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COMBUSTION ENGINE****Publication Classification**(51) **Int. Cl.**
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Correspondence Address:

**OBLON, SPIVAK, MCCLELLAND MAIER &
NEUSTADT, P.C.**
1940 DUKE STREET
ALEXANDRIA, VA 22314 (US)(73) **Assignee:** **TOYOTA JIDOSHA
KABUSHIKI KAISHA,**
Toyota-shi (JP)(21) **Appl. No.:** **12/143,235**(22) **Filed:** **Jun. 20, 2008**(30) **Foreign Application Priority Data**

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(57) **ABSTRACT**

Exhaust ports and an exhaust gas gathering portion are formed within a cylinder head. A main passage is formed within an engine body. Through the main passage, a coolant is introduced from the inside of a cylinder block into the inside of the cylinder head at portions near exhaust valves, flows in portions near intake valves and portions near intake ports toward a side wall face of the cylinder head in the lateral direction of the engine body, and then flows into the cylinder block. A portion of the coolant, which is introduced into the portions near the exhaust valves, is caused to flow in portions near the exhaust ports toward a side wall face of the cylinder head, and then flows along the side wall face toward a coolant outlet.

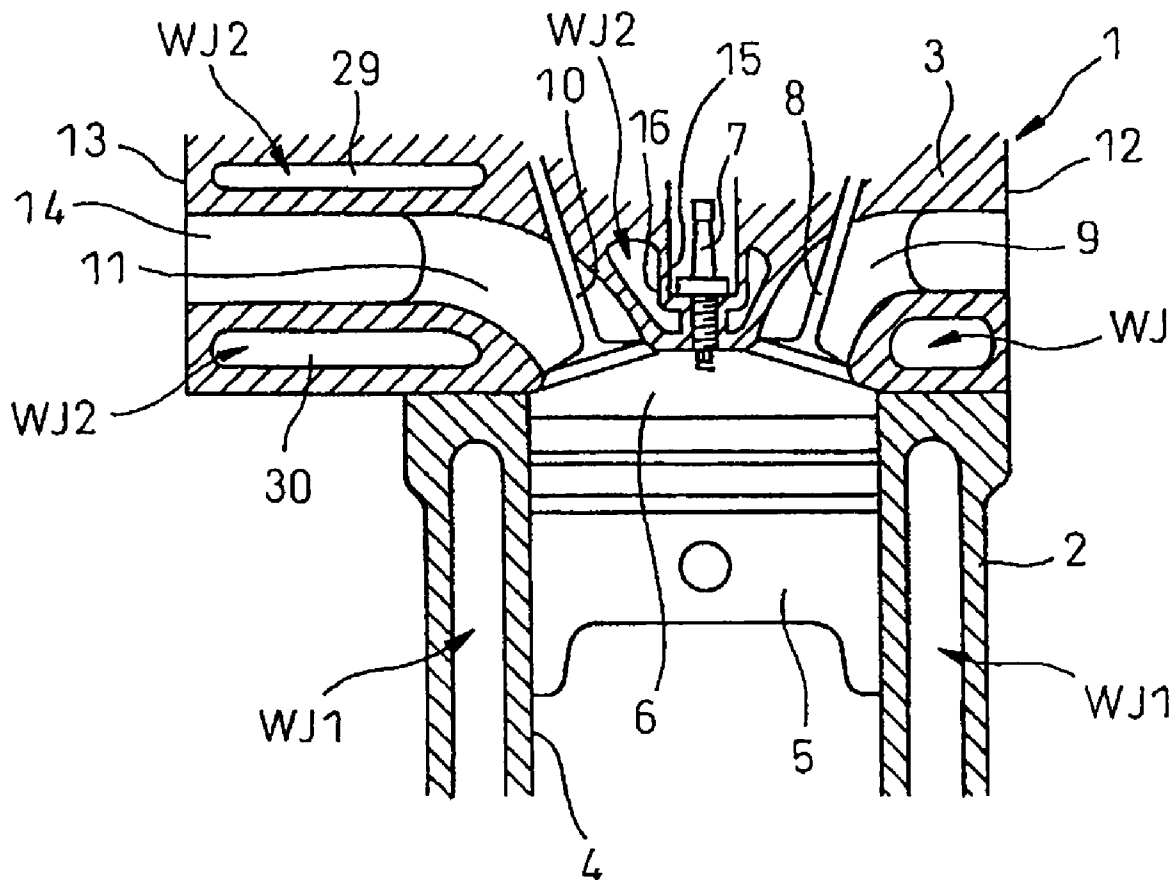
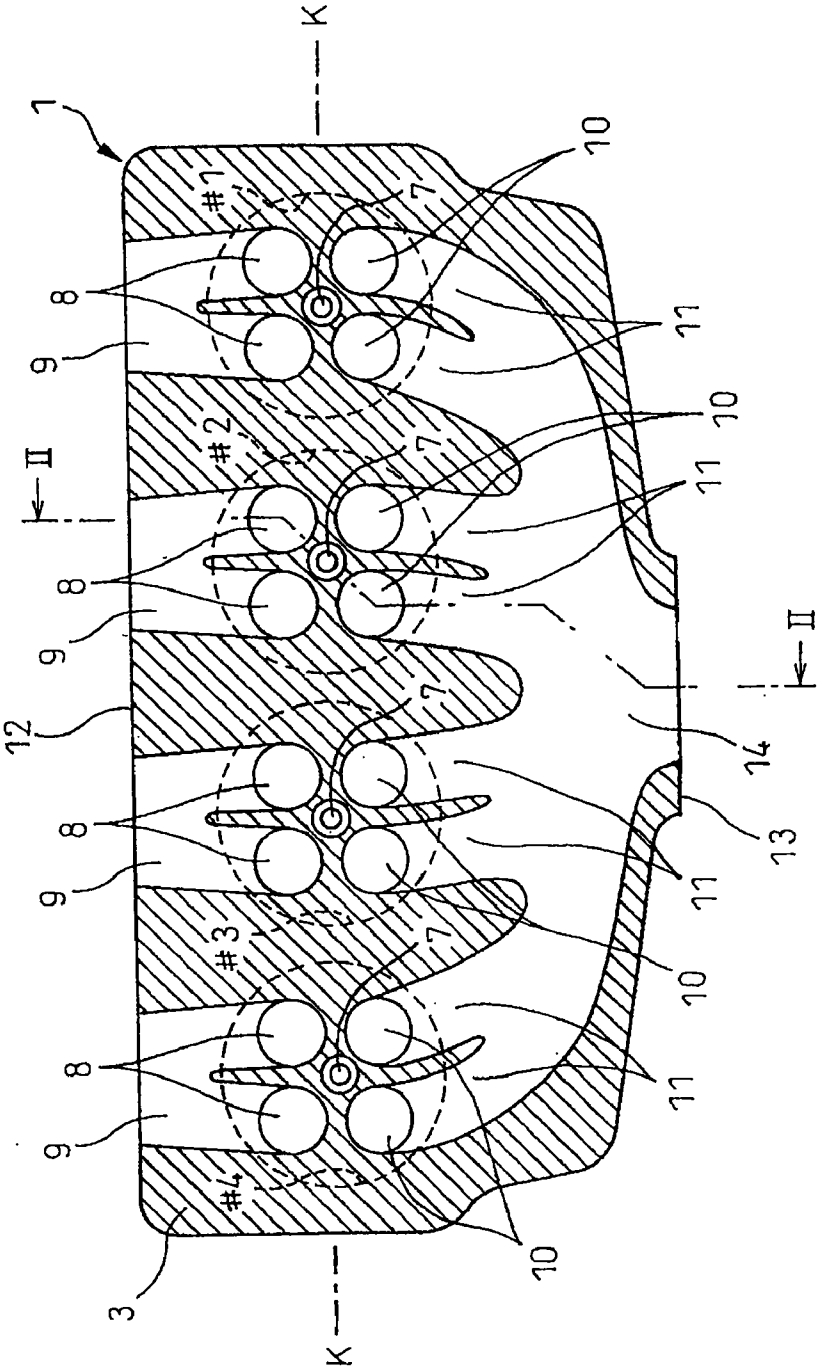


FIG. 1



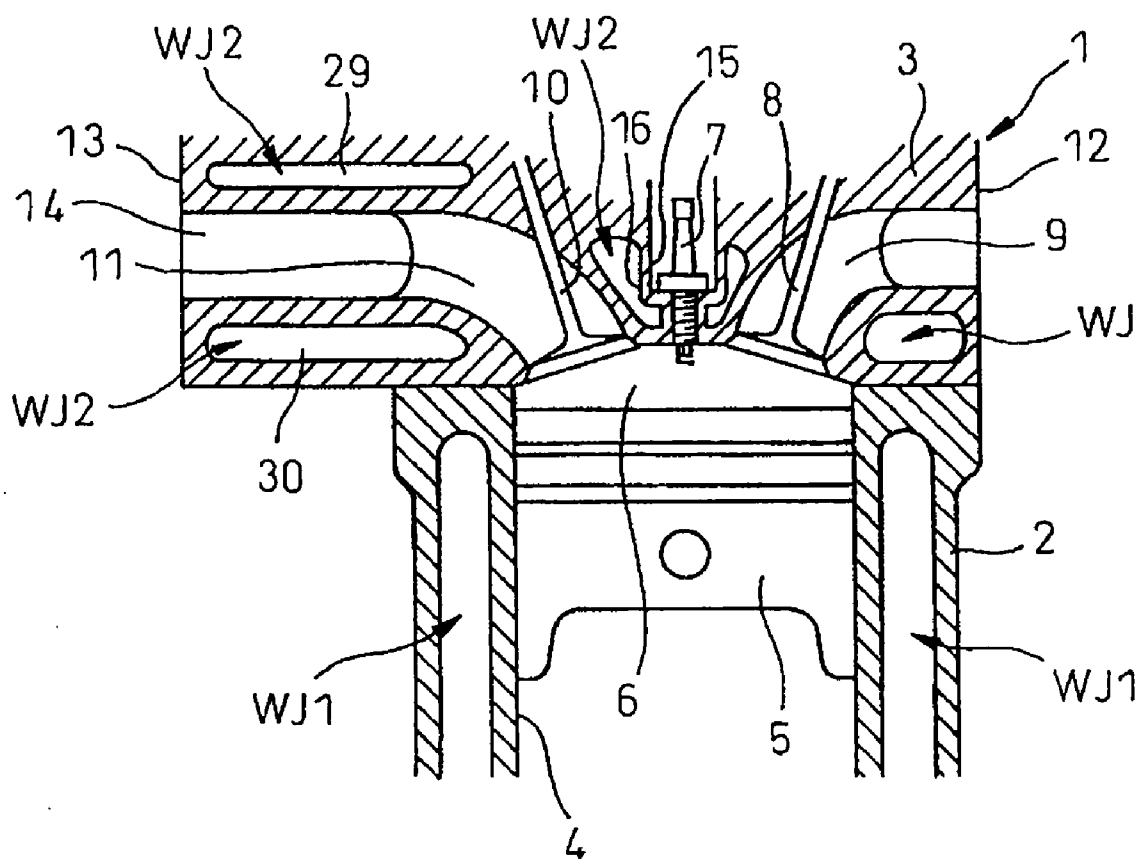


FIG. 3

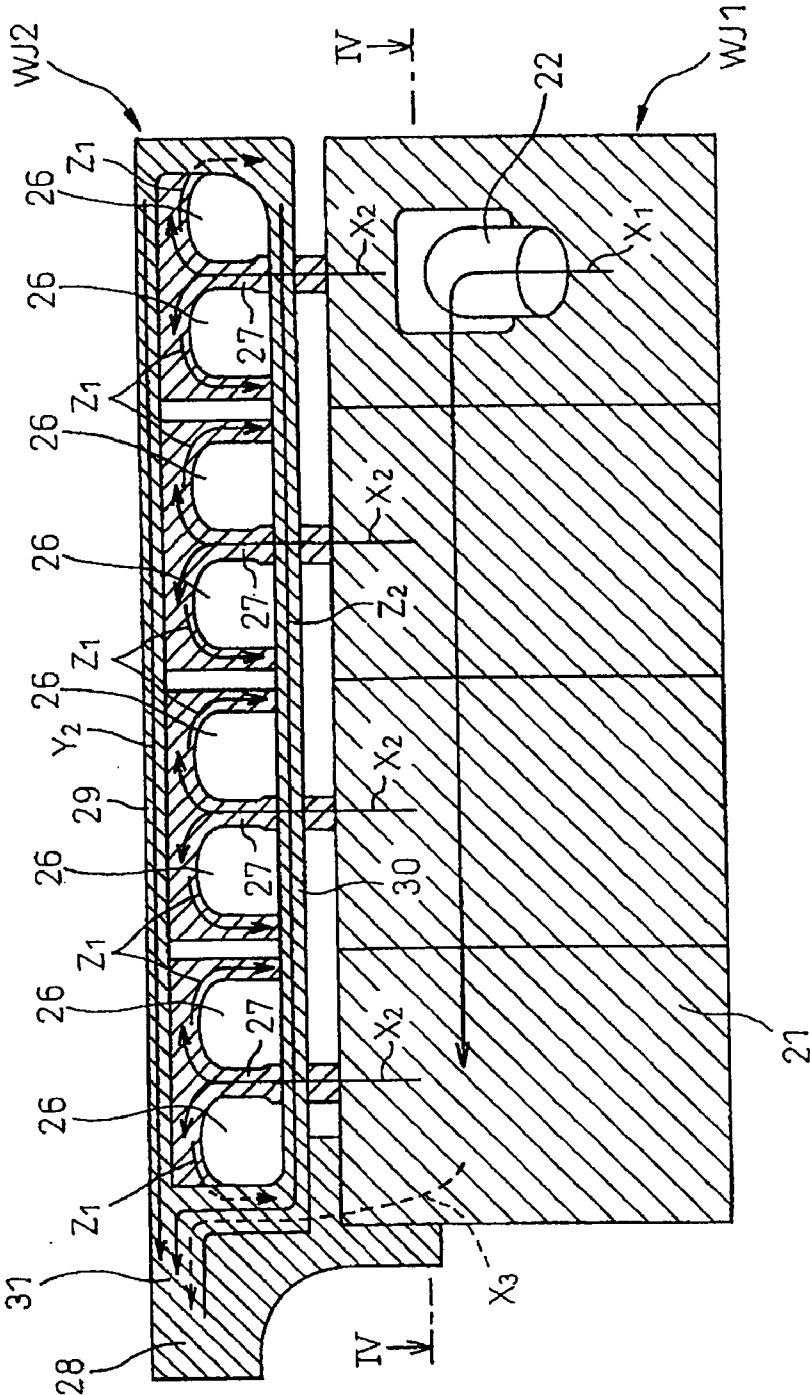


FIG. 4

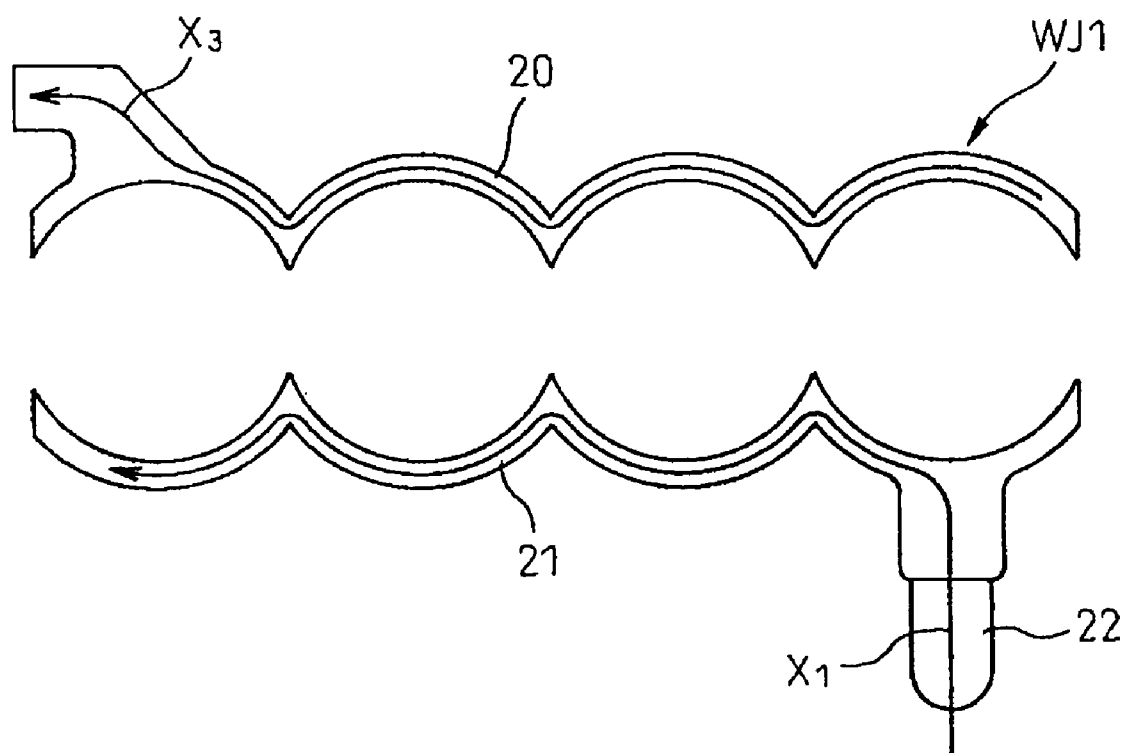
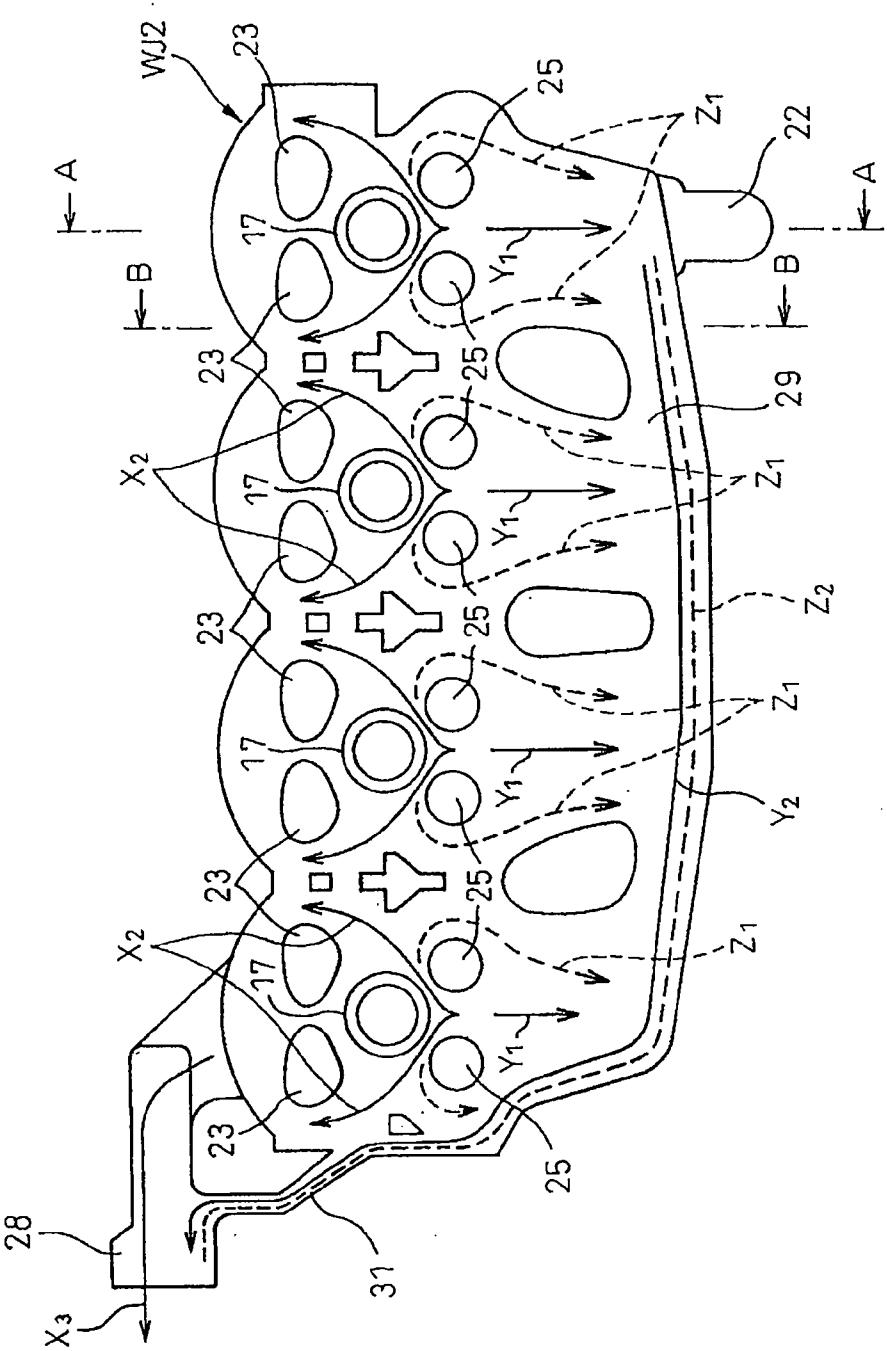
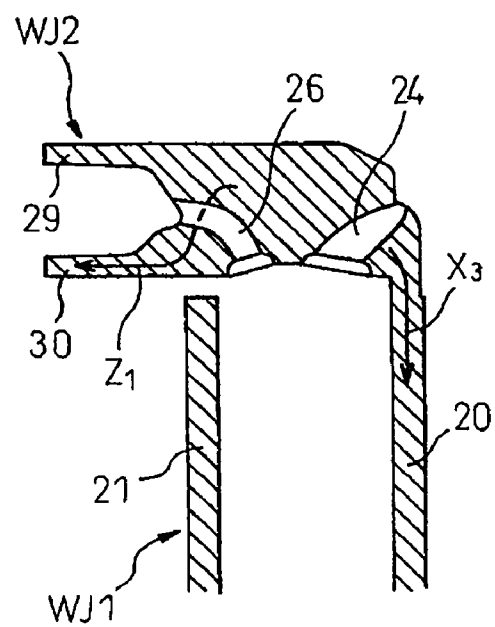


FIG. 5





STRUCTURE FOR COOLING INTERNAL COMBUSTION ENGINE

INCORPORATION BY REFERENCE

[0001] The disclosure of Japanese Patent Application No. 2007-165058 filed on Jun. 22, 2007 including the specification, drawings and abstract is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates to a structure for cooling an internal combustion engine.

[0004] 2. Description of the Related Art

[0005] In a cylinder head of an internal combustion engine, the temperature of portions near exhaust valves and the temperature of portions near ignition plugs become considerably high. Therefore, these portions need to be cooled intensively. Accordingly, Japanese Examined Utility Model Application Publication No. 05-17373 (JP-UM-B-05-17373) describes the following structure of an internal combustion engine, which is applied to a multi-cylinder internal combustion engine in which multiple cylinders are arranged in line along the longitudinal axis of an engine body, intake valves and intake ports are arranged on one side of the longitudinal axis, and exhaust valves and exhaust ports are arranged on the other side of the longitudinal axis. In the structure described in JP-UM-B-05-17373, a water jacket formed within a cylinder block is partitioned into an intake port-side water jacket, which is on one side of the longitudinal axis, and an exhaust port-side water jacket, which is on the other side of the longitudinal axis. With the structure, a coolant in the exhaust port-side water jacket is introduced into a cylinder head at portions near exhaust valves and portions near ignition plugs, whereby these portions are cooled. Next, the coolant is caused to flow in portions near the intake valves and portions near the intake ports within the cylinder head in the lateral direction, that is, the direction perpendicular to the longitudinal axis. Then, the coolant flows into the intake port-side water jacket. [0006] However, in the internal combustion engine described in JP-UM-B-05-17373, it is not possible to sufficiently cool portions near the exhaust ports where the temperature becomes considerably high.

SUMMARY OF THE INVENTION

[0007] The invention provides a structure with which portions near exhaust ports are cooled.

[0008] An aspect of the invention provides a structure for cooling an internal combustion engine which includes multiple cylinders that are arranged in line along the longitudinal axis of an engine body, and in which intake ports are open on a first side wall face of a cylinder head, the first wall face being on one side of the longitudinal axis on which intake valves are arranged, and exhaust ports are open on a second wall face of the cylinder head, the second wall face being on the other side of the longitudinal axis on which exhaust valves are arranged. The structure includes a main passage which is formed within the engine body. Through the main passage, a coolant is introduced from the inside of a cylinder block into the inside of the cylinder head at portions near the exhaust valves, flows in portions near the intake valves and portions near the intake ports toward the first wall face in the lateral direction of the engine body, and then flows into the cylinder block. A portion

of the coolant, which is introduced from the inside of the cylinder block into the inside of the cylinder head at the portions near the exhaust valves, is caused to flow in portions near the exhaust ports in the direction, which is opposite to the direction of a coolant flow along the main passage, toward the second side wall face in the lateral direction, and then flows along the second side wall face toward a coolant outlet from the engine body in the direction of the longitudinal axis.

[0009] A portion of the coolant, which is introduced into the portions near the exhaust valves, is caused to flow in the portions near the exhaust ports in the lateral direction and then flow toward the coolant outlet from the engine body in the direction of the longitudinal axis of the engine body. With this structure, it is possible to cool the portions near the exhaust ports sufficiently.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The foregoing and further features and advantages of the invention will become apparent from the following description of an example embodiment with reference to the accompanying drawings, wherein the same or corresponding portions will be denoted by the same reference numerals and wherein:

[0011] FIG. 1 is a plan cross-sectional view showing a cylinder head;

[0012] FIG. 2 is a cross-sectional view showing a cylinder block and the cylinder head taken along the line II-II in FIG. 1;

[0013] FIG. 3 is a side view showing the shapes of water jackets;

[0014] FIG. 4 is a view showing the cross-sectional shape of the water jacket taken along the line IV-IV in FIG. 3;

[0015] FIG. 5 is a top view showing the shape of the water jacket;

[0016] FIG. 6A is a view showing the cross-sectional shapes of the water jackets taken along the line A-A in FIG. 5; and

[0017] FIG. 6B is a view showing the cross-sectional shapes of the water jackets taken along the line B-B in FIG. 5.

DETAILED DESCRIPTION OF THE EMBODIMENT

[0018] Hereafter, an embodiment of the invention will be described with reference to the accompanying drawings. FIG. 1 is a plan view showing an internal combustion engine, and FIG. 2 is a cross-sectional view showing the internal combustion engine taken along the line II-II in FIG. 1. As shown in FIGS. 1 and 2, the internal combustion engine includes an engine body 1, a cylinder block 2, a cylinder head 3 that is fixed onto the cylinder block 2, cylinder bores 4 that are formed within the cylinder block 2, pistons 5, combustion chambers 6, ignition plugs 7 that are arranged at center portions of the top faces of the combustion chambers 6, intake valves 8 that are arranged in the cylinder head 3, intake ports 9 that are formed within the cylinder head 3, exhaust valves 10 that are arranged in the cylinder head 3, and exhaust ports 11 that are formed within the cylinder head 3.

[0019] As shown in FIG. 1, the internal combustion engine includes multiple cylinders that are arranged in line along a longitudinal axis K-K of the engine body 1, which passes through cylinder axes of the cylinder bores 4, that is, four cylinders #1 to #4 in the example shown in FIG. 1. Each of the cylinders #1 to #4 is provided with a pair of intake valves 8

and a pair of exhaust valves 10. In the internal combustion engine shown in FIG. 1, the intake ports 9 open on a side wall face 12 of the cylinder head 3. The side wall face 12 is on one side of the longitudinal axis K-K, on which the intake valves 8 are arranged. In addition, the exhaust ports 11 open on a side wall face 13 of the cylinder head 3. The side wall face 13 is on the other side of the longitudinal axis K-K, on which the exhaust valves 10 are arranged.

[0020] In the internal combustion engine shown in FIG. 1, the exhaust ports 11 of the cylinders #1 to #4 meet each other within the cylinder head 3 at an exhaust gas gathering portion 14 that is shared by all the exhaust ports 11. The exhaust gas gathering portion 14 opens on the side wall face 13. That is, in the internal combustion engine shown in FIG. 1, the cylinder head 3 is formed of a so-called exhaust gas manifold integrated cylinder head within which the intake ports 10 of the cylinders #1 to #4 and the exhaust gas gathering portion 14 are formed.

[0021] As shown in FIG. 2, a water jacket WJ1 in which an engine coolant (hereinafter, referred to as "coolant") flows is formed within the cylinder block 2. In addition, a water jacket WJ2 in which the coolant flows is formed within the cylinder head 3. FIGS. 3 to 6 show the shapes of cores that are used to form the water jackets WJ1 and WJ2, in other words, the shapes of the water jackets WJ1 and WJ2.

[0022] FIG. 3 shows the shapes of the water jackets WJ1 and WJ2 when viewed from the left side in FIG. 2. The hatched portions in FIG. 3 show water jacket portions. FIG. 4 shows the cross-sectional shape of the water jacket WJ1 formed within the cylinder block 2 taken along the line IV-IV in FIG. 3. FIG. 5 shows the shape of the water jacket WJ2 formed within the cylinder head 3 when viewed from above. FIG. 6A is a cross-sectional view showing the water jackets WJ1 and WJ2 taken along the line A-A in FIG. 5. FIG. 6B is a cross-sectional view showing the water jackets WJ1 and WJ2 taken along the line B-B in FIG. 5. In FIGS. 6A and 6B, the hatched portions show cross-sections of the water jacket portions.

[0023] The actual shapes of the water jackets are more complicated than the shapes of the water jackets WJ1 and WJ2 shown in FIGS. 3 to 6. However, to facilitate the understanding of main flows of the coolant within the water jackets, the shapes of the water jackets WJ1 and WJ2 are shown in simplified forms in FIGS. 3 to 6.

[0024] The water jacket WJ1 formed within the cylinder block 2 is partitioned into an intake port-side water jacket 20 and an exhaust port-side water jacket 21. The intake port-side water jacket 20 is positioned on one side of the longitudinal axis K-K of the engine body 1, and the exhaust port-side water jacket 21 is positioned on the other side of the longitudinal axis K-K. As shown in FIG. 4, the water jackets 20 and 21 each extend along the periphery of the cylinder bore 4 of each of the cylinders #1 to #4 in an arc. A coolant inlet 22 through which the coolant flows into the engine body 1 is formed at an end portion of the exhaust port-side water jacket 21. The end portion at which the exhaust port-side water jacket 21 is formed is at the end of the exhaust port-side water jacket 21 in the direction of the longitudinal axis K-K. The coolant that is cooled by a radiator (not shown) is supplied into the engine body 1 through the coolant inlet 22, as indicated by an arrowed line X_1 shown in FIGS. 3, 4 and 6A. Then, the coolant flows in the exhaust port-side water jacket 21 in the direction of the longitudinal axis K-K of the engine body 1.

[0025] As shown in FIG. 2, the cylinder head 3 has cylindrical walls 16 that surround fitting holes 15 in which the ignition plugs 7 are fitted. As shown in FIGS. 5 and 6A, each cylindrical wall 16 has an outer peripheral face 17. FIGS. 3, 5 and 6B show regions in which the water jacket WJ2 cannot be formed because the intake valves 8, the intake ports 9, the exhaust valves 10, the exhaust ports 11, etc. are arranged in the regions, that is, intake valve fitting regions 23, intake port forming regions 24, exhaust valve fitting regions 25, and exhaust port forming regions 26.

[0026] As described above, in the cylinder head 3 of the internal combustion engine, the temperature of portions near the exhaust valves 10 and the temperature of portions near the ignition plugs 7 become considerably high. Therefore, the portions near the exhaust valves 10 and the portions near the ignition plugs 7 need to be cooled intensively. Accordingly, a main coolant passage is formed within the engine body 1 so that the coolant flows in the following manner. As indicated by arrowed lines X_2 in FIGS. 3, 5 and 6A, after the coolant flows from the inside of the cylinder block 2 into the inside of the cylinder head 3 at the portions near the exhaust valves 10, the coolant flows in portions near the intake valves 8 and portions near the intake ports 9 toward the side wall face 12 in the lateral direction of the engine body 1, that is, the direction perpendicular to the longitudinal axis K-K of the engine body 1, and then flows into the cylinder block 2 as indicated by an arrowed line X_3 in FIG. 6B.

[0027] The flow of the coolant along the main passage according to the embodiment of the invention will be described in more detail below. The coolant is introduced from the exhaust port-side water jacket 21 formed within the cylinder block 2 into the cylinder head 3, flows in portions between the paired exhaust valves 10, reaches the outer peripheral faces 17 of the cylindrical walls 16 that surround the ignition plug fitting holes 15, and then flows in the portions near the intake valves 8 and the portions near the intake ports 9 toward the side wall face 12 in the lateral direction. Because the coolant is caused to flow in the portions between the paired exhaust valves 10 toward the outer peripheral faces 17 of the cylindrical walls 16 that surround the ignition plugs 7, it is possible to sufficiently cool the portions near the exhaust valves 10 and the portions near the ignition plugs 7 where the temperature becomes considerably high.

[0028] In order to cause the coolant to flow in the portions between the paired exhaust valves 10 toward the outer peripheral walls 17 of the cylindrical walls 16 that surround the ignition plugs 7, each of the cylinders #1 to #4 is provided with a coolant passage 27. Each coolant passage 27 extends from the inside of the exhaust port-side water jacket 21 upward, curves toward the ignition plug 7, and then extends toward the outer peripheral wall 17 of the cylindrical wall 16. In the embodiment of the invention, the entire or most of the coolant that is supplied from the exhaust port-side water jacket 21 into the cylinder head 3 flows through the coolant passages 27.

[0029] In the embodiment of the invention, the coolant, which flows along the main passage, flows within the cylinder head 3, and then flows into the intake port-side water jacket 20. Next, as indicated by an arrowed line X_3 in FIG. 4, the coolant flows in the intake port-side water jacket 29 in the direction of the longitudinal axis K-K of the engine body 1. Then, as indicated by the arrowed line X_3 in FIG. 3, the

coolant flows upward and flows out of the engine body 1 through a coolant outlet 28 that is formed at a corner portion of the cylinder head 3.

[0030] As shown in FIG. 5, the coolant outlet 28 is formed at the corner portion of the cylinder head 3, which is diagonally opposite to the coolant inlet 22 through which the coolant flows into the engine body 1, when viewed from above. The coolant outlet 28 is formed at a position higher than the coolant inlet 22 so that the air that is present in the water jackets WJ1 and WJ2 is bled from the water jackets WJ1 and WJ2.

[0031] In order to cool portions near the exhaust ports 11, a portion of the coolant, which is introduced from the inside of the cylinder block 2 into the inside of the cylinder head 3 at the portions near the exhaust valves 10, is caused to flow in the portions near the exhaust ports 11 in the direction opposite to the direction of the coolant flow along the main passage indicated by the arrowed lines X_2 (hereinafter, referred to as "main passage X_2 " where appropriate), toward the side wall face 13 in the lateral direction. Then, the coolant is caused to flow along the side wall face 13 toward the coolant outlet 28 in the direction of the longitudinal axis K-K of the engine body 1. That is, a portion of the coolant is diverted, on the outer peripheral faces 17 of the cylindrical walls 16, from the coolant that flows along the main passage X_2 , and then flows in the direction opposite to the direction of the coolant flow along the main passage X_2 .

[0032] In the embodiment of the invention, a flat upper water jacket 29 is formed above the exhaust ports 11 of the cylinders #1 to #4 and the exhaust gas gathering portion 14, and a flat lower water jacket 30 is formed below the exhaust ports 11 of the cylinders #1 to #4 and the exhaust gas gathering portion 14. A portion of the coolant, which is diverted from the coolant that flows along the main passage, flows within the upper water jacket 29 as indicated by arrowed lines Y_1 toward the side wall face 13 in the lateral direction, and then flows along the side wall face 13 as indicated by an arrowed line Y_2 toward the coolant outlet 28 in the direction of the longitudinal axis K-K of the engine body 1. At the same time, another portion of the coolant, which is diverted from the coolant that flows along the main passage, flows within the lower water jacket 30 as indicated by arrowed lines Z_1 toward the side wall face 13 in the lateral direction, and then flows along the side wall face 13 as indicated by an arrowed line Z_2 toward the coolant outlet 28 in the direction of the longitudinal axis K-K of the engine body 1.

[0033] That is, as indicated by the arrowed lines Y_1 in FIGS. 5 and 6A, a portion of the coolant, which is introduced into the cylinder head 3, changes the flow direction on the outer peripheral faces 17 of the cylindrical walls 16, and then flows toward the side wall face 13 in the lateral direction. As indicated by the arrowed lines Z_1 in FIGS. 3, 5 and 6B, a portion of the coolant, which is introduced into the cylinder head 3, gradually flows downward while flowing in portions near the exhaust port forming regions 26, and then flows toward the side wall face 13 in the lateral direction.

[0034] The upper water jacket 29 is connected to the coolant outlet 28 via an air-bleed passage 31, at an end portion on the coolant outlet 28 side in the direction of the longitudinal axis K-K of the engine body 1. The lower water jacket 30 is connected to the air-bleed passage 31, at an end portion on the coolant outlet 28 side in the direction of the longitudinal axis

K-K of the engine body 1. Therefore, the lower water jacket 30 is also connected to the coolant outlet 28 via the air-bleed passage 31.

[0035] When the water jackets 29 and 30 are connected to the coolant outlet 28 via the air-bleed passage 31, as indicated by the arrowed lines Y_2 and Z_2 in FIGS. 3 and 5, the coolant in the water jacket 29 and the coolant in the water jacket 30 flow along the side wall face 13 toward the coolant outlet 28 smoothly without stagnation. Thus, as indicated by the arrowed lines Y_1 and Z_1 in FIGS. 3 and 5, the coolant flows in the upper water jacket 29 and the lower water jacket 30, from the portions near the exhaust valves 10 toward the side wall face 13 smoothly without stagnation. As a result, the portions near the exhaust ports 11 are cooled appropriately.

[0036] When the exhaust manifold integrated cylinder head 3 as shown in FIG. 1 is used, the temperature of the exhaust gas gathering portion 14 becomes considerably high. In this case as well, the exhaust gas gathering portion 14 is cooled from above by the coolant in the upper water jackets 29 and from below by the coolant in the lower water jackets 30. Therefore, it is possible to prevent overheating of the exhaust gas gathering portion 14.

[0037] The embodiment of the invention that has been described in the specification is to be considered in all respects as illustrative and not restrictive. The technical scope of the invention is defined by claims, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed is:

1. A structure for cooling an internal combustion engine which includes multiple cylinders that are arranged in line along a longitudinal axis of an engine body, and in which intakes ports are open on a first side wall face of a cylinder head, the first wall face being on one side of the longitudinal axis on which intake valves are arranged, and exhaust ports are open on a second wall face of the cylinder head, the second wall face being on the other side of the longitudinal axis on which exhaust valves are arranged, comprising:

a main passage which is formed within the engine body, and through which a coolant is introduced from an inside of a cylinder block into an inside of the cylinder head at portions near the exhaust valves, flows in portions near the intake valves and portions near the intake ports toward the first wall face in a lateral direction of the engine body, and then flows into the cylinder block,

wherein a portion of the coolant, which is introduced from the inside of the cylinder block into the inside of the cylinder head at the portions near the exhaust valves, is caused to flow in portions near the exhaust ports in a direction, which is opposite to a direction of a coolant flow along the main passage, toward the second side wall face in the lateral direction, and then flows along the second side wall face toward a coolant outlet from the engine body in a direction of the longitudinal axis.

2. The structure according to claim 1, wherein:

a pair of the intake valves and a pair of the exhaust valves are arranged around each of ignition plugs;

the coolant, which flows along the main passage, flows from the inside of the cylinder block into the inside of the cylinder head, flows in portions between the paired exhaust valves, reaches outer peripheral faces of cylindrical walls that surround holes in which the ignition plugs are fitted, and then flows in the portions near the intake valves and the portions near the intake ports toward the first side wall face in the lateral direction; and

a portion of the coolant, which is introduced from the inside of the cylinder block into the inside of the cylinder head at the portions near the exhaust valves, is diverted, on the outer peripheral faces of the cylindrical walls, from the coolant that flows along the main passage, and flows in the direction which is opposite to the direction of the coolant flow along the main passage.

3. The structure according to claim 1, wherein:

the exhaust ports of the respective cylinders meet each other within the cylinder head at an exhaust gas gathering portion that is shared by all the exhaust ports, and the exhaust gas gathering portion opens on the second side wall face;

a flat upper water jacket is formed above the exhaust ports of the cylinders and the exhaust gas gathering portion, and a flat lower water jacket is formed below the exhaust ports of the cylinders and the exhaust gas gathering portion;

a portion of the coolant, which flows in the direction opposite to the direction of the coolant flow along the main passage, flows within the upper water jacket toward the second side wall face in the lateral direction and then flows along the second side wall face toward the coolant outlet in the direction of the longitudinal axis; and

another portion of the coolant, which flows in the direction opposite to the direction of the coolant flow along the main passage, flows within the lower water jacket toward the second side wall face in the lateral direction and then flows along the second side wall face toward the coolant outlet in the direction of the longitudinal axis.

4. The structure according to claim 3, further comprising: an air-bleed passage,

wherein the upper water jacket is connected to the coolant outlet via the air-bleed passage, at an end portion on a coolant outlet side in the direction of the longitudinal axis of the engine body.

5. The structure according to claim 3, further comprising: an air-bleed passage,

wherein the lower water jacket is connected to the coolant outlet via the air-bleed passage at an end portion on a coolant outlet side in the direction of the longitudinal axis of the engine body.

6. The structure according to claim 1, wherein:

a water jacket formed within the cylinder block is partitioned into an intake port-side water jacket which is on one side of the longitudinal axis and an exhaust port-side water jacket which is on the other side of the longitudinal axis; and

the coolant, which flows along the main passage, flows from the exhaust port-side water jacket, flows within the cylinder head, and flows toward the intake port-side water jacket.

7. The structure according to claim 1, wherein:

a coolant inlet to the engine body is formed at an end portion of the exhaust port-side water jacket in the direction of the longitudinal axis; and

the coolant outlet is formed in the cylinder head at a corner portion that is diagonally opposite to the coolant inlet when the engine body is viewed from above.

8. The structure according to claim 1, further comprising: a coolant inlet,

wherein the coolant is supplied through the coolant inlet, and

wherein the coolant outlet is at a position that is higher than the coolant inlet.

9. A structure for cooling an internal combustion engine that includes multiple cylinders which are arranged in line along a longitudinal axis of an engine body, intake ports that open at a portion of a cylinder head, which is on one side of the longitudinal axis, and exhaust ports that open at another portion of the cylinder head, which is on the other side of the longitudinal axis, comprising:

an exhaust port-side water jacket that is formed in an exhaust port-side portion of a cylinder block;

an intake port-side water jacket that is formed in an intake port-side portion of the cylinder block;

a coolant inlet;

a main passage through which a coolant, which is introduced into the exhaust port-side water jacket through the coolant inlet, flows into the cylinder head at portions near exhaust valves, flows in portions near the intake ports, and then flows into the intake port-side water jacket formed within the cylinder block;

a passage through which the coolant, which is introduced from the exhaust port-side water jacket into the cylinder head at the portions near the exhaust valves, flows in portions near the exhaust ports in a direction opposite to a direction of a coolant flow along the main passage, and then flows in a direction of the longitudinal axis; and

a coolant outlet through which the coolant flows out of the engine body.

10. The structure according to claim 9, wherein:

ignition plugs are provided in the cylinder head;

a pair of the intake ports and a pair of the exhaust ports are formed around each ignition plug;

the main passage is formed so that the coolant flows from an inside of the cylinder block into an inside of the cylinder head, flows in portions between the paired exhaust ports within the cylinder head, reaches outer peripheral faces of cylindrical walls that surround holes in which the ignition plugs are fitted, and flows in portions near intake valves and the portions near the intake ports toward the intake port-side water jacket; and

the passage is formed so that a portion of the coolant, which is introduced from the exhaust port-side water jacket into the cylinder head at the portions near the exhaust valves, is diverted, on the outer peripheral faces of the cylindrical walls, from the coolant that flows along the main passage, and flows in the direction opposite to the direction of the coolant flow along the main passage.

11. The structure according to claim 9, further comprising: an exhaust gas gathering portion that is formed within the cylinder head, and that is shared by the exhaust ports of all the cylinders;

an upper water jacket that is formed above the exhaust ports of the cylinders and the exhaust gas gathering portion;

a lower water jacket that is formed below the exhaust ports of the cylinders and the exhaust gas gathering portion;

a passage through which a portion of the coolant, which flows in the direction opposite to the direction of the coolant flow along the main passage, flows within the upper water jacket toward the coolant outlet in the direction of the longitudinal axis; and

a passage through which another portion of the coolant, which flows in the direction opposite to the direction of the coolant flow along the main passage, flows within the lower water jacket toward the coolant outlet in the direction of the longitudinal axis.

12. The structure according to claim **11**, further comprising:

an air-bleed passage,

wherein the upper water jacket is connected to the coolant outlet via the air-bleed passage, at an end portion on a coolant outlet side in the direction of the longitudinal axis of the engine body.

13. The structure according to claim **11**, further comprising:

an air-bleed passage,

wherein the lower water jacket is connected to the coolant outlet via the air-bleed passage, at an end portion on a coolant outlet side in the direction of the longitudinal axis of the engine body.

14. The structure according to claim **9**, wherein:

the coolant inlet is formed at an end portion of the exhaust port-side water jacket in the direction of the longitudinal axis; and

the coolant outlet is formed at a corner portion of the cylinder head, which is diagonally opposite to the coolant inlet, when the engine body is viewed from above.

15. The structure according to claim **9**, wherein the coolant outlet is at a position that is higher than the coolant inlet.

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