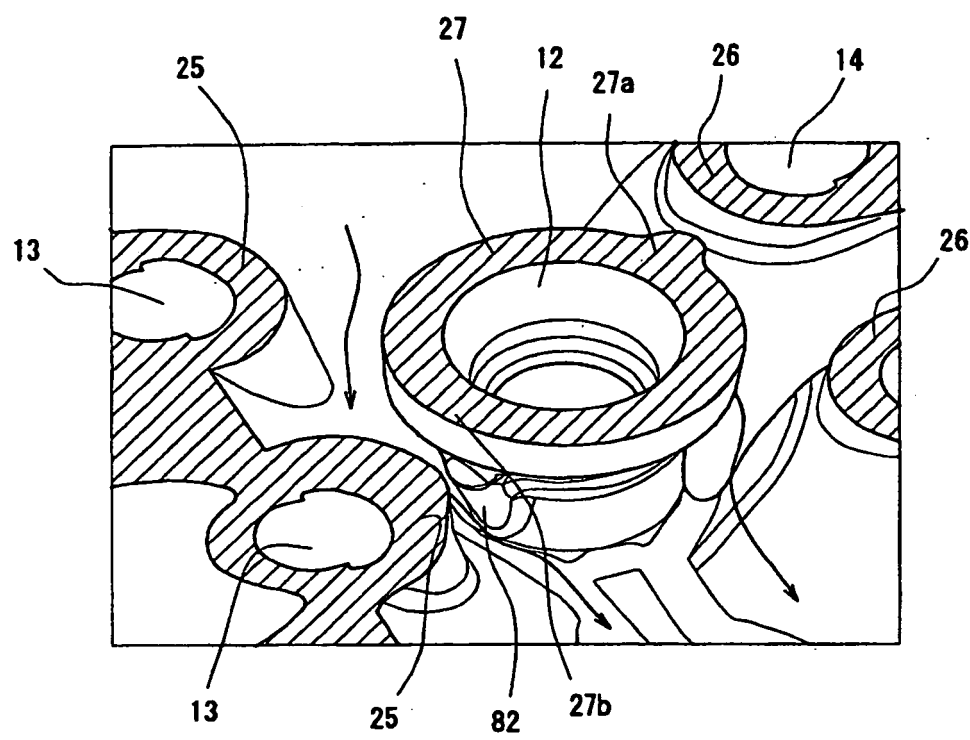
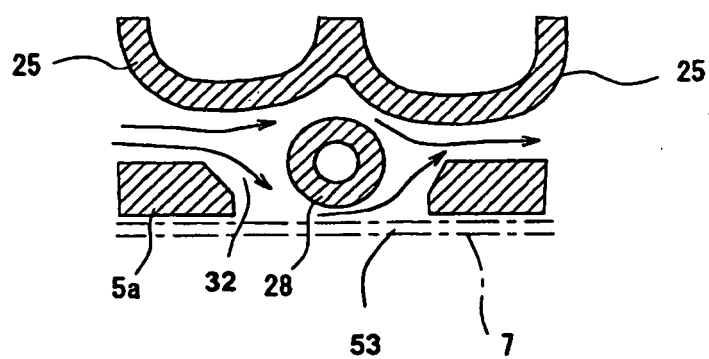


FIG. 12



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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