

Description

{Technical Field}

[0001] The present invention relates to a turbine.

{Background Art}

[0002] In order to improve the output power of an internal combustion engine, various turbochargers are used. This turbocharger is configured such that a turbine and a compressor are coaxially mounted, and has a function of compressing air supplied to an internal combustion engine at high density by driving the compressor with exhaust gas of the internal combustion engine introduced on a turbine side as an energy source.

[0003] Moving blades provided in this turbine may interfere with other components that configure the turbocharger, thereby sometimes causing breakage. Japanese Unexamined Patent Application, Publication No. 2003-3804 discloses an axial flow turbine for an exhaust driven turbocharger formed such that fragments of a broken turbine disk do not scatter out from a turbine chamber even at a very high circumferential speed, when the turbine disk is broken.

[0004] Japanese Unexamined Patent Application, Publication No. Hei10-47012 discloses an exhaust gas turbine for an exhaust gas turbosupercharger in which easy and reliable fixing of a nozzle ring is guaranteed. In the exhaust gas turbine, the nozzle ring has an outer ring which is in contact with a cover ring, and an inner ring which is in contact with a gas inlet casing, an axial expansion gap is formed between the outer ring and the gas inlet casing, and a radial expansion gap is formed between the outer ring and a gas outlet casing.

{Citation List}

{Patent Literature}

[0005]

{PTL 1}

Japanese Unexamined Patent Application, Publication No. 2003-3804

{PTL 2}

Japanese Unexamined Patent Application, Publication No. Hei10-47012

{Summary of Invention}

{Technical Problem}

[0006] Such a turbocharger is desired to stably supply compressed combustion air to an internal combustion engine. Therefore, in a turbine, moving blades are desired to be prevented from interfering with other components.

[0007] An object of the present invention is to provide a turbine in which moving blades are prevented from interfering with other components at startup.

[0008] Another object of the present invention is to provide a turbine in which moving blades are prevented from interfering with other components at stop.

{Solution to Problem}

[0009] A turbine according to a first aspect of the present invention has a moving blade, and a gas outlet guide arranged outside the moving blade in a turbine radial direction, and generates rotation power by using exhaust gas. The gas outlet guide includes a gas outlet diffuser, and a shroud ring. A clearance is formed between the gas outlet diffuser and the shroud ring. The shroud ring includes a cylindrical portion formed with a cylindrical surface that faces the moving blade, a flange portion that projects from the cylindrical portion to a side far from the moving blade, and a hooking portion that protrudes from the flange portion. The gas outlet diffuser is formed with a hooking surface that faces the hooking portion.

[0010] In such a turbine, when the moving blade, the gas outlet diffuser, and the shroud ring are heated, the temperature of the shroud ring rises more quickly than that of the gas outlet diffuser, and the shroud ring expands such that the clearance becomes narrow. In such a turbine, the shroud ring expands more quickly than the gas outlet diffuser, so that the moving blade can be prevented from coming into contact with the shroud ring. Furthermore, in such a turbine, when the moving blade and the shroud ring are cooled, the hooking portion is hooked on the gas outlet diffuser, so that the shroud ring is prevented from contracting more quickly than the moving blade, and the shroud ring is prevented from coming into contact with the moving blade.

[0011] The hooking portion may be formed from a plurality of projections arranged along a circumference having a rotation axis of the moving blade as the center.

[0012] Such plurality of projections can be more easily produced compared to other hooking portion that is annularly formed along the circumference having the rotation axis of the moving blade as the center.

[0013] The turbine according to the present invention may further include a support member configured to support the flange portion on the gas outlet diffuser.

[0014] In such a turbine, the shroud ring can be prevented from coming off from the gas outlet diffuser, and more reliably arranged at a predetermined position.

[0015] A turbocharger according to a second aspect of the present invention includes the turbine according to the first aspect, and a compressor configured to generate combustion air by compressing air by using rotation power of the turbine. In such a turbocharger, the moving blade generated by the turbine is prevented from coming into contact with the shroud ring, so that combustion air can be stably generated.

[0016] A vessel according to a third aspect of the present invention includes the turbocharger according to the second aspect, an internal combustion engine configured to generate power by using combustion air; a hull equipped with the turbocharger and the internal combustion engine; and a propulsion unit configured to propel the hull by using the power.

[0017] In such a vessel, the turbocharger stably supplies combustion air to the internal combustion engine, so that the internal combustion engine can stably generate power and the vessel can stably sail.

{Advantageous Effects of Invention}

[0018] In a turbine according to the present invention, a moving blade can be prevented from interfering with other components.

{Brief Description of Drawings}

[0019]

{Fig. 1}

Fig. 1 is a partial cross section configuration diagram showing a turbocharger utilizing an axial flow turbine.

{Fig. 2}

Fig. 2 is a sectional view of a gas outlet guide.

{Fig. 3}

Fig. 3 is a graph showing the temperature change of exhaust gas and the position change of tips of turbine blades, and showing the position change of the inner diameter of a shroud ring.

{Fig. 4}

Fig. 4 is a sectional view showing a gas outlet guide of Comparative Example.

{Fig. 5}

Fig. 5 is a graph showing the position change of the inner diameter of a shroud ring of Comparative Example.

{Description of Embodiments}

[0020] Hereinafter, a turbocharger (also referred to as an "exhaust gas turbocharger") having a turbine according to a first embodiment of the present invention will be described with reference to Fig. 1. Fig. 1 is a partial cross section configuration diagram showing a turbocharger having a turbine. The turbocharger includes an axial flow type axial flow turbine 10, and a compressor 20, and is configured such that compressed air compressed at high density is supplied to an internal combustion engine by rotating the coaxial compressor 20 with the shaft output power obtained by expanding exhaust gas of the internal combustion engine introduced in the axial flow turbine 10.

[0021] The axial flow turbine 10 includes a rotor shaft 1, a rotor disk 2, and moving blades 3. The rotor shaft 1 is formed in a bar shape, and rotatably supported about a rotation axis 5. The rotor disk 2 is formed in a substan-

tially disk shape. The center of the disk is joined to an end of the rotor shaft 1, so that the rotor disk 2 is fixed to the rotor shaft 1, and rotatably supported about the rotation axis 5. The moving blades 3 have a wing profile, and are formed at a plurality of places. Respective blade roots of the moving blades 3 are joined to the outer periphery of the rotor disk 2, so that the moving blades 3 are fixed to the rotor shaft 1 and rotatably supported about the rotation axis 5.

[0022] The axial flow turbine 10 further includes a gas inlet casing 6 and a gas outlet casing 7. The gas inlet casing 6 is arranged on the side opposite to the rotor shaft 1 with respect to the rotor disk 2, namely, the rotor disk 2 is arranged between the gas inlet casing 6 and the rotor shaft 1. The gas inlet casing 6 includes an outer casing 11, an inner casing 12, and a nozzle ring 14.

[0023] The outer casing 11 is formed in a substantially hollow tubular shape. The outer casing 11 is formed with an exhaust gas inlet flow passage 15 beside the tube. The inner casing 12 is formed in a substantially tubular shape, and arranged inside the outer casing 11.

[0024] The gas inlet casing 6 is further formed with an annular gas passage 18. The annular gas passage 18 is formed between the inner casing 12 and the outer casing 11, and is annularly formed so as to surround the rotation axis 5. The annular gas passage 18 is connected to the exhaust gas inlet flow passage 15.

[0025] The nozzle ring 14 is annularly formed. The nozzle ring 14 is arranged on the side opposite to the rotor shaft 1 with respect to the moving blades 3, namely, the moving blades 3 are arranged between the nozzle ring 14 and the rotor shaft 1. The nozzle ring 14 includes an outer peripheral side member 21 and an inner peripheral side member 22. The outer peripheral side member 21 is formed in a tubular shape. The inner peripheral side member 22 is formed in a tubular shape having a diameter smaller than the outer peripheral side member 21, and arranged inside the outer peripheral side member 21. The inner peripheral side member 22 is joined to the inner casing 12, so that the nozzle ring 14 is fixed to the gas inlet casing 6. The nozzle ring 14 forms an annular nozzle that surrounds the rotation axis 5.

[0026] The gas outlet casing 7 is formed in a hollow shape. The gas outlet casing 7 is joined to an end, close to the moving blades 3, of the outer casing 11 such that an inner space is connected to the annular gas passage 18 and the annular gas passage 18 formed by the gas inlet casing 6 via the moving blades 3. The gas outlet casing 7 includes a gas outlet guide 61. The gas outlet guide 61 is formed in a substantially tubular shape, and arranged inside the gas outlet casing 7. The gas outlet guide 61 is formed such that the diameter of a certain part of the tube is larger than the diameter of a part, closer to the moving blades 3 than the certain part, of the tube.

[0027] Heat insulating materials 4 are placed for the purposes of insulation and soundproofing.

[0028] As shown in Fig. 2, the gas outlet guide 61 includes a gas outlet diffuser 62, a shroud ring 63, and a

bolt 64. The gas outlet diffuser 62 forms most part of the gas outlet guide 61. The gas outlet diffuser 62 is formed with a mounting surface 65, a female screw 66, and a hooking surface 67. The mounting surface 65 is formed in an end, close to the gas inlet casing 6, of the gas outlet diffuser 62, and is formed along a plane perpendicular to the rotation axis 5. The female screw 66 is formed in the mounting surface 65. The hooking surface 67 is formed near the mounting surface 65. The hooking surface 67 is formed on a circumferential surface with the rotation axis 5 as the center.

[0029] The shroud ring 63 is formed from carbon steel, and formed in a substantially tubular shape by machining. The mass of the shroud ring 63 is smaller than the mass of the gas outlet diffuser 62. Therefore, the heat capacity of the shroud ring 63 is smaller than the heat capacity of the gas outlet diffuser 62. The shroud ring 63 includes a cylindrical portion 68, a flange portion 69, and a hooking portion 70. The cylindrical portion 68 is formed in a substantially tubular shape, and formed with an inner surface 71 inside the tube. The cylindrical portion 68 is arranged such that the inner surface 71 of the tube faces the moving blades 3, and the inner surface 71 is separated from the blade tips 44 of the moving blades 3 by a predetermined distance. Furthermore, the cylindrical portion 68 is arranged such that a clearance 72 is formed between the cylindrical portion 68 and the gas outlet diffuser 62.

[0030] The flange portion 69 is formed so as to project from an end of the cylindrical portion 68 to the outside along the plane perpendicular to the rotation axis 5. The flange portion 69 is formed with a through hole 73. The bolt 64 passes through the through hole 73 of the flange portion 69, to be fastened to the female screw 66 of the gas outlet diffuser 62. The bolt 64 is fastened to the female screw 66 of the gas outlet diffuser 62, so that the flange portion 69 is supported on the gas outlet diffuser 62. The shroud ring 63 is supported on the gas outlet diffuser 62 with the bolt 64, so that the shroud ring 63 is prevented from coming off from the gas outlet diffuser 62, thereby enabling more reliable arrangement at a predetermined position. At this time, the bolt 64 loosely supports the shroud ring 63 on the gas outlet diffuser 62 such that the size of the clearance 72 can be changed.

[0031] The hooking portion 70 is formed in a substantially tubular shape, and is formed so as to project from the outer edge in the turbine radial direction of the flange portion 69 to the side close to the gas outlet diffuser 62. At this time, the shroud ring 63 is arranged such that the hooking surface 67 of the gas outlet diffuser 62 faces the hooking portion 70, namely, such that the hooking surface 67 of the gas outlet diffuser 62 is arranged between the hooking portion 70 and the rotation axis 5.

[0032] The compressor 20 includes a movable part, and a fixing part. The movable part is rotatably supported by the fixing part about the rotation axis 5, and fixed to the rotor shaft 1. When the movable part rotates about the rotation axis 5, the compressor 20 compresses air by using rotation power generated by the axial flow tur-

bine 10, to generate combustion air.

[0033] The turbocharger is utilized in an internal combustion engine (not shown). That is, the internal combustion engine burns fuel by using combustion air generated by the turbocharger, to generate power. The internal combustion engine further generates exhaust gas by burning the fuel, to supply the exhaust gas to the exhaust gas inlet flow passage 15 of the axial flow turbine 10.

[0034] The internal combustion engine is used in a vessel. The vessel includes the internal combustion engine, the turbocharger, a hull, and a propulsion unit. The hull is equipped with the internal combustion engine, and the turbocharger. The propulsion unit propels the hull by using power generated by the internal combustion engine.

[0035] The operation of the turbine mainly includes three operation modes, namely, a startup operation, a normal operation, and a stop operation.

[0036] The startup operation is started by guiding exhaust gas exhausted by the internal combustion engine to a turbine part. At this time, the moving blades 3 and the gas outlet guide 61 each are sufficiently at a low temperature, and more specifically, are at a temperature of the same degree as an outdoor temperature.

[0037] When the moving blades 3 and the gas outlet guide 61 each are at a low temperature, the internal combustion engine generates exhaust gas by burning fuel, to supply the exhaust gas to the exhaust gas inlet flow passage 15. The exhaust gas is supplied from the internal combustion engine to the exhaust gas inlet flow passage 15, so that the exhaust gas inlet flow passage 15 supplies the exhaust gas to the annular gas passage 18. The exhaust gas is supplied from the exhaust gas inlet flow passage 15 to the annular gas passage 18, so that the annular gas passage 18 supplies the exhaust gas to the nozzle ring 14. The exhaust gas is supplied from the annular gas passage 18 to the nozzle ring 14, so that the nozzle ring 14 jets the exhaust gas to the moving blades 3.

[0038] The nozzle ring 14 jets the exhaust gas, so that the moving blades 3 rotate about the rotation axis 5, to rotate the rotor shaft 1 about the rotation axis 5 via the rotor disk 2. That is, the exhaust gas is supplied from the internal combustion engine, so that the axial flow turbine 10 generates rotation power. When the rotor shaft 1 rotates about the rotation axis 5, the compressor 20 of the turbocharger compresses air by using the rotation power generated by the axial flow turbine 10, to supply the compressed combustion air to the internal combustion engine. The internal combustion engine burns the fuel by using the combustion air.

[0039] At this time, the moving blades 3 come into contact with the exhaust gas jetted from the nozzle ring 14 to be heated, and the blade tips 44 expand so as to go away from the rotation axis 5. The exhaust gas is jetted from the nozzle ring 14, so that the gas outlet diffuser 62 is heated and expands. At this time, the heat capacity of the gas outlet diffuser 62 is larger than the heat capacity of the moving blades 3, so that the gas outlet diffuser 62

is heated more slowly than the moving blades 3, and expands more slowly than the moving blades 3.

[0040] The exhaust gas is jetted from the nozzle ring 14, so that the shroud ring 63 is heated. At this time, the heat capacity of the shroud ring 63 is smaller than the heat capacity of the gas outlet diffuser 62, so that the shroud ring 63 is heated more quickly than the gas outlet diffuser 62. The shroud ring 63 is expanded by being heated. The shroud ring 63 is loosely supported on the gas outlet diffuser 62, and the clearance 72 is formed between the gas outlet diffuser 62 and the shroud ring 63, so that the gas outlet diffuser 62 does not hinder the expansion, and expands such that the clearance 72 becomes smaller.

[0041] A temperature difference between the shroud ring 63 and the gas outlet diffuser 62 gradually reduces during the startup operation. Operation in a steady state, in which this temperature difference does not change, is defined as a normal operation. That is, the normal operation is started, after the temperatures of the moving blades 3 and the gas outlet guide 61 sufficiently rise up to a predetermined temperature after the startup operation is performed. The internal combustion engine burns fuel to generate power, and supplies rotation power to an external apparatus. Furthermore, the internal combustion engine exhausts exhaust gas to supply the exhaust gas to the turbocharger.

[0042] In the axial flow turbine 10, the exhaust gas inlet flow passage 15 supplies the exhaust gas supplied from the internal combustion engine to the turbocharger, to the annular gas passage 18. The exhaust gas is supplied from the exhaust gas inlet flow passage 15 to the annular gas passage 18, so that the annular gas passage 18 supplies the exhaust gas to the nozzle ring 14. The exhaust gas is supplied from the annular gas passage 18 to the nozzle ring 14, so that the nozzle ring 14 jets the exhaust gas to the moving blades 3.

[0043] The nozzle ring 14 jets the exhaust gas to the moving blades 3, so that the moving blades 3 rotates about the rotation axis 5, to rotate the rotor shaft 1 about the rotation axis 5 via the rotor disk 2. That is, the axial flow turbine 10 generates rotation power by using the exhaust gas exhausted from the internal combustion engine. The compressor 20 compresses air by using the rotation power generated by the axial flow turbine 10, to supply the compressed combustion air to the internal combustion engine. The internal combustion engine burns the fuel by using the combustion air compressed by the compressor 20, to generate exhaust gas, thereby generating predetermined power.

[0044] The stop operation is started right after the normal operation ends. For example, the internal combustion engine is stopped, thereby starting the stop operation starts. In the stop operation, in the axial flow turbine 10, the exhaust gas inlet flow passage 15 supplies the exhaust gas supplied from the internal combustion engine to the turbocharger, to the annular gas passage 18. The exhaust gas is supplied from the exhaust gas inlet flow

passage 15, so that the annular gas passage 18 supplies the exhaust gas to the nozzle ring 14. The exhaust gas is supplied from the annular gas passage 18, so that the nozzle ring 14 jets the exhaust gas to the moving blades 3.

[0045] In a period during which the stop operation is performed, the amount of exhaust gas flown into the turbine part is reduced, and an ambient temperature inside the turbine part falls. At this time, the ambient temperature inside the turbine part falls, and therefore the moving blades 3 are cooled, and contract such that the blade tips 44 approach the rotation axis 5. The gas outlet diffuser 62 is cooled and contracts with the falling of the ambient temperature inside the turbine part. At this time, the heat capacity of the gas outlet diffuser 62 is relatively large, so that the gas outlet diffuser 62 is relatively slowly cooled, and relatively slowly contracts.

[0046] The shroud ring 63 is cooled with the falling of the ambient temperature inside the turbine part. At this time, the heat capacity of the shroud ring 63 is smaller than the heat capacity of the gas outlet diffuser 62, so that the shroud ring 63 is cooled more quickly than the gas outlet diffuser 62. The shroud ring 63 contracts by being cooled. At this time, the shroud ring 63 is loosely supported on the gas outlet diffuser 62, so that the shroud ring 63 contracts such that the inner surface 71 approaches the rotation axis 5. The heat capacity of the gas outlet diffuser 62 is larger than the heat capacity of the shroud ring 63, so that the gas outlet diffuser 62 is cooled more slowly than the shroud ring 63, and contracts more slowly than the shroud ring 63. At this time, the hooking portion 70 is hooked on the hooking surface 67 of the gas outlet diffuser 62, so that the shroud ring 63 is hindered from contracting such that the inner surface 71 approaches the rotation axis 5 in the turbine radial direction.

[0047] Fig. 3 shows the change of the ambient temperature inside the turbine part. The turbine part inside temperature change 51 shows that the ambient temperature inside the turbine part rises over time during the startup operation. The turbine part inside temperature change 51 further shows that the ambient temperature inside the turbine part does not largely change but is kept substantially constant during the normal operation. The turbine part inside temperature change 51 further shows that the ambient temperature inside the turbine part falls during the stop operation.

[0048] Fig. 3 further shows the change of the positions of the blade tips 44 of the moving blades 3. The blade tip position change 52 shows that the blade tips 44 move to the side far from the rotation axis 5 over time during the startup operation. That is, the blade tip position change 52 shows that when the ambient temperature inside the turbine part rises, the temperatures of the moving blades 3 rise over time, so that the moving blades 3 expand over time.

[0049] The blade tip position change 52 further shows that the blade tips 44 do not largely move over time during the normal operation. That is, the blade tip position

change 52 shows that when the ambient temperature inside the turbine part is kept constant, the temperatures of the moving blades 3 do not largely change, and the moving blades 3 do not largely expand or contract.

[0050] The blade tip position change 52 further shows that the blade tips 44 move to the side close to the rotation axis 5 over time during the stop operation. That is, the blade tip position change 52 shows that when the ambient temperature inside the turbine part falls, the temperatures of the moving blades 3 fall, so that the moving blades 3 contract.

[0051] Fig. 3 further shows the change of the position of the inner surface 71 of the shroud ring 63. The inner surface position change 81 shows that the inner surface 71 moves to the side far from the rotation axis 5 over time during the startup operation. That is, the inner surface position change 81 shows that when the ambient temperature inside the turbine part rises, the temperature of the shroud ring 63 rises, so that the shroud ring 63 expands.

[0052] The inner surface position change 81 further shows that when the position of the inner surface 71 does not largely change and is kept constant during the normal operation. That is, the inner surface position change 81 shows that when the ambient temperature inside the turbine part is substantially kept constant, the temperature of the shroud ring 63 does not largely change, and the shroud ring 63 does not largely expand or contract.

[0053] The inner surface position change 81 further shows that when the inner surface 71 moves to the side close to the rotation axis 5 over time during the stop operation. That is, the inner surface position change 81 shows that when the ambient temperature inside the turbine part falls, the temperature of the shroud ring 63 falls, so that the shroud ring 63 contracts.

[0054] The blade tip position change 52 and the inner surface position change 81 show that the inner surface 71 of the shroud ring 63 moves more slowly than the blade tips 44 of the moving blades 3 during the stop operation. The blade tip position change 52 and the inner surface position change 81 further show that the blade tips 44 of the moving blades 3 are not in contact with the inner surface 71 of the shroud ring 63 during the stop operation.

[0055] In the axial flow turbine 10, as shown by the blade tip position change 52 and the inner surface position change 81, the clearance 72 is formed between the gas outlet diffuser 62 and the shroud ring 63, so that the moving blades 3 can be prevented from coming into contact with the inner surface 71 of the shroud ring 63 during the startup operation or the normal operation. That is, the clearance 72 is formed to be sufficiently large, such that the gas outlet diffuser 62 does not hinder the expansion of the shroud ring 63, and such that the moving blades 3 do not come into contact with the inner surface 71 of the shroud ring 63, during the startup operation or the normal operation.

[0056] Fig. 4 shows a gas outlet guide of Comparative

Example. In a gas outlet guide 131 of Comparative Example, the hooking portion 70 of the shroud ring 63 of the gas outlet guide 61, which is already described, is omitted. That is, the gas outlet guide 131 of Comparative Example includes a gas outlet diffuser 133, a shroud ring 134, and a bolt 135. The gas outlet diffuser 133 forms most of the gas outlet guide 131. The gas outlet diffuser 133 is formed with a mounting surface 136, and a female screw 137. The mounting surface 136 is formed in an end, close to the gas inlet casing 6, of the gas outlet diffuser 133, and is formed along a plane perpendicular to a rotation axis 5. The female screw 137 is formed in the mounting surface 136.

[0057] The shroud ring 134 is formed from carbon steel, and formed in a substantially tubular shape by machining. The mass of the shroud ring 134 is smaller than the mass of the gas outlet diffuser 133. Therefore, the heat capacity of the shroud ring 134 is smaller than the heat capacity of the gas outlet diffuser 133. The shroud ring 134 includes a cylindrical portion 138, and a flange portion 139. The cylindrical portion 138 is formed in a substantially tubular shape. The cylindrical portion 138 is arranged such that the inner surface 141 of the tube faces moving blades 3, and the inner surface 141 is separated from blade tips 44 of the moving blades 3 by a predetermined distance. Furthermore, the cylindrical portion 138 is arranged such that a clearance 142 is formed between the cylindrical portion 138 and the gas outlet diffuser 133.

[0058] The flange portion 139 is formed so as to project from an end of the cylindrical portion 138 to the outside along a plane perpendicular to the rotation axis 5. The flange portion 139 is formed with a through hole 143. The bolt 135 passes through the through hole 143 of the flange portion 139, to be fastened to the female screw 137 of the gas outlet diffuser 133. The bolt 135 is fastened to the female screw 137 of the gas outlet diffuser 133, so that the flange portion 139 is supported on the gas outlet diffuser 133. The shroud ring 134 is supported on the gas outlet diffuser 133 with the bolt 135, so that the shroud ring 134 is prevented from coming off from the gas outlet diffuser 133, thereby enabling more reliable arrangement at a predetermined position. At this time, the bolt 135 loosely supports the shroud ring 134 on the gas outlet diffuser 133 such that the size of the clearance 142 can be changed.

[0059] Fig. 5 shows the change of the position of the inner surface 141 of the shroud ring 134 of Comparative Example. The inner surface position change 53 shows that the inner surface 141 moves to the side far from the rotation axis 5 over time during the startup operation. That is, the inner surface position change 53 shows that when the ambient temperature inside a turbine part rises, the temperature of the shroud ring 134 rises, so that the shroud ring 134 expands.

[0060] The inner surface position change 53 further shows that when the position of the inner surface 141 does not largely change, but is kept constant during the

normal operation. That is, the inner surface position change 53 shows that when the ambient temperature inside the turbine part is substantially kept constant, the temperature of the shroud ring 134 does not largely change, and the shroud ring 134 does not largely expand or contract.

[0061] The inner surface position change 53 further shows that the inner surface 141 moves to the side close to the rotation axis 5 over time during the stop operation. That is, the inner surface position change 53 shows that when the ambient temperature inside the turbine part falls, the temperature of the shroud ring 134 falls, so that the shroud ring 134 contracts.

[0062] The blade tip position change 52 and the inner surface position change 53 show that the blade tips 44 of the moving blades 3 are not in contact with the inner surface 141 of the shroud ring 134 during the startup operation and the normal operation. The blade tip position change 52 and the inner surface position change 53 further show that the inner surface 141 of the shroud ring 134 moves toward the rotation axis 5 more quickly than the blade tips 44 of the moving blades 3 during the stop operation. The blade tip position change 52 and the inner surface position change 53 further show that there is a possibility that the blade tips 44 of the moving blades 3 are in contact with the inner surface 141 of the shroud ring 134 during the stop operation.

[0063] The inner surface position change 53 and the inner surface position change 81 of Fig. 3 show that the inner surface 71 of the shroud ring 63 moves toward the rotation axis 5 more slowly than the inner surface 141 of the shroud ring 134 of Comparative Example during the stop operation. That is, the inner surface position change 53 and the inner surface position change 81 of Fig. 3 show that the hooking portion 70 of the shroud ring 63 is hooked on the hooking surface 67 of the gas outlet diffuser 62 during the stop operation, and show that the hooking portion 70 hinders the shroud ring 63 from contracting.

[0064] In the axial flow turbine that includes the gas outlet guide 61, as shown by the inner surface position change 81, the moving blades 3 can be more reliably prevented from coming into contact with the inner surface 71 of the shroud ring 63 during the stop operation. That is, the gas outlet diffuser 62 is formed so as to have heat capacity large enough to sufficiently slowly contract such that the inner surface 71 of the shroud ring 63 does not come into contact with the moving blades 3 when the hooking portion 70 is hooked on the hooking surface 67.

[0065] The hooking portion 70 can be replaced with other hooking portion formed in a shape different from an annular shape. As the hooking portion, a plurality of projections arranged at equal intervals along the circumference having the rotation axis 5 as the center are exemplified. The plurality of projections project from the outer edge of the flange portion 69 to the side close to the gas outlet diffuser 62, the hooking surface 67 of the gas outlet diffuser 62 is arranged between each of the plurality

of projections and the rotation axis 5. Also in the axial flow turbine that utilizes such a hooking portion, the moving blades 3 can be more reliably prevented from coming into contact with the inner surface 71 of the shroud ring 63 during the stop operation, similarly to the axial flow turbine of the embodiment, which is already described.

[0066] The shroud ring 63 can be replaced with other shroud ring formed from cast iron produced by casting. Also in an axial flow turbine, to which such a shroud ring is applied, the moving blades 3 can be prevented from interfering with other components, similarly to the axial flow turbine of the embodiment, which is already described.

[0067] The axial flow turbine can be utilized in a VTI turbocharger (variable turbine inlet turbocharger). Furthermore, the axial flow turbine can be utilized in other apparatus different from the turbocharger. Also in an axial flow turbine, the moving blades 3 can be prevented from coming into contact with other components, similarly to the axial flow turbine of the embodiment, which is already described.

[0068] The internal combustion engine that includes the turbocharger can be utilized in other apparatus different from the vessel. As other apparatus, a generator is exemplified. The generator generates electric power by using power generated by the internal combustion engine. Also in a turbocharger applied to other apparatus, the moving blades 3 can be prevented from interfering with other components, and compressed air can be stably supplied to the internal combustion engine, similarly to the turbocharger of the embodiment, which is already described.

{Reference Signs List}

[0069]

3	Moving blade
10	Axial flow turbine
20	Compressor
44	Blade tip
61	Gas outlet guide
62	Gas outlet diffuser
63	Shroud ring
64	Bolt
65	Mounting surface
67	Hooking surface
68	Cylindrical portion
69	Flange portion
70	Hooking portion
71	Inner surface
72	Clearance

Claims

1. A turbine comprising:

a shroud ring arranged outside a moving blade
 in a turbine radial direction; and
 a gas outlet diffuser arranged to provide a clear-
 ance outside the shroud ring in the turbine radial
 direction,

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wherein

the gas outlet diffuser further includes a hooking sur-
 face that faces a hooking portion provided in the
 shroud ring.

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2. The turbine according to claim 1, wherein
 the hooking portion is a plurality of projections
 formed along a circumference having a rotation axis
 of the moving blade as the center.

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3. The turbine according to claim 1 or 2, further com-
 prising a support member which supports the shroud
 ring on the gas outlet diffuser.

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4. A turbocharger comprising:

the turbine according to any one of claims 1 to
 3; and
 a compressor configured to compress air by us-
 ing rotation power of the turbine.

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5. A vessel comprising:

the turbocharger according to claim 4;
 an internal combustion engine configured to
 generate power by using combustion air;
 a hull equipped with the turbocharger and the
 internal combustion engine; and
 a propulsion unit configured to propel the hull by
 using the power.

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FIG. 2

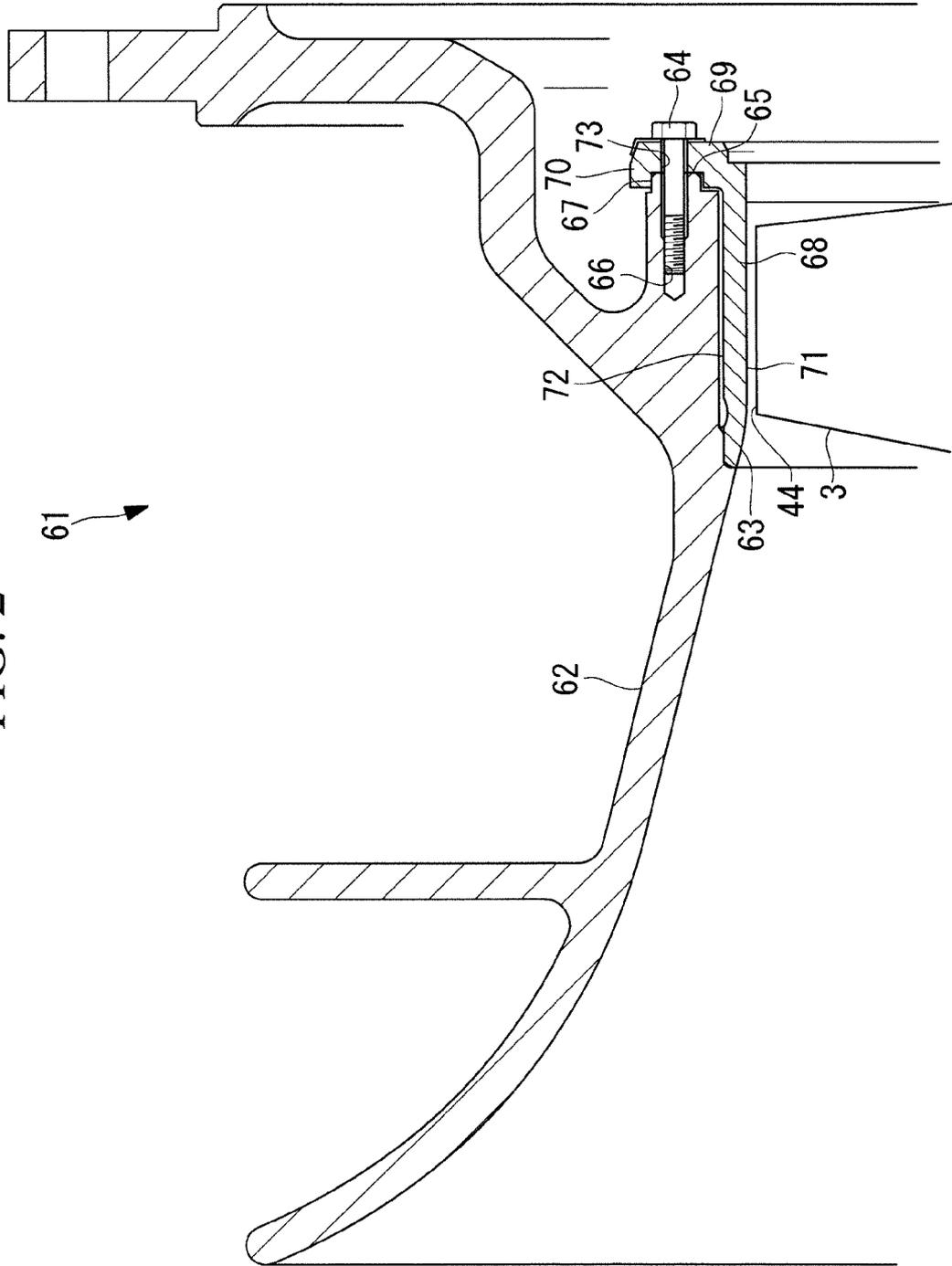


FIG. 3

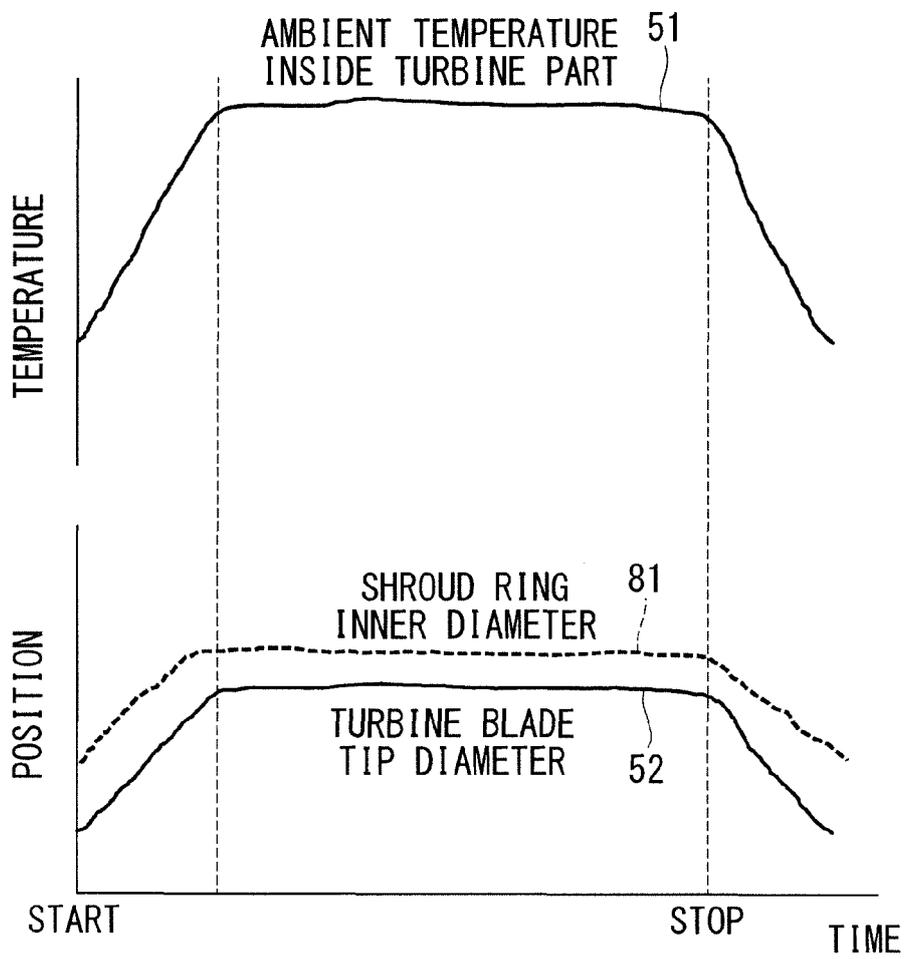


FIG. 4

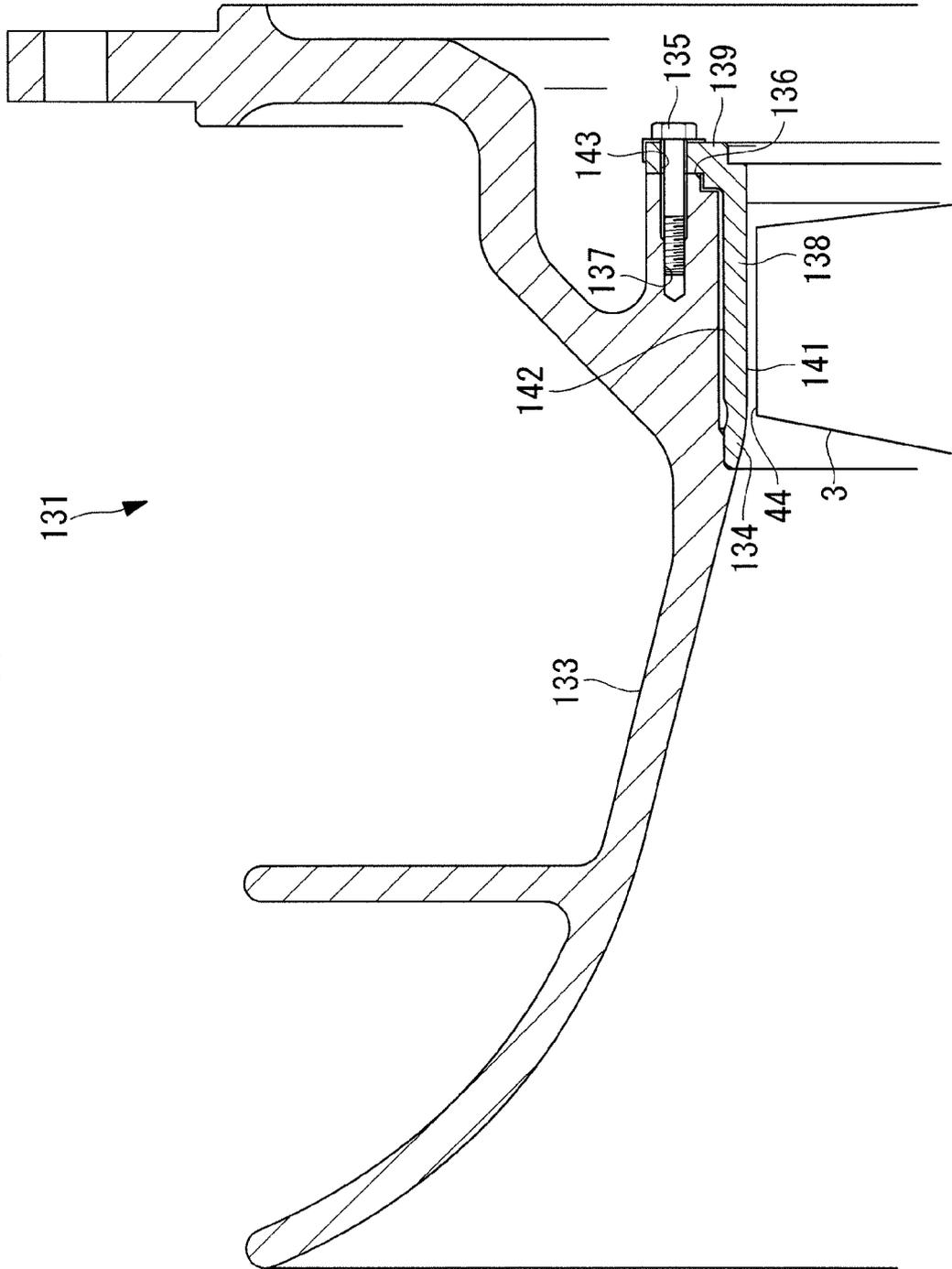
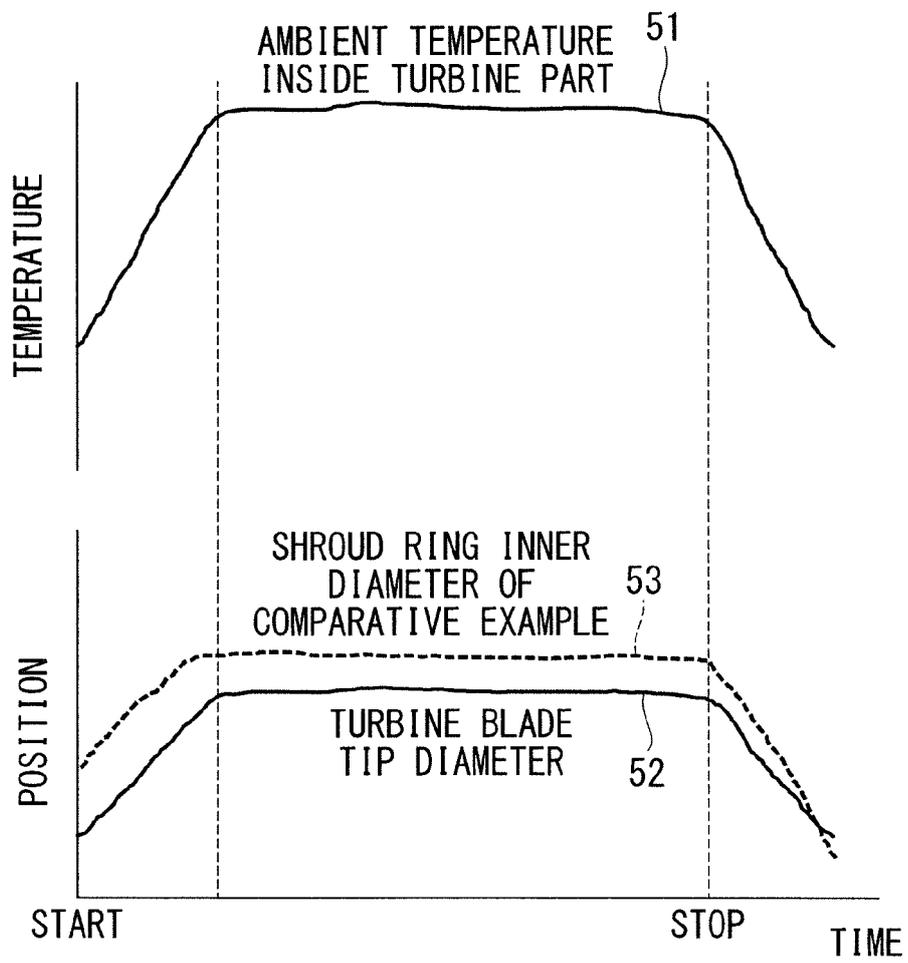


FIG. 5





EUROPEAN SEARCH REPORT

Application Number
EP 14 19 2437

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2007/071598 A1 (DENECE F; DENECE F R D; PHILIPPOT V) 29 March 2007 (2007-03-29) * figure 1 * * paragraph [0002] * -----	1,3-5	INV. F01D11/18 F01D11/08 F01D11/24
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