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(54) WATER COOLED TURBINE HOUSING

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F02B 39/00 (2006.01)

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CPC F01P 2060/12; F01P 11/04; F01D 25/14; F01D 25/28; F02B 39/005
See application file for complete search history.

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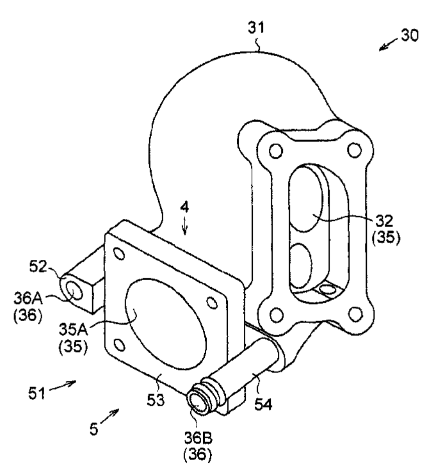
(57) **ABSTRACT**

A gas passage that is connected to an exhaust passage and a water passage that is connected to a water jacket are formed in a turbine housing. The water passage and the gas passage are arranged adjacent to each other in an exhaust gas-introducing side joint part of the turbine housing, and a mating face in which the water passage opens and a mating face in which the gas passage opens are formed not to connect smoothly to each other. The turbine housing is attached to the cylinder head with an O-ring that prevents leakage of coolant interposed between the mating face and the cylinder head, and a seal member that prevents leakage of exhaust gas interposed between the mating face and the cylinder head.

3 Claims, 4 Drawing Sheets



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CPC *F05D 2220/40* (2013.01); *F05D 2240/55* (2013.01); *F05D 2250/38* (2013.01); *F05D 2250/51* (2013.01)

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FIG. 1

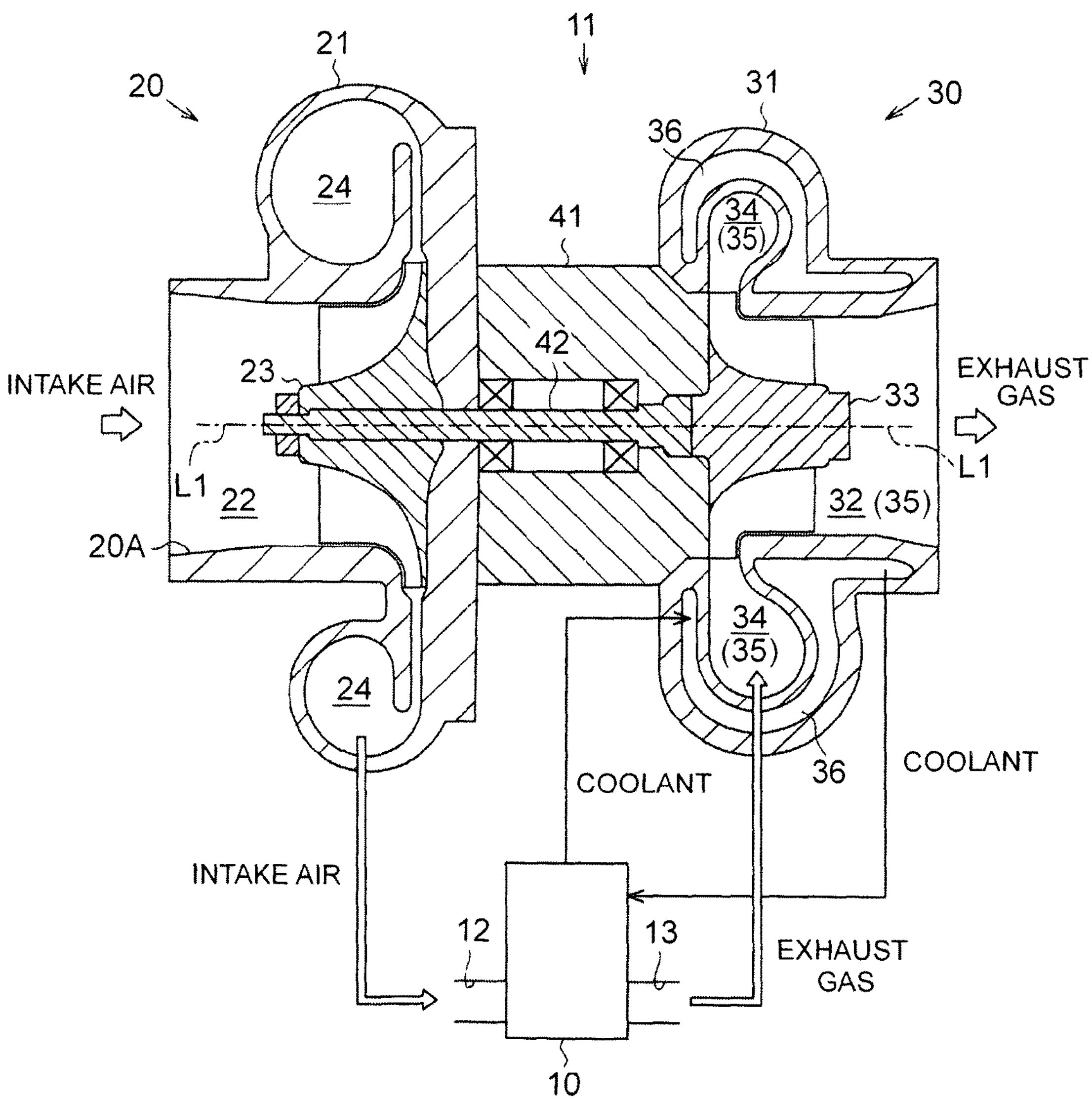

11
20
21
24
41
31
30
36
34
(35)
42
23
INTAKE AIR
EXHAUST
GAS
33
L1
22
32 (35)
20A
COOLANT
36
INTAKE AIR
12
13
EXHAUST
GAS
10

FIG. 2

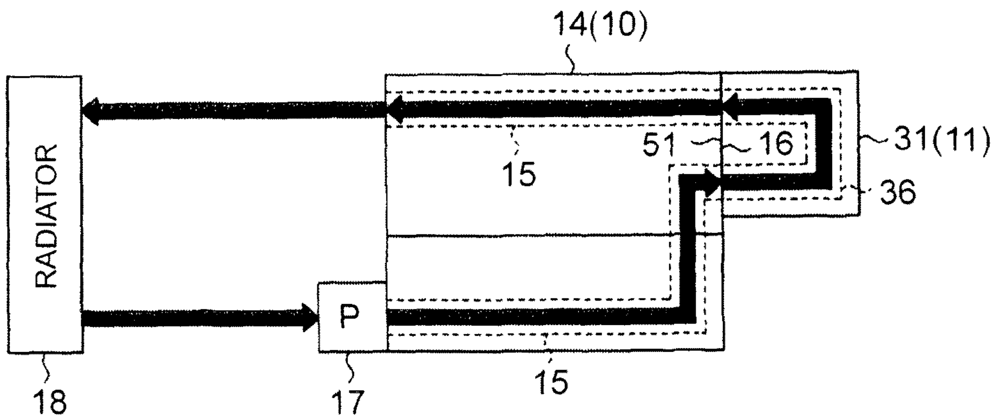

14(10)
RADIATOR
51
16
31(11)
15
36
P
18
17
15

FIG. 3

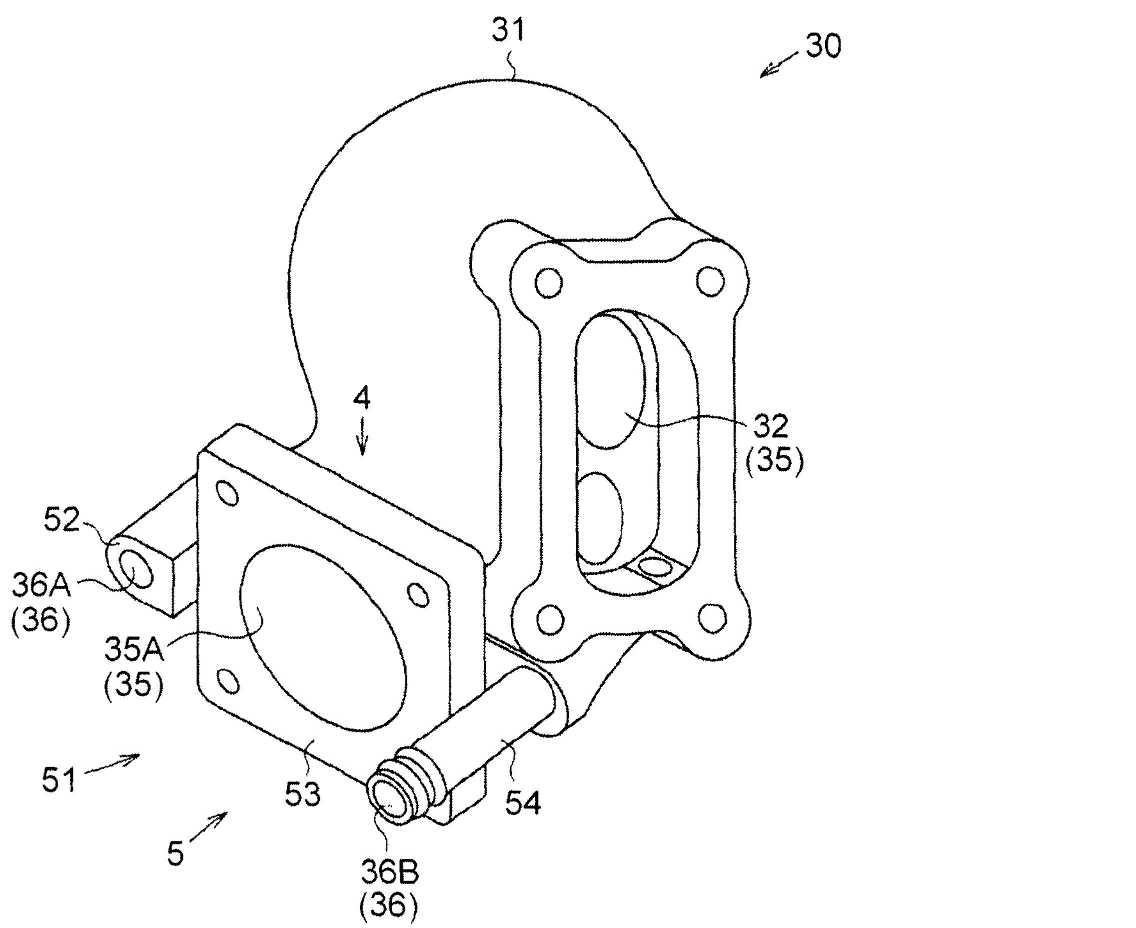

31
30
4
32
(35)
52
36A
(36)
35A
(35)
51
53
54
5
36B
(36)

FIG. 4

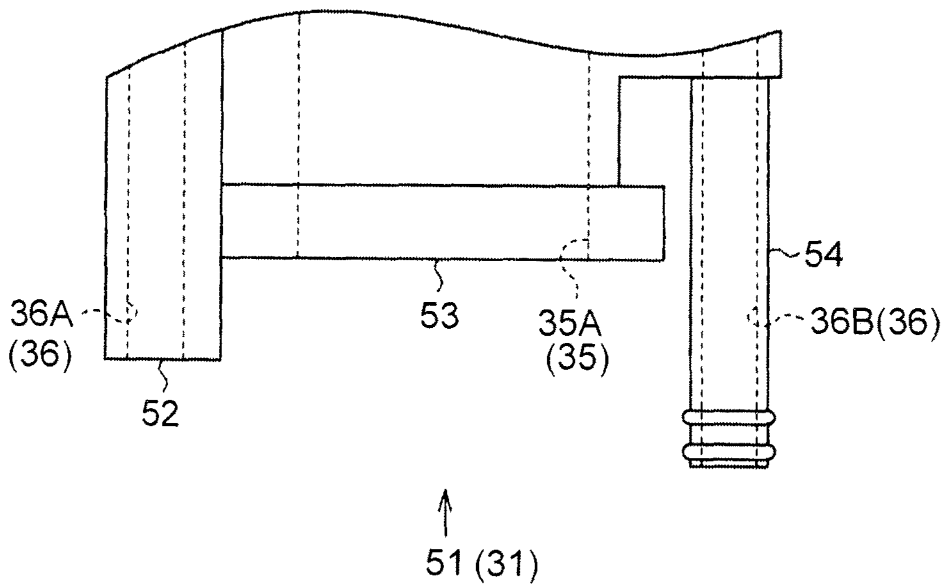

54
36A
(36)
53
35A
(35)
36B(36)
52
51 (31)

FIG. 5

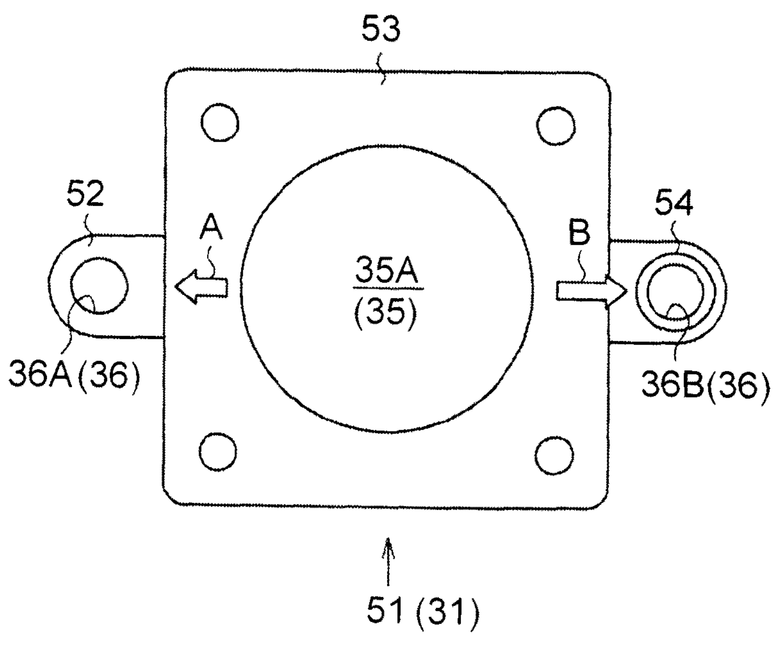
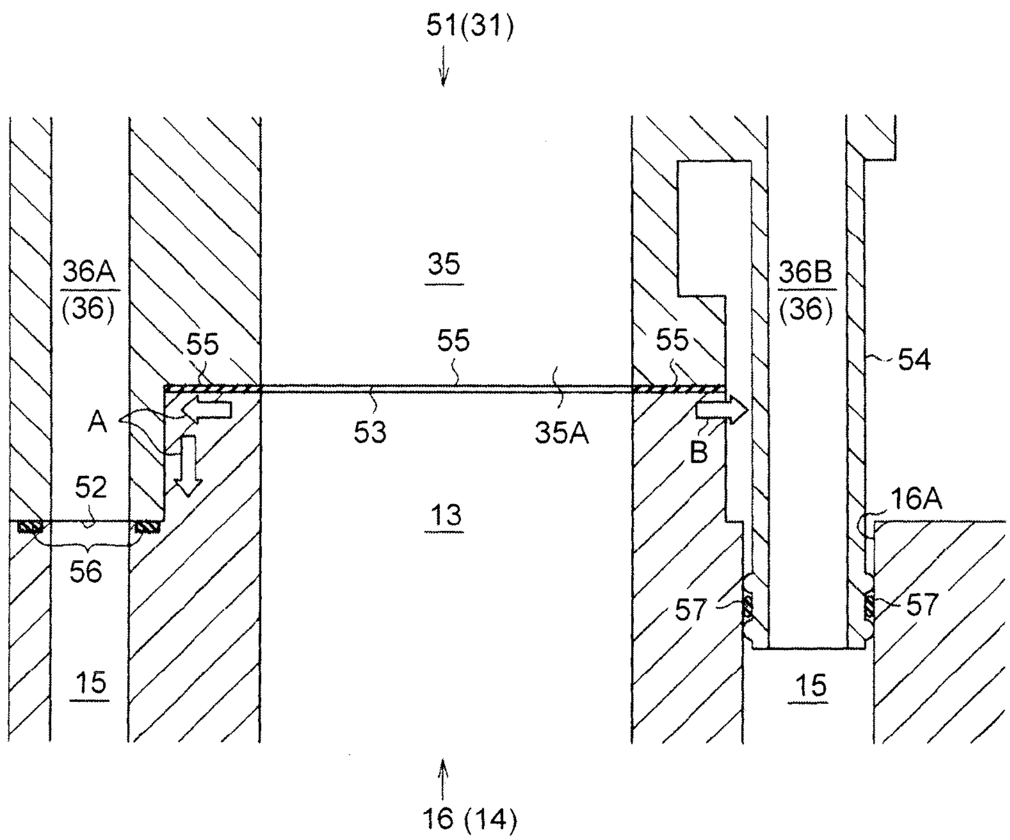

53
52
A
35A
(35)
B
54
36A(36)
36B(36)
51 (31)

FIG. 6



51(31)
36A
(36)
35
36B
(36)
55
55
55
54
A
53
35A
B
52
16A
13
56
57
57
15
15
16 (14)

WATER COOLED TURBINE HOUSING

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a turbine housing in which a water passage through which engine coolant flows is formed.

2. Description of Related Art

A water-cooled turbocharger is proposed in US 2009/0151327 A. In the turbine housing for a turbocharger that is disclosed in US 2009/0151327 A, a gas passage through which exhaust gas flows and a water passage through which coolant flows both extend to open in the part that will be connected to an internal combustion engine (specifically, a connecting flange on the side from which exhaust gas is introduced). Thus, the gas passage is connected to the exhaust passage of the internal combustion engine and the water passage is connected to the water jacket of the internal combustion engine through an operation of attaching the turbine housing to the internal combustion engine. Therefore, the turbocharger can be attached easily compared to the case where the gas passage and the water passage should be connected to the internal combustion engine through separate operations.

SUMMARY OF THE INVENTION

A metal seal member that prevents leakage of exhaust gas from the gas passage and a rubber O-ring that prevents leakage of coolant from the water passage are provided at the connection between the turbine housing and the internal combustion engine (specifically, between their mating faces). In a turbocharger, there is a possibility that a tiny amount of exhaust gas leaks from the connection between the gas passage and the exhaust passage in spite of the presence of a seal member at the connection.

In the turbine housing that is disclosed in US 2009/0151327 A, the gas passage and the water passage open in the same face. Thus, the exhaust gas that leaks from the gas passage into the gap between the mating faces of the turbine housing and the internal combustion engine is blown onto the O-ring between the same mating faces. In this case, the high-temperature exhaust gas may cause thermal degradation of the O-ring, resulting in a deterioration of the sealing performance of the O-ring.

The present invention provides a turbine housing which has a structure that enables it to be attached easily and is less likely to cause deterioration of the sealing performance of the water passage.

The means for it and its advantages are described below. A turbine housing according an aspect of the present invention includes a water passage, a gas passage, a joint part, a first seal member and a second seal member. The water passage is provided in the turbine housing. The water passage is connected to a water jacket of an internal combustion engine. The gas passage is provided in the turbine housing. The gas passage is connected to an exhaust passage of the internal combustion engine. The joint part is provided at a gas-introducing side of the turbine housing. The joint part has a first mating face in which the water passage opens and a second mating face in which the gas passage opens. The water passage and the gas passage are arranged adjacent to each other in the joint part. The second mating face does not connect smoothly to the first mating face. The first seal member is interposed between the first mating face and the internal combustion engine to prevent coolant from leaking.

The second seal member is interposed between the second mating face and the internal combustion engine to prevent exhaust gas from leaking.

In the turbine housing, the water passage and the gas passage are arranged in a side-by-side manner in the exhaust gas-introducing side joint part, and the water passage and the gas passage both open at the joint part. Thus, the gas passage can be connected to the exhaust passage and the water passage can be connected to the water jacket through an operation of connecting the joint part to the internal combustion engine (specifically, the cylinder head or exhaust passage thereof). Thus, the turbine housing has a structure that enables it to be attached easily.

In addition the first mating face, in which the water passage opens, and the second mating face, in which the gas passage opens, are formed not to connect smoothly to each other. Thus, when exhaust gas leaks from the gas passage onto the second mating face, on which the second seal member is located, the flow of the leaking exhaust gas is disturbed by the part between the first mating face and the second mating face, in other words, the part that do not connect smoothly to the mating face and the second mating face. This is a structure in which the exhaust gas that leaks onto the second mating face is less likely to reach the first mating face compared to the case where the water passage and the gas passage open in the same face. Thus, the turbine housing has a structure in which deterioration of the sealing performance of the water passage that is caused by exposure of the O-ring, which is provided on the first mating face to prevent leakage of coolant from the water passage, is less likely to occur.

In the turbine housing, the first mating face, the second mating face, and a connection portion that connects the first mating face to the second mating face may form a shape that is bent at one or more portions between an opening of the water passage and an opening of the gas passage.

According to the above turbine housing, because the flow of exhaust gas that leaks from the gas passage onto the second mating face and travels toward the first mating face is less likely to reach the first mating face because it is blocked by the Z-shaped surface. Thus, the first seal member on the first mating face can be prevented from being exposed to high-temperature exhaust gas.

In the turbine housing, the bent shape may be a stepwise shape that one of the first mating face and the second mating face protrudes relative to the other of the first mating face and the second mating face.

In the turbine housing, the joint part may have a pipe that extends in a direction across the second mating face, the pipe may constitute a part of the water passage, and the first mating face may be an outer periphery of a distal end portion of the pipe.

According to turbine housing, the water passage can be connected to the water jacket through an operation of connecting the joint part of the turbine housing to the internal combustion engine with a distal end portion of the pipe inserted into the connecting port of the internal combustion engine. In this case, the first seal member is provided between the outer periphery of the distal end portion of the pipe and the inner periphery of the connecting port of the internal combustion engine to prevent leakage of coolant from the water passage.

In the turbine housing, because the pipe extends in a direction across the second mating face, exhaust gas that leaks from the gas passage onto the second mating face is blown onto the outer periphery of the pipe. Thus, the exhaust gas that leaks onto the second mating face is less likely to reach the first mating face, in other words, the outer periphery of the distal end portion of the pipe that is inserted into the internal combustion engine. Thus, the first seal member on the first mating face can be prevented from being exposed to high-temperature exhaust gas.

In the turbine housing, the second mating face may be planar, and the pipe may extend in a direction normal to the second mating face.

According to the above turbine housing, the exhaust gas that leaks from the gas passage onto the second mating face is blown onto the outer periphery of the pipe almost at a right angle. Thus, the flow of exhaust gas is less likely to be directed toward the first mating face and is therefore unlikely to reach the first mating face. Thus, the first seal member on the first mating face can be suitably prevented from being exposed to high-temperature exhaust gas.

BRIEF DESCRIPTION OF THE DRAWINGS

Features, advantages, and technical and industrial significance of exemplary embodiments of the invention will be described below with reference to the accompanying drawings, in which like numerals denote like elements, and wherein:

FIG. **1** is a cross-sectional view that schematically illustrates a cross-sectional structure of a turbocharger to which a turbine housing according to one embodiment which embodies the present invention is applied;

FIG. **2** is a schematic diagram that illustrates the manner in which coolant is circulated in an internal combustion engine and the turbine housing;

FIG. **3** is a perspective view that illustrates a perspective structure of the turbine housing;

FIG. **4** is a side view that illustrates a side structure of a joint part of the turbine housing as seen in the direction of arrow **4** in FIG. **3**;

FIG. **5** is a side view that illustrates a side structure of the joint part of the turbine housing as seen in the direction of arrow **5** in FIG. **3**; and

FIG. **6** is a cross-sectional view that illustrates the cross-sectional structure of joint parts and surrounding portions along a direction in which the gas passage and water passage extend.

DETAILED DESCRIPTION OF EMBODIMENTS

Description is hereinafter made of a turbine housing according to one embodiment that embodies the present invention. As shown in FIG. **1**, a turbocharger **11** includes a compressor **20** that is installed in an intake passage **12** of an internal combustion engine **10**, a turbine **30** that is installed in an exhaust passage **13** of the internal combustion engine **10**, and a center housing **41** that couples the compressor **20** and the turbine **30**.

A compressor housing **21** defines a compressor chamber **22**, and a compressor wheel **23** is housed in the compressor chamber **22**. A turbine housing **31** defines a turbine chamber **32**, and a turbine wheel **33** is housed in the turbine chamber **32**. A shaft **42** is rotatably supported by the center housing **41**. The compressor wheel **23** is secured to one end of the shaft **42**, and the turbine wheel **33** is secured to the other end of the shaft **42**. The turbocharger **11** is constructed such that the compressor wheel **23** and the turbine wheel **33** rotate together.

The compressor chamber **22** extends along the rotation axis L1 of the compressor wheel **23**. A scroll passage **24** that extends spirally around the compressor wheel **23** is formed in the compressor housing **21**.

The turbine chamber **32** extends along the rotation axis L1 of the turbine wheel **33**. A scroll passage **34** that extends spirally around the turbine wheel **33** is formed in the turbine housing **31**. In this embodiment, the turbine chamber **32** and the scroll passage **34** function as a gas passage **35** through which exhaust gas flows.

The turbocharger **11** supercharges the internal combustion engine **10** as described below. When the exhaust gas from the internal combustion engine **10** is blown onto the turbine wheel **33** through the scroll passage **34**, the turbine wheel **33** is rotated by the energy of the exhaust gas stream. Then, the rotation of the turbine wheel **33** is transmitted to the compressor wheel **23** via the shaft **42** and rotates the compressor wheel **23**. Then, in the compressor **20**, the intake air that flows into the compressor chamber **22** through an inlet **20**A of the compressor **20** is fed to the scroll passage **24** then to each cylinder of the internal combustion engine **10** by the effect of the centrifugal force from the rotation of the compressor wheel **23**. The internal combustion engine **10** uses the energy of exhaust gas to supercharge the intake air to improve the engine output.

As shown in FIG. **1** or FIG. **2**, a water-cooled turbocharger in which a water passage **36** which allows coolant flow through the turbine housing **31** is formed is adopted as the turbocharger **11**. A portion of the coolant that is used to cool the internal combustion engine **10** is supplied to the water passage **36** when the internal combustion engine **10** is being operated.

The water passage **36** opens at a joint part **51** on the side from which exhaust gas is introduced into the scroll passage **34** (exhaust gas-introducing side) in the turbine housing **31**. The joint part **51** is secured by bolts to a joint part **16** of a cylinder head **14** of the internal combustion engine **10** at which a water jacket **15** opens. Thus, the water passage **36** of the turbine housing **31** is communicated with the water jacket **15** of the internal combustion engine **10**.

When the internal combustion engine **10** is started and a water pump **17** is driven, the coolant that is delivered under pressure by the water pump **17** is circulated through the coolant passage including the water jacket **15**, the water passage **36** and a radiator **18** as indicated by arrows in FIG. **2**. The internal combustion engine **10** and the turbocharger **11** are cooled by the circulation of the coolant.

A metal seal member that prevents leakage of exhaust gas from the gas passage **35** and a rubber O-ring that prevent leakage of coolant from the water passage **36** are provided between the joint part **51** of the turbine housing **31** and the joint part **16** of the cylinder head **14**. In this embodiment, a tiny amount of exhaust gas may leak from the gas passage **35** into a gap between the mating faces of the joint parts **16** and **51** in spite of the presence of the seal member. When the leaking exhaust gas is blown onto the O-ring, the high-temperature exhaust gas may cause thermal degradation of the O-ring, resulting in a deterioration of the sealing performance of the O-ring.

In view of this point, a structure is employed in this embodiment which can reduce the possibility that the exhaust gas that leaks into the gap between the mating faces of the joint part **51** of the turbine housing **31** and the joint part **16** of the cylinder head **14** is blown onto the O-ring. The structure is described in detail below.

As shown in FIG. **3** to FIG. **5**, the water passage **36** and the gas passage **35**, which are formed in the turbine housing **31**, are arranged adjacent to each other (in a side-by-side manner) in the exhaust gas-introducing side joint part **51** of the turbine housing **31**. Also, an exhaust gas-introducing side end **35**A of the gas passage **35**, a water introduction port **36**A through which coolant is introduced into the water passage **36** and a water discharge port **36**B through which coolant is discharged from the water passage **36** open at the joint part **51**.

In addition, a mating face **52** in which the water introduction port **36**A of the water passage **36** open and a mating face **53** in which the end **35**A of the gas passage **35** open are both formed in a planar shape and do not connect smoothly to each other in the joint part **51**. Specifically, the joint part **51** is formed in a stepwise configuration with the mating face **52** protruding relative to the mating face **53**. Thus, because a face that extends in a direction across (in this embodiment, normal to) the mating faces **52** and **53** is formed between the mating faces **52** and **53**, the mating faces **52** and **53** do not connect smoothly to each other. In other words, a part where the surface curvature changes more significantly than in the adjacent areas is formed between the mating faces **52** and **53**.

In the joint part **51** of the turbine housing **31**, a pipe **54** that forms a part of the water discharge port **36**B of the water passage **36** is also located on the opposite side of the mating face **52** with respect to the mating face **53** and extends in a direction normal to the mating face **53**. The pipe **54** protrudes in such a location that a gap is formed between its outer periphery and the mating face **53**.

The effect of forming the joint part **51** of the turbine housing **31** in the shape as described above is described below. FIG. **6** shows a cross-sectional view that illustrates the cross-sectional structure of the joint parts **16** and **51** and surrounding portions along a direction in which the gas passage **35** and the water passage **36** extend.

As shown in FIG. **4** to FIG. **6**, the water introduction port **36**A and the water discharge port **36**B of the water passage **36** and the gas passage **35** are arranged side-by-side in the exhaust gas-introducing side joint part **51** of the turbine housing **31**. In addition, the water introduction port **36**A and the water discharge port **36**B of the water passage **36** and the gas passage **35** open at the joint part **51**. In addition, in the joint part **16** of the cylinder head **14**, the water jacket **15** opens at a location corresponding to the opening of the water introduction port **36**A, and a connecting port **16**A into which the pipe **54** can be inserted and which is communicated with the water jacket **15** is formed at a location corresponding to the pipe **54** as shown in FIG. **6**. The exhaust passage **13** also opens at a location corresponding to the opening of the gas passage **35** in the joint part **16**.

Thus, the gas passage **35** can be connected to the exhaust passage **13** and the water introduction port **36**A and the water discharge port **36**B of the water passage **36** can be connected to the water jacket **15** through the operation of securing the joint part **51** of the turbine housing **31** to the joint part **16** of the cylinder head **14** with the distal end of the pipe **54** inserted into the connecting port **16**A of the cylinder head **14**. This is a structure that enables the turbine housing **31**, therefore the turbocharger **11**, to be attached easily.

As shown in FIG. **6**, the turbine housing **31** is attached to the cylinder head **14** with one metal seal member **55** and two rubber O-rings **56** and **57** interposed between the joint part **51** of the turbine housing **31** and the joint part **16** of the cylinder head **14**. The seal member **55** is provided between the mating face **53** of the turbine housing **31** and the joint part **16** of the cylinder head **14** to prevent leakage of exhaust gas from the gas passage **35**. The O-ring **56** is provided between the mating face **52** of the turbine housing **31** and the joint part **16** of the cylinder head **14** to prevent leakage of coolant from the water introduction port **36**A of the water passage **36**. The O-ring **57** is provided between the pipe **54** of the turbine housing **31** and the connecting port **16**A of the cylinder head **14** to prevent leakage of coolant from the water discharge port **36**B of the water passage **36**.

In this embodiment, the mating face **52** of the turbine housing **31** and the outer periphery of a distal end portion (specifically, the part which is inserted into the connecting port **16**A of the cylinder head **14**) of the pipe **54** both function as a first mating face, and the O-rings **56** and **57** both function as a first seal member. In this embodiment, the mating face **53** of the turbine housing **31** functions as a second mating face, and the seal member **55** functions as a second seal member.

In addition, the joint part **51** of the turbine housing **31** has a third face normal to the mating faces **52** and **53** between the mating faces **52** and **53**, and the mating faces **52** and **53** and the third face form a shape that is bent at two portions between an opening of the water passage **36** and an opening of the gas passage **35**. The bent shape is a stepwise configuration with the mating face **52** protruding from the mating face **53**. Further, the portions of the joint part **16** of the cylinder head **14** to which the mating faces **52** and **53** are connected also form generally the same stepwise configuration as the mating faces **52** and **53** and the third face do. Thus, the gap between the joint part **16** of the cylinder head **14** and the joint part **51** of the turbine housing **31** is bent in a stepwise fashion. Therefore, the flow of exhaust gas that leaks from the gas passage **35** onto the mating face **53** and travels toward the mating face **52** (the flow indicated by arrows A in FIG. **5** and FIG. **6**) is less likely to reach the mating face **52** because it is blocked by the portion between the mating faces **52** and **53** (or the bent shape). Thus, the turbine housing **31** has a structure in which the exhaust gas that leaks from the gas passage **35** onto the mating face **53** is less likely to reach the mating face **52** compared to the case where the water passage and the gas passage open in the same face. This is a structure in which deterioration of the sealing performance of the water introduction port **36**A of the water passage **36** that is caused by exposure of the O-ring **56** on the mating face **52** to high-temperature exhaust gas is less likely to occur.

In addition, in the turbine housing **31**, the exhaust gas that leaks from the gas passage **35** onto the mating face **53** is blown onto the outer periphery of the pipe **54** as indicated by arrow B in FIG. **5** and FIG. **6** because the pipe **54** is located at a distance from the mating face **53** and extends in a direction normal to the mating face **53**. Especially, the turbine housing **31** has a structure in which the exhaust gas that leaks onto the mating face **53** is less likely to be directed toward the gap between the pipe **54** and the connecting port **16**A and is therefore unlikely to flow into the gap compared to the case where the direction in which the gap between the pipe **54** and the connecting port **16**A extends form a dull angle with the direction in which the exhaust gas is blown onto the outer periphery of the pipe **54** because the exhaust gas is blown onto the outer periphery of the pipe **54** almost at a right angle. Thus, the turbine housing **31** has a structure in which the exhaust gas that leaks from the gas passage **35** onto the mating face **53** is less likely to flow into the gap between the pipe **54** and the connecting port **16**A compared to the case where the water discharge port and the gas passage open in the same face. This is a structure in which deterioration of the sealing performance of the O-ring **57** in the gap between the pipe **54** and the connecting port **16**A that is caused by exposure of the O-ring **57** to high-temperature exhaust gas is less likely to occur.

As described above, this embodiment provides the following advantages. (1) The gas passage **35** and the water introduction port **36**A of the water passage **36** are arranged adjacent to each other in the joint part **51** of the turbine housing **31**, and a third face is formed between the mating face **52**, in which the water introduction port **36**A opens, and the mating face **53**, in which the gas passage **35** opens. The mating faces **52** and **53** and the third face form the above bent shape. Thus, the turbine housing **31** has a structure that enables it to be attached easily. In addition, this is a structure in which deterioration of the sealing performance of the water introduction port **36**A of the water passage **36** that is caused by exposure of the O-ring **56** on the mating face **52** to high-temperature exhaust gas is less likely to occur.

(2) The joint part **51** of the turbine housing **31** is formed to have a stepwise configuration with the mating face **52**, in which the water introduction port **36**A opens, protruding relative to the mating face **53**, in which the gas passage **35** opens. Thus, a portion having the above bent shape can be formed between the mating faces **52** and **53**. Alternatively, the mating faces **52** and **53** and the face between the mating faces **52** and **53** can form the above bent shape.

(3) The gas passage **35** and the water discharge port **36**B of the water passage **36** are arranged adjacent to each other in the joint part **51** of the turbine housing **31**, and the pipe **54**, which constitutes a part of the water discharge port **36**B, protrudes in a direction across the mating face **53**, in which the gas passage **35** opens. Thus, the turbine housing **31** has a structure that enables it to be attached easily. In addition, this is a structure in which deterioration of the sealing performance of the water discharge port **36**B of the water passage **36** that is caused by exposure of the O-ring **57** in the gap between the pipe **54** and the connecting port **16**A of the cylinder head **14** to high-temperature exhaust gas is less likely to occur.

(4) The mating face **53** of the turbine housing **31** is formed to have a planar shape and the pipe **54** extends in a direction normal to the mating face **53**. This is a structure in which exhaust gas is less likely to flow into the gap between the pipe **54** and the connecting port **16**A.

The above embodiment may be implemented with any of the following modifications. The mating face **52**, in which the water introduction port **36**A of the water passage **36** opens, and the mating face **53**, in which the gas passage **35** opens, may be partially or entirely curved slightly.

The pipe **54** does not necessarily have to extend normal to the mating face **53** and may extend in any direction across the mating face **53**. The joint part **51** of the turbine housing **31** may be formed in a stepwise configuration such that the mating face in which the gas passage **35** open protrudes relative to the mating face in which the water introduction port **36**A open.

A structure in which a pipe extends in a direction across the mating face **53**, in which the gas passage **35** open, and the pipe constitutes a part of the water introduction port **36**A may be adopted instead of the structure in which the water introduction port **36**A opens in the planar mating face **52**. With this structure, the turbine housing is attached to the internal combustion engine with the end of the pipe inserted into the connecting port of the internal combustion engine and a rubber O-ring is provided between the outer periphery of a distal end portion of the pipe and the inner periphery of the connecting port of the internal combustion engine.

A structure in which the water discharge port **36**B opens in a planar mating face of the turbine housing **31** may be adopted instead of the structure in which the pipe **54**, which extends in a direction across the mating face **53**, in which the gas passage **35** open, constitutes a part of the water discharge port **36**B. With this configuration, the joint part of the turbine housing is formed in a stepwise configuration with one of the mating faces in which the pipe **54** and the water discharge port **36**B open protruding relative to the other of the mating faces.

Only one of the water introduction port **36**A and water discharge port **36**B of the water passage **36** may be formed in the joint part **51** of the turbine housing **31**.

The invention claimed is:

1. A turbine housing, comprising:

a water passage provided in the turbine housing, the water passage, through which coolant flows, being connected to a water jacket of an internal combustion engine,

a gas passage provided in the turbine housing, the gas passage, through which exhaust gas flows, being connected to an exhaust passage of the internal combustion engine,

the gas passage and the water passage both extend to open in the part that will be connected to the internal combustion engine,

a joint part provided at a gas-introducing side of the turbine housing, the joint part having a first mating face in which the water passage opens and a single second mating face in which the gas passage opens, the water passage and the gas passage being arranged adjacent to each other in the joint part, and the second mating face not connecting smoothly to the first mating face,

a first seal member interposed between the first mating face and the internal combustion engine to prevent coolant from leaking, and

a second seal member interposed between the second mating face and the internal combustion engine to prevent exhaust gas from leaking, wherein

the water passage and the gas passage are arranged in a side-by-side manner in the exhaust gas-introducing side joint part, and the water passage and the gas passage both open at the joint part,

the first mating face, the second mating face, and a connection portion that connects the first mating face to the second mating face form a shape that is bent at one or more portions between an opening of the water passage and an opening of the gas passage, and

the bent shape is a shape where one of the first mating face and the second mating face protrudes relative to the other of the first mating face and the second mating face, whereby a gap between the joint part of the turbine housing and a joint part of a cylinder head defines a predominantly stepwise shape, so as to block a flow of exhaust gas travelling toward the first mating face.

2. The turbine housing according to claim **1**, wherein

the joint part has a pipe that extends in a direction across the second mating face, the pipe constitutes a part of the water passage, and

the first mating face is an outer periphery of a distal end portion of the pipe.

3. The turbine housing according to claim **2**, wherein the second mating face is planar, and

the pipe extends in a direction normal to the second mating face.

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