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(54) **FUEL FLOW RATE SETTING METHOD, DEVICE FOR IMPLEMENTING SAID METHOD, AND GAS TURBINE PLANT PROVIDED WITH SAID DEVICE**

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(57) **ABSTRACT**

A gas turbine fuel flow rate setting device includes a flow rate ratio computing unit and a flow rate computing unit. The flow rate ratio computing unit accepts a parameter having a correlation with a gas turbine output, and uses a predetermined flow rate ratio relationship between the parameter and a fuel flow rate ratio between a plurality of premixing nozzle groups to determine a fuel flow rate ratio corresponding to the accepted parameter. The flow rate computing unit uses the fuel flow rate ratio determined by the flow rate ratio computing unit to determine a flow rate of a fuel to be supplied to each of the plurality of premixing nozzle groups.
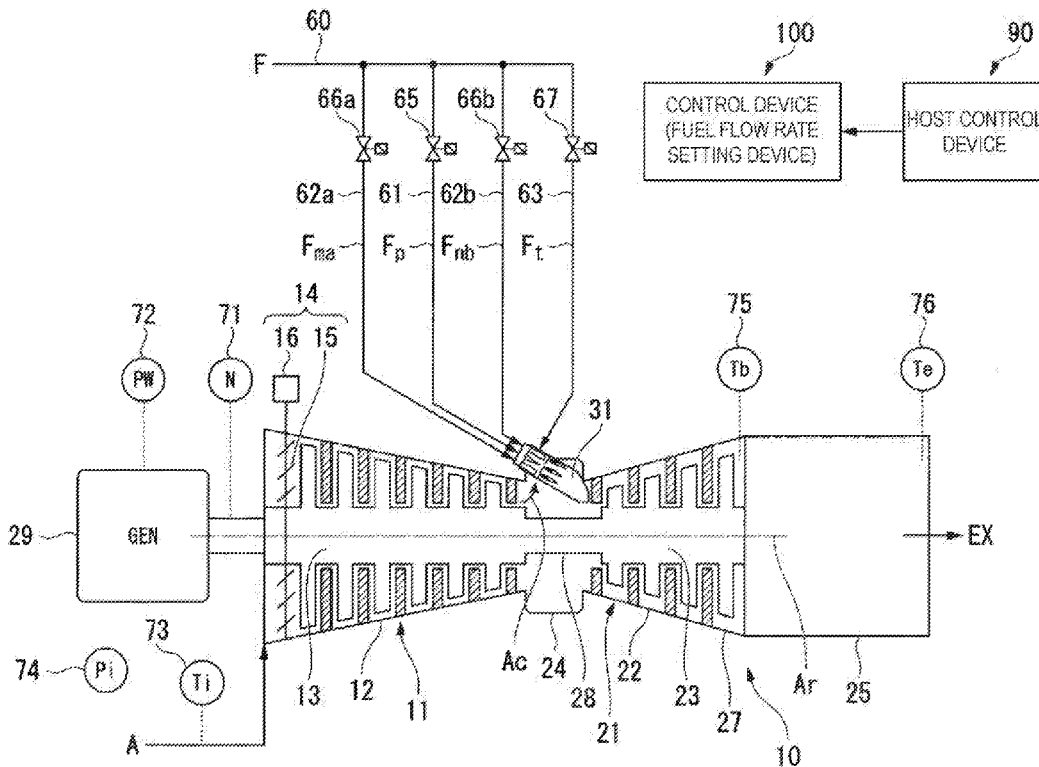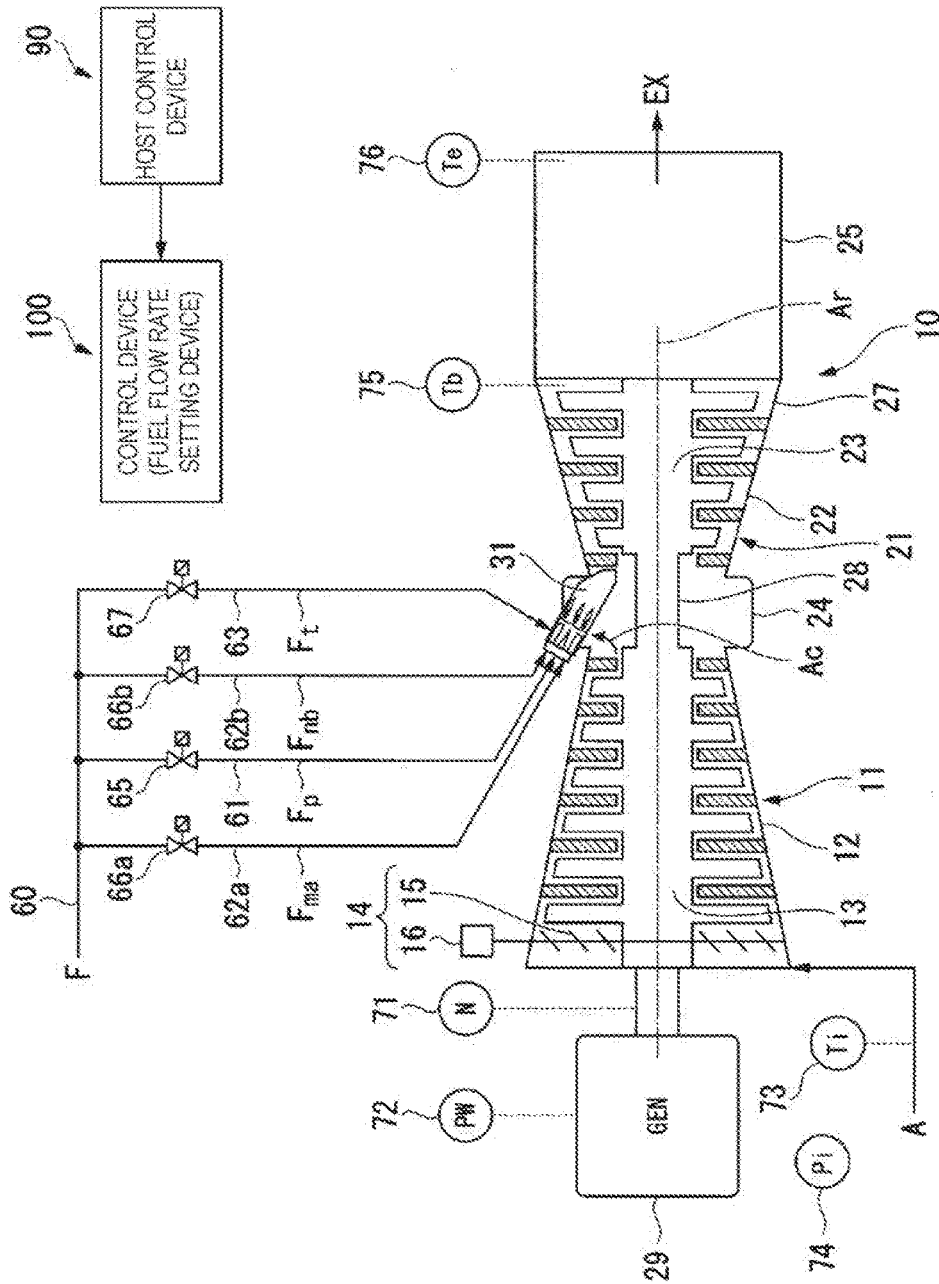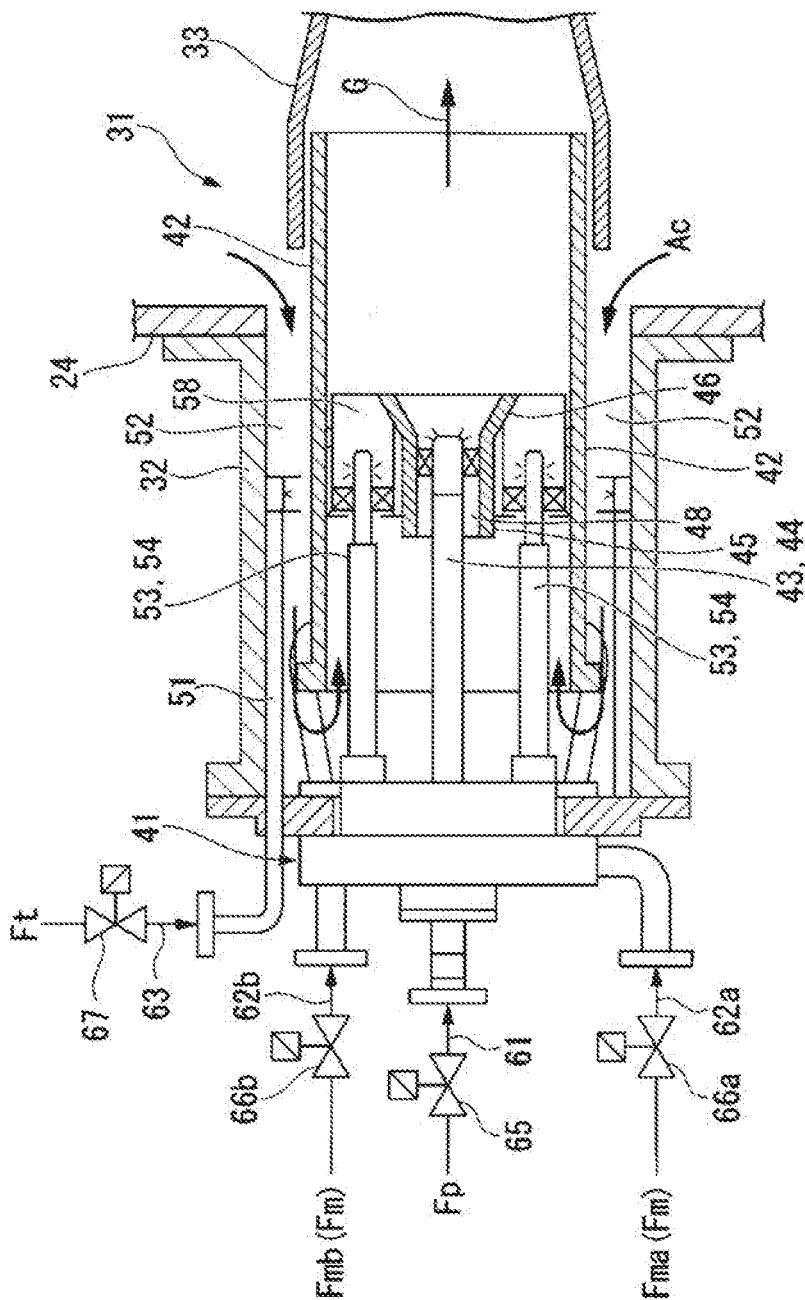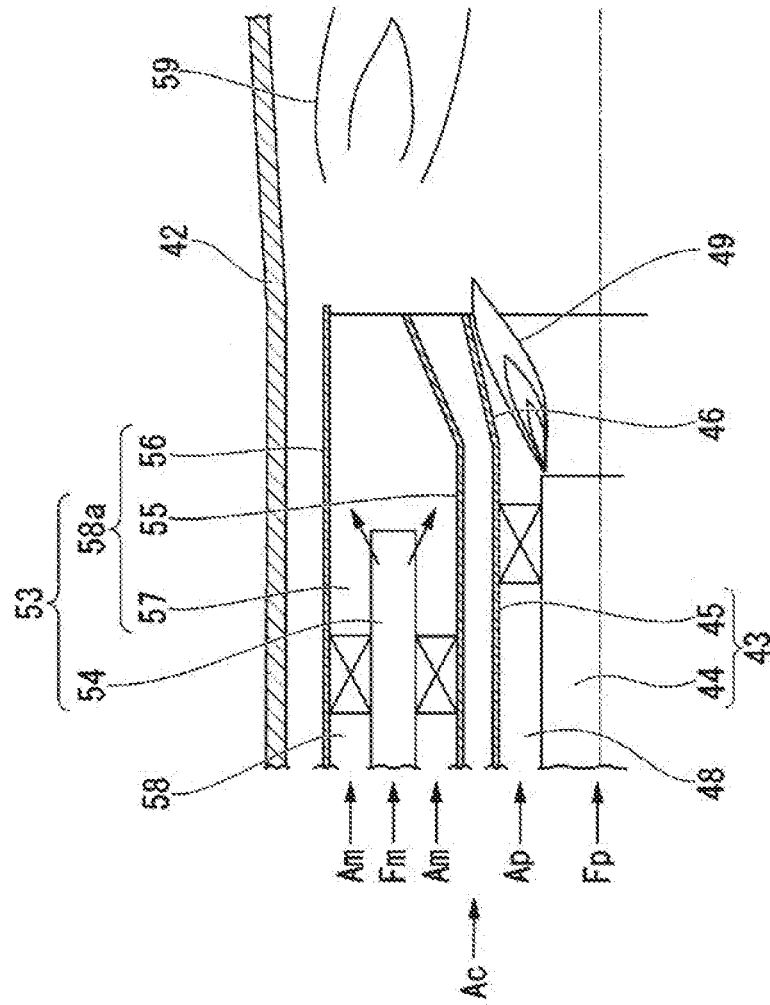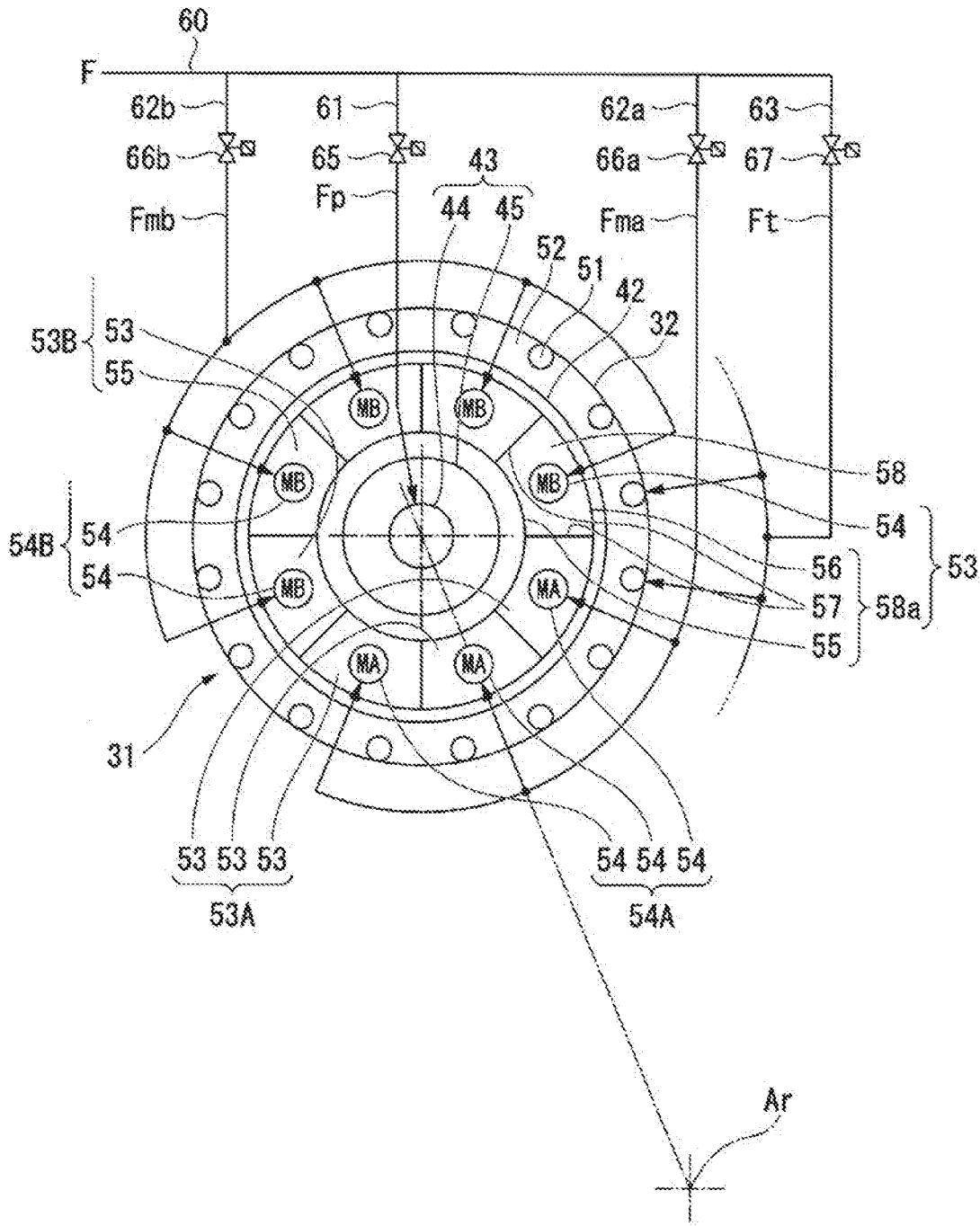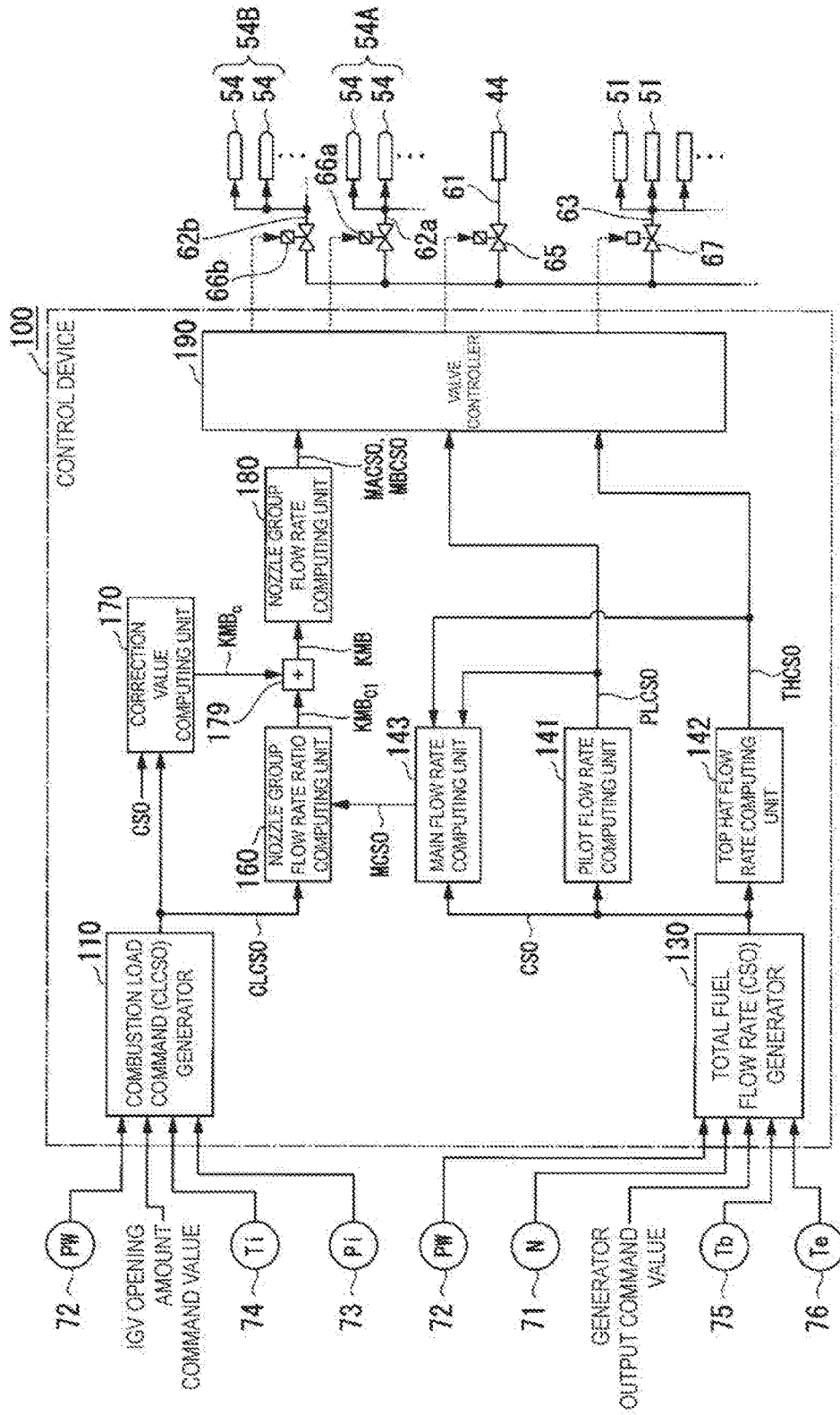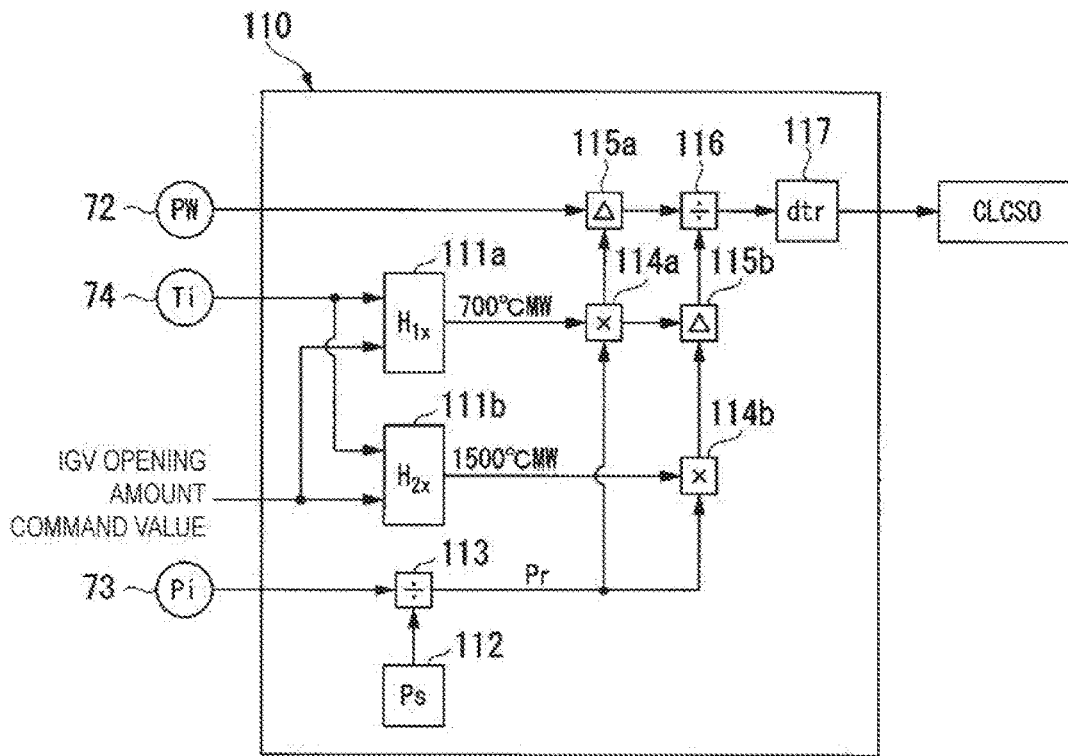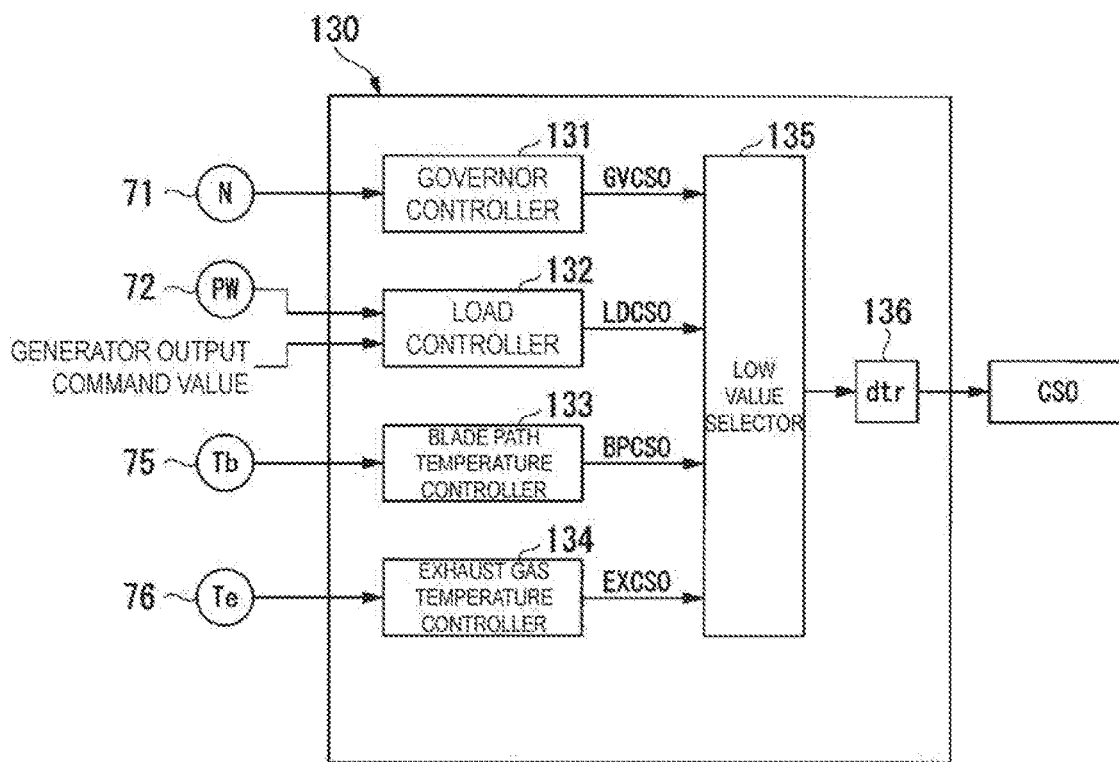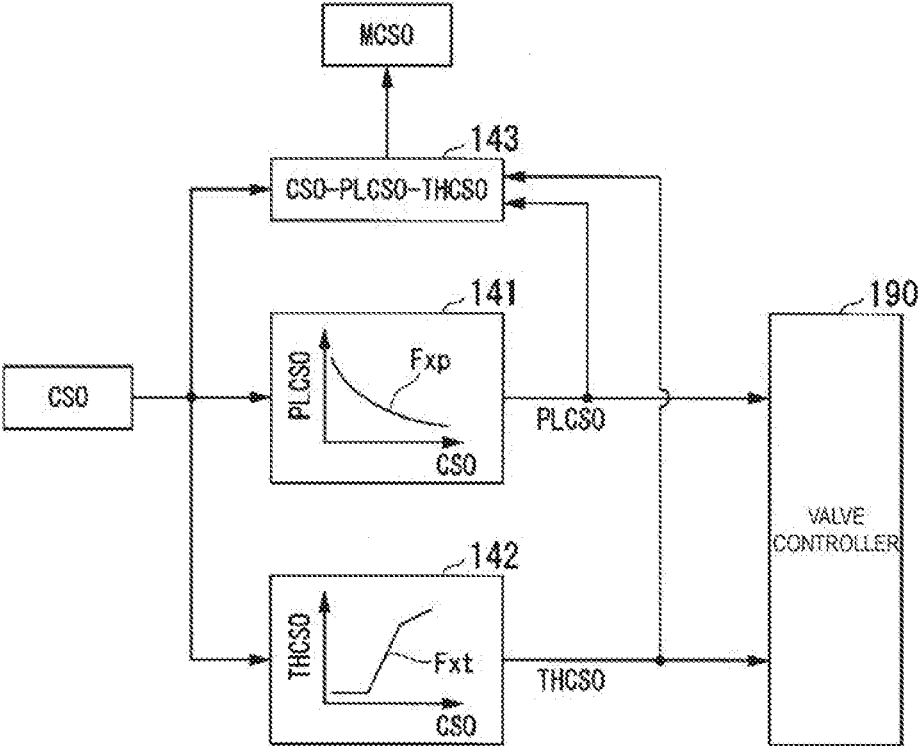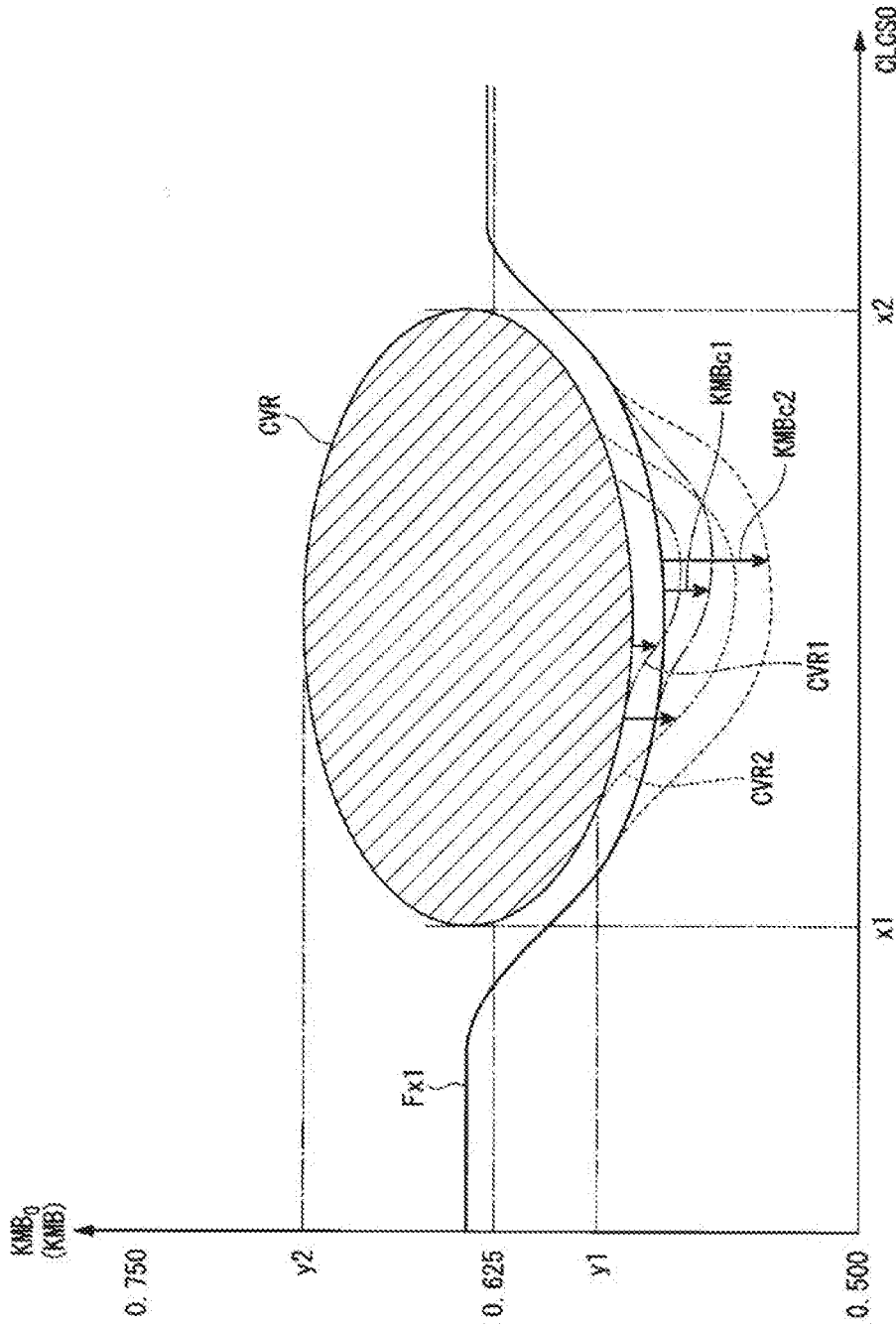
FIG. 1

FIG. 2

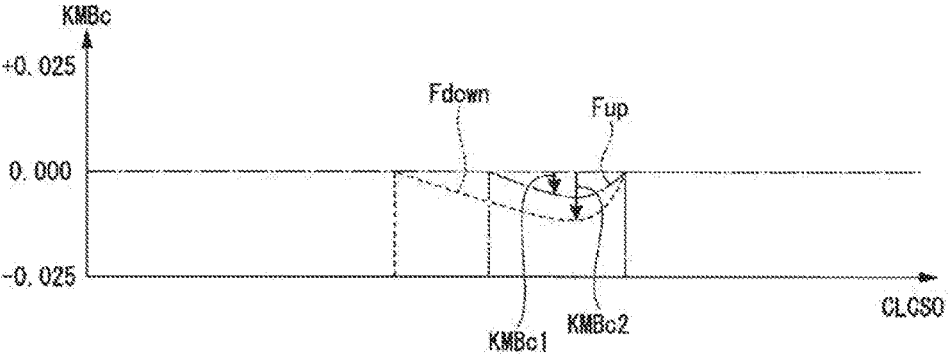FIG. 3

FIG. 4

FIG. 5

FIG. 6

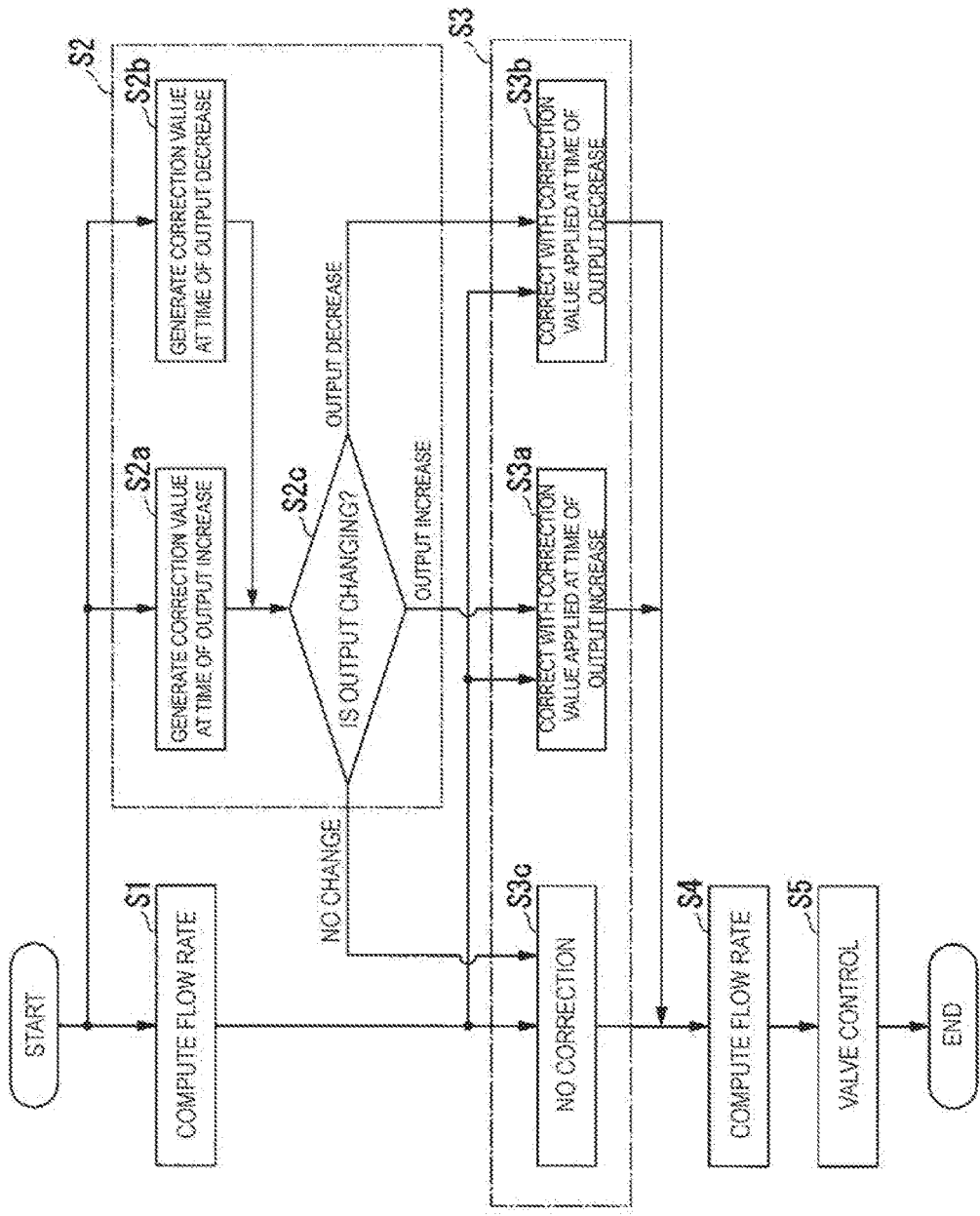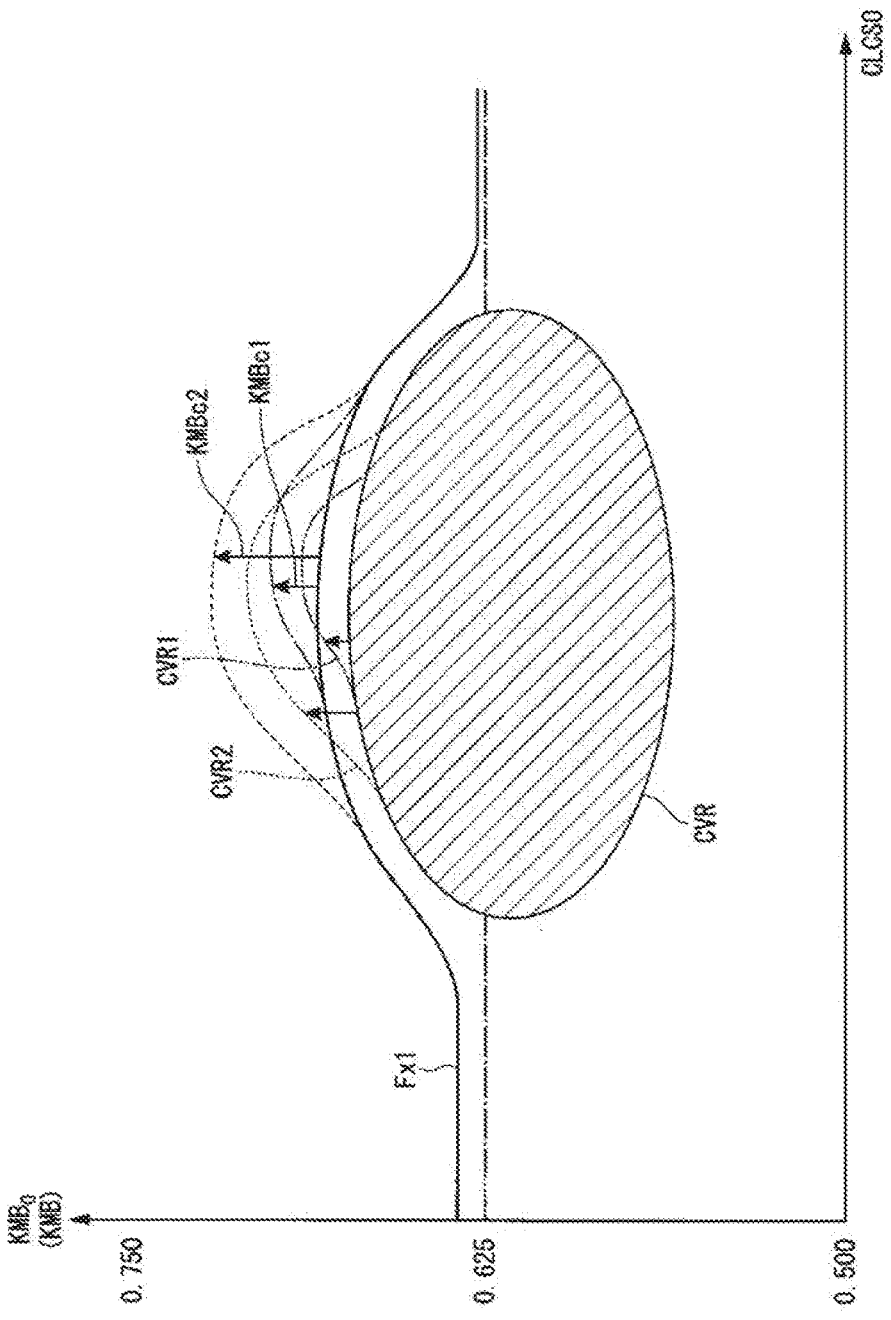FIG. 7

FIG. 8

FIG. 9

FIG. 10
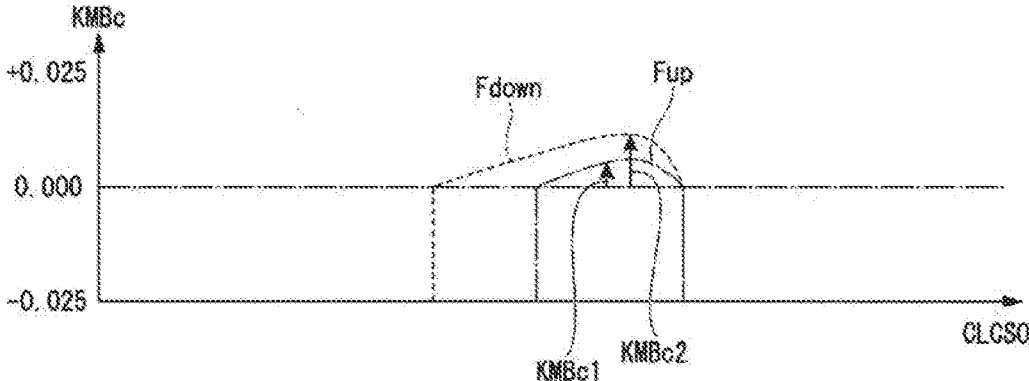
FIG. 11

FIG. 12

FIG. 13

FIG. 14

FUEL FLOW RATE SETTING METHOD, DEVICE FOR IMPLEMENTING SAID METHOD, AND GAS TURBINE PLANT PROVIDED WITH SAID DEVICE

TECHNICAL FIELD

[0001] The present invention relates to a fuel flow rate setting method of a gas turbine provided with a plurality of premixing nozzles that spray a fuel to be combusted through premixed combustion, a device for implementing the method, and a gas turbine plant provided with the device.

[0002] This application claims priority based on JP 2015-152152 filed in Japan on Jul. 31, 2015, of which the contents are incorporated herein by reference.

BACKGROUND ART

[0003] A gas turbine includes a compressor that compresses air, a combustor that combusts a fuel in the air compressed by the compressor to generate combustion gas, and a turbine that is driven by the combustion gas. In many cases, the combustor includes a plurality of main burners that combust the fuel through premixed combustion. Each of the main burners includes a main nozzle and a gas channel frame inside which the main nozzle is disposed. Inside the gas channel frame, premixed gas is generated as a result of the fuel sprayed from the main nozzle and the air from the compressor being mixed. This premixed gas is sprayed from the gas channel frame into a combustion liner of the combustor.

[0004] Examples of the combustor provided with the plurality of main burners include a combustor disclosed in Patent Document 1 described below. In this combustor, in order to achieve combustion stability of the fuel, the number of main nozzles that supply the fuel is increased sequentially as load of the gas turbine increases.

CITATION LIST

Patent Document

[0005] Patent Document 1 JP 2006-145073 A

SUMMARY OF INVENTION

Technical Problems

[0006] It is true that the technology disclosed in Patent Document 1 can achieve combustion stability of a fuel. However, in this technical field, there is demand for further improvement in the combustion stability.

[0007] In light of the foregoing, an object of the present invention is to provide a technology capable of improving combustion stability of a fuel in a gas turbine provided with a plurality of premixing nozzles that spray a fuel to be combusted through premixed combustion.

Solution to Problems

[0008] A fuel flow rate setting device according to a first aspect of the invention for achieving the above-described object is

[0009] a fuel flow rate setting device of a gas turbine provided with a plurality of premixing nozzle groups each formed by at least one premixing nozzle that sprays a fuel to be combusted through premixed combustion. The fuel flow rate setting device includes: a flow rate ratio computing unit configured to accept a parameter having a correlation with a gas turbine output and to determine, using a predetermined flow rate ratio relationship between the parameter and a fuel flow rate ratio between the plurality of premixing nozzle groups, the fuel flow rate ratio corresponding to the accepted parameter; and a flow rate computing unit configured to determine a flow rate of the fuel to be supplied to each of the plurality of premixing nozzle groups, using the fuel flow rate ratio determined by the flow rate ratio computing unit. The flow rate ratio relationship is a relationship in which the fuel flow rate ratio changes continuously as the parameter changes.

[0010] A combustion oscillation region may occur in a region in which the gas turbine output is within a predetermined range and the fuel flow rate ratio between the plurality of premixing nozzle groups is within a predetermined range. Thus, in the fuel flow rate setting device, the occurrence of the combustion oscillation in the course of combusting the fuel is suppressed by changing the fuel flow rate ratio in accordance with the parameter having a correlation with the gas turbine output. Further, the predetermined flow rate ratio relationship between the parameter and the fuel flow rate ratio is a relationship in which the fuel flow rate ratio changes continuously as the parameter changes. Thus, in the fuel flow rate setting device, the fuel flow rate ratio does not suddenly change significantly. As a result, the fuel flow rate setting device can improve combustion stability of the fuel.

[0011] The fuel flow rate setting device according to a second aspect of the invention for achieving the above-described object is

[0012] the fuel flow rate setting device according to the first aspect that further includes a valve controller that specifies an opening amount for a fuel flow rate adjustment valve provided for each of the plurality of premixing nozzle groups that adjusts a flow rate of the fuel to be supplied to the premixing nozzle group. Using the fuel flow rate for each of the plurality of premixing nozzle groups, the valve controller determines the opening amount for the fuel flow rate adjustment valve provided for each of the plurality of premixing nozzle groups.

[0013] The fuel flow rate setting device according to a third aspect of the invention for achieving the above-described object is

[0014] the fuel flow rate setting device according to the first or second aspect in which the flow rate ratio relationship is a relationship determined in order to avoid a combustion oscillation region in which combustion oscillation occurs among regions defined by the parameter and the fuel flow rate ratio.

[0015] The fuel flow rate setting device according to a fourth aspect of the invention for achieving the above-described object is

[0016] the fuel flow rate setting device according to any one of the first to third aspects that further includes:

[0017] a correction value computing unit that determines a correction value in relation to the fuel flow rate ratio applied when the gas turbine output is changing; and a corrector that corrects the fuel flow rate ratio determined by the flow rate ratio computing unit, using the correction value determined by the correction value computing unit. When the gas turbine output is changing, the flow rate computing

unit determines the fuel flow rate for each of the plurality of premixing nozzle groups, using the fuel flow rate ratio corrected by the corrector.

[0018] When the gas turbine output is changing, the combustion oscillation region also changes in accordance with the change in the gas turbine output. Thus, in the fuel flow rate setting device, when the gas turbine output is changing, the combustion oscillation that occurs in the course of combusting the fuel is avoided by correcting the fuel flow rate ratio, in order to achieve the combustion stability of the fuel.

[0019] The fuel flow rate setting device according to a fifth aspect of the invention for achieving the above-described object is

[0020] the fuel flow rate setting device according to the fourth aspect in which the correction value computing unit accepts the parameter and determines the correction value corresponding to the accepted parameter, using a predetermined correction value relationship between the parameter and the correction value.

[0021] The change in the combustion oscillation region, which occurs when the gas turbine output is changing, varies depending on the gas turbine output at the time. Thus, in the fuel flow rate setting device, the correction value is determined in accordance with the parameter having a correlation with the gas turbine output.

[0022] The fuel flow rate setting device according to a sixth aspect of the invention for achieving the above-described object is

[0023] the fuel flow rate setting device according to the fifth aspect in which the correction value computing unit determines whether the change in the gas turbine output is an output increase or an output decrease. When the change in the gas turbine output is the output increase, the correction value computing unit determines the correction value using, as the correction value relationship, a correction value relationship applied at a time of the output increase. When the change in the gas turbine output is the output decrease, the correction value computing unit determines the correction value using, as the correction value relationship, a correction value relationship applied at a time of the output decrease.

[0024] Forms of the change in the gas turbine output include the output increase and the output decrease. The change in the combustion oscillation region is different between when the gas turbine output is increasing and when the gas turbine output is decreasing. Thus, in the fuel flow rate setting device, when the change in the gas turbine output is the output increase, the correction value is determined using the correction value relationship applied at a time of the output increase, and when the change in the gas turbine output is the output decrease, the correction value is determined using the correction value relationship applied at a time of the output decrease.

[0025] The fuel flow rate setting device according to a seventh aspect of the invention for achieving the above-described object is

[0026] the fuel flow rate setting device according to the fifth or sixth aspect in which the correction value relationship is the fuel flow rate ratio corrected by the corrector and is a relationship determined so as to be able to avoid the combustion oscillation region in which combustion oscillation occurs when the gas turbine output is changing among regions defined by the parameter and the correction value.

[0027] The fuel flow rate setting device according to an eighth aspect of the invention for achieving the above-described object is

[0028] the fuel flow rate setting device according to any one of the fifth to seventh aspects in which, among the plurality of premixing nozzle groups, one of the premixing nozzle groups has a greater number of premixing nozzles than the other premixing nozzle groups, and the correction value determined by the correction value relationship is a value that decreases the flow rate of the fuel to be supplied to the one of the premixing nozzle groups.

[0029] The fuel flow rate setting device according to a ninth aspect of the invention for achieving the above-described object is

[0030] the fuel flow rate setting device according to any one of the first to eighth aspects that further includes a parameter generator that generates, as the parameter, an inlet temperature-correlated value having a positive correlation with a temperature of a turbine inlet, inside a turbine of the gas turbine, into which combustion gas from a combustor of the gas turbine flows.

[0031] The fuel flow rate setting device according to a tenth aspect of the invention for achieving the above-described object is

[0032] the fuel flow rate setting device according to any one of the first to ninth aspects that further includes a total premixed fuel computing unit that determines a flow rate of the fuel to be supplied to all of the plurality of premixing nozzle groups. The flow rate computing unit determines a fuel flow rate for each of the plurality of premixing nozzle groups, using the fuel flow rate determined by the total premixed fuel computing unit and the fuel flow rate ratio determined by the flow rate ratio computing unit.

[0033] A gas turbine plant according to an eleventh aspect of the invention for achieving the above-described object includes:

[0034] the fuel flow rate setting device according to any one of the first to tenth aspects; and the gas turbine. The gas turbine includes: a compressor that compresses air; a combustor that combusts a fuel in the air compressed by the compressor to generate combustion gas; and a turbine that is driven by the combustion gas. The combustor includes: a combustion liner in which the fuel is combusted; and a plurality of main burners that spray premixed gas which is formed by mixing a fuel and air into the combustion liner. Each of the plurality of main burners includes: one main nozzle as the premixing nozzle; and a gas channel frame that generates the premixed gas by mixing the fuel sprayed from the one main nozzle and the air compressed by the compressor and sprays the premixed gas into the combustion liner. The combustor includes a plurality of main burner groups each formed by at least one of the main burners. The fuel flow rate setting device determines a fuel flow rate for each of the plurality of main burner groups.

[0035] A gas turbine plant according to a twelfth aspect of the invention for achieving the above-described object includes:

[0036] the fuel flow rate setting device according to any one of the first to tenth aspects; and the gas turbine. The gas turbine includes: a compressor that compresses air; a combustor that combusts a fuel in the air compressed by the compressor to generate combustion gas; and a turbine that is driven by the combustion gas. The combustor includes: a combustion liner in which the fuel is combusted; a plurality

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of main burners that spray premixed gas which is formed by mixing a fuel and the air from the compressor into the combustion liner; and a plurality of top hat nozzles, as the premixing nozzles, which spray the fuel into the air from the compressor, the air flowing into the main burners. The combustor includes a plurality of top hat nozzle groups each formed by at least one of the top hat nozzles. The fuel flow rate setting device determines a fuel flow rate for each of the plurality of top hat nozzle groups.

[0037] A fuel flow rate setting method according to a thirteenth aspect of the invention for achieving the above-described object is

[0038] a fuel flow rate setting method of a gas turbine provided with a plurality of premixing nozzle groups each formed by at least one premixing nozzle that sprays a fuel to be combusted through premixed combustion. The fuel flow rate setting method includes: a flow rate ratio computing step of accepting a parameter having a correlation with a gas turbine output and determining, using a predetermined flow rate ratio relationship between the parameter and a fuel flow rate ratio between the plurality of premixing nozzle groups, the fuel flow rate ratio corresponding to the accepted parameter; and a flow rate computing step of determining, using the fuel flow rate ratio determined at the flow rate ratio computing step, a fuel flow rate for each of the plurality of premixing nozzle groups. The flow rate ratio relationship is a relationship in which the fuel flow rate ratio changes continuously as the parameter changes.

[0039] The combustion oscillation region may occur in the region in which the gas turbine output is within the predetermined range and the fuel flow rate ratio between the plurality of premixing nozzle groups is within the predetermined range. Thus, in the fuel flow rate setting method, the occurrence of the combustion oscillation in the course of combusting the fuel is suppressed by changing the fuel flow rate ratio in accordance with the parameter having a correlation with the gas turbine output. Further, the predetermined flow rate ratio relationship between the parameter and the fuel flow rate ratio is a relationship in which the fuel flow rate ratio changes continuously as the parameter changes. Thus, in the fuel flow rate setting method, the fuel flow rate ratio does not suddenly change significantly. As a result, the fuel flow rate setting method can improve the combustion stability of the fuel.

[0040] The fuel flow rate setting method according to a fourteenth aspect of the invention for achieving the above-described object is

[0041] the fuel flow rate setting method according to the thirteenth aspect that further includes a valve controlling step of specifying an opening amount for a fuel flow rate adjustment valve provided for each of the plurality of premixing nozzle groups that adjusts a flow rate of the fuel to be supplied to the premixing nozzle group. At the valve controlling step, the opening amount for the fuel flow rate adjustment valve provided for each of the plurality of premixing nozzle groups is determined using the fuel flow rate for each of the plurality of premixing nozzle groups.

[0042] The fuel flow rate setting method according to a fifteenth aspect of the invention for achieving the above-described object is

[0043] the fuel flow rate setting method according to the thirteenth or fourteenth aspect in which a combustion oscillation region in which combustion oscillation occurs among regions defined by the parameter and the fuel flow rate ratio

is identified in advance, and the flow rate ratio relationship is a relationship determined such that the fuel flow rate ratio corresponding to the parameter avoids the combustion oscillation region.

[0044] The fuel flow rate setting method according to a sixteenth aspect of the invention for achieving the above-described object is

[0045] the fuel flow rate setting method according to any one of the thirteenth to fifteenth aspects that further includes: a correction value computing step of determining a correction value in relation to the fuel flow rate ratio applied when the gas turbine output is changing; and

[0046] a correcting step of correcting the fuel flow rate ratio determined at the flow rate ratio computing step, using the correction value determined at the correction value computing step. At the flow rate computing step, when the gas turbine output is changing, a fuel flow rate for each of the plurality of premixing nozzle groups is determined using the fuel flow rate ratio corrected at the correcting step.

[0047] When the gas turbine output is changing, the combustion oscillation region also changes in accordance with the change in the gas turbine output. Thus, in the fuel flow rate setting method, when the gas turbine output is changing, the combustion oscillation that occurs in the course of combusting the fuel is avoided by correcting the fuel flow rate ratio, in order to achieve the combustion stability of the fuel.

[0048] The fuel flow rate setting method according to a seventeenth aspect of the invention for achieving the above-described object is

[0049] the fuel flow rate setting method according to the sixteenth aspect in which, at the correction value computing step, the parameter is accepted and the correction value corresponding to the accepted parameter is determined using a predetermined correction value relationship between the parameter and the correction value.

[0050] The fuel flow rate setting method according to an eighteenth aspect of the invention for achieving the above-described object is

[0051] the fuel flow rate setting method according to the seventeenth aspect in which, at the correction value computing step, whether the change in the gas turbine output is an output increase or an output decrease is determined. When the change in the gas turbine output is the output increase, the correction value is determined using, as the correction value relationship, a correction value relationship applied at a tune of the output increase. When the change in the gas turbine output is the output decrease, the correction value is determined using, as the correction value relationship, a correction value relationship applied at a time of the output decrease.

[0052] The fuel flow rate setting method according to a nineteenth aspect of the invention for achieving the above-described object is

[0053] the fuel flow rate setting method according to the seventeenth or eighteenth aspect in which a combustion oscillation region in which combustion oscillation occurs when the gas turbine output is changing among regions defined by the parameter and the correction value is identified in advance, and the correction value relationship is a relationship determined such that the fuel flow rate ratio after the correcting step is able to avoid the combustion oscillation region.

[0054] The fuel flow rate setting method according to a twentieth aspect of the invention for achieving the above-described object is

[0055] the fuel flow rate setting method according to any one of the seventeenth to nineteenth aspects in which, among the plurality of premixing nozzle groups, one of the premixing nozzle groups has a greater number of premixing nozzles than the other premixing nozzle groups, and the correction value determined by the correction value relationship is a value that decreases the flow rate of the fuel to be supplied to the one of the premixing nozzle groups.

[0056] The fuel flow rate setting method according to a twenty-first aspect of the invention for achieving the above-described object is

[0057] the fuel flow rate setting method according to any one of the thirteenth to twentieth aspects that further includes a parameter generating step of generating, as the parameter, an inlet temperature-correlated value having a positive correlation with a temperature of a turbine inlet, inside a turbine of the gas turbine, into which combustion gas from a combustor of the gas turbine flows.

Advantageous Effects of Invention

[0058] According to an aspect of the present invention, combustion stability of a fuel can be improved in a gas turbine provided with a plurality of premixing nozzles that spray the fuel to be combusted through premixed combustion.

BRIEF DESCRIPTION OF DRAWINGS

[0059] FIG. 1 is a system diagram illustrating a gas turbine plant according to an embodiment of the present invention.

[0060] FIG. 2 is a cross-sectional view of a combustor according to the embodiment of the present invention.

[0061] FIG. 3 is a cross-sectional view illustrating a main portion of the combustor according to the embodiment of the present invention.

[0062] FIG. 4 is a schematic diagram illustrating a fuel feeder according to the embodiment of the present invention, when viewed from an axial direction thereof.

[0063] FIG. 5 is a function block diagram of a control device according to the embodiment of the present invention.

[0064] FIG. 6 is a function block diagram of a combustion load command generator according to the embodiment of the present invention.

[0065] FIG. 7 is a function block diagram of a total fuel flow rate generator according to the embodiment of the present invention.

[0066] FIG. 8 is a function block diagram of a pilot flow rate computing unit, a top hat flow rate computing unit, and a main flow rate computing unit according to the embodiment of the present invention.

[0067] FIG. 9 is a function block diagram of a nozzle group flow rate ratio computing unit, a correction value computing unit, a corrector, and a nozzle group flow rate computing unit according to the embodiment of the present invention.

[0068] FIG. 10 is an explanatory diagram illustrating a function that specifies a relationship between a combustion load command value and a nozzle group flow rate ratio, and a combustion oscillation region according to the embodiment of the present invention.

[0069] FIG. 11 is a graph showing a relationship between a correction value in relation to the nozzle group flow rate ratio and the combustion load command value according to the embodiment of the present invention.

[0070] FIG. 12 is a flowchart illustrating operations of the nozzle group flow ratio computing unit, the correction value computing unit, the corrector, the nozzle group flow rate computing unit, and a valve controller according to the embodiment of the present invention.

[0071] FIG. 13 is an explanatory diagram illustrating a function that specifies the relationship between the combustion load command value and the nozzle group flow rate ratio, and the combustion oscillation region according to a modified example of the embodiment of the present invention.

[0072] FIG. 14 is a graph showing the relationship between the correction value in relation to the nozzle group flow rate ratio and the combustion load command value according to the modified example of the embodiment of the present invention.

DESCRIPTION OF EMBODIMENT

[0073] An embodiment and a modified example of a fuel flow rate setting device according to the present invention and of a gas turbine plant provided with the device will be described below with reference to the drawings.

Embodiment

[0074] The gas turbine plant according to the present embodiment includes a gas turbine 10 and a generator 29 that generates power by being driven by the gas turbine 10, as illustrated in FIG. 1.

[0075] The gas turbine 10 includes a compressor 11 that compresses air, a combustor 31 that combusts a fuel F in the air compressed by the compressor 11 to generate combustion gas, and a turbine 21 that is driven by the high-temperature high-pressure combustion gas.

[0076] The compressor 11 includes a compressor rotor 13 that rotates around an axis Ar, a compressor casing 12 that covers the compressor rotor 13 while allowing the compressor rotor 13 to rotate, and an inlet guide vane (IGV) 14 provided at an intake port of the compressor casing 12. The IGV 14 includes a plurality of guide vanes 15 and a driver 16 that drives the plurality of guide vanes 15. This IGV 14 adjusts a flow rate of the air taken into the compressor casing 12.

[0077] The turbine 21 includes a turbine rotor 23 that is rotated around the axis Ar by the combustion gas from the combustor 31, and a turbine casing 22 that covers the turbine rotor 23 while allowing the turbine rotor 23 to rotate. The turbine rotor 23 and the compressor rotor 13 rotate around the same axis Ar, and are connected to each other to form a gas turbine rotor 28. A rotor of the generator 29 is connected to the gas turbine rotor 28.

[0078] The gas turbine 10 further includes an intermediate casing 24 and an exhaust duct 25. The intermediate casing 24 is disposed between the compressor casing 12 and the turbine casing 22 so as to connect the compressor casing 12 and the turbine casing 22. The exhaust duct 25 is connected to the turbine casing 22, and an exhaust gas EX, which is the combustion gas that has passed through the interior of the turbine casing 22, flows through the exhaust duct 25. The compressor casing 12, the intermediate casing 24, and the

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turbine casing **22** are connected to one another to form a gas turbine casing **27**. The combustor **31** is fixed to the intermediate casing **24**.

[0079] The combustor **31** includes an external cylinder **32**, a combustion liner (or a transition piece) **33**, and a fuel feeder **41**, as illustrated in FIG. **2**. The external cylinder **32** is fixed to the intermediate casing **24**. The combustion liner **33** is disposed inside the intermediate casing **24** and supplies the combustion gas into a combustion gas channel of the turbine **21**. The fuel feeder **41** feeds the fuel and the air into the combustion liner **33**.

[0080] The fuel feeder **41** includes a combustor basket **42**, a pilot burner **43**, a plurality of main burners **53**, and a top hat nozzle **51**, as illustrated in FIG. **2** to FIG. **4**. The pilot burner **43** is disposed on the central axis of the combustor basket **42**. The plurality of main burners **53** are disposed in the circumferential direction at equal intervals so as to be centered around the pilot burner **43**. The top hat nozzle **51** is disposed on the inner circumferential side of the external cylinder **32** and on the outer circumferential side of the combustor basket **42**. Note that in the following description, in a direction in which the central axis of the combustor basket **42** extends, a side toward which combustion gas G flows inside the combustion liner **33** will be referred to as a "downstream side", and the side opposite thereto will be referred to as an "upstream side".

[0081] The pilot burner **43** includes a pilot nozzle **44** disposed on the central axis of the combustor basket **42** and a tubular pilot air tube **45** that surrounds the outer circumference of the pilot nozzle **44**. The downstream side of the pilot air tube **45** forms a pilot cone **46** whose diameter gradually becomes greater toward the downstream side. The inner circumferential side of the pilot air tube **45** forms a pilot air channel **48** through which compressed air Ac from the compressor **11** flows as pilot air Ap. A pilot fuel Fp sprayed from the pilot nozzle **44** is combusted (through diffusion combustion) in the pilot air Ap sprayed from the pilot air channel **48** to form a diffusion flame **49** (see FIG. **3**)

[0082] Each of the main burners **53** includes a main air combustor basket **55**, a main air external cylinder **56**, a partition plate **57**, and a main nozzle **54**. The main air combustor basket **55** is formed in a tubular shape so as to surround the outer circumference of the pilot air tube **45**. The main air external cylinder **56** is formed in a tubular shape so as to surround the outer circumference of the main air combustor basket **55**. The partition plate **57** is disposed in an annular space between the outer circumferential side of the main air combustor basket **55** and the inner circumferential side of the main air external cylinder **56** and divides the annular space into a plurality of spaces in the circumferential direction. The main nozzles **54** are each disposed between the plurality of partition plates **57**. A gas channel frame **58***a* in each of the main burners **53** is formed by the main air combustor basket **55**, the main air external cylinder **56**, and a pair of the partition plates **57** adjacent to each other in the circumferential direction. The plurality of spaces defined by the main air combustor basket **55**, the main air external cylinder **56**, and the plurality of partition plates **57** form a main air channel **58** through which the compressed air Ac from the compressor **11** flows as main air Am. A main fuel Fm is sprayed from the main nozzles **54** disposed inside the main air channel **58** into the main air Am flowing through the main air channel **58**. As a result, premixed gas, which is

a mixture of the main air Am and the main fuel Fm, flows in the main air channel **58** further to the downstream side than a tip end portion (downstream end) of the main nozzle **54**. After being sprayed out of the main air channel **58**, this premixed gas is combusted (through premixed combustion) and a premixed flame **59** is formed (see FIG. **3**). Thus, the main nozzles **54** of the present embodiment are premixing nozzles. The above-described diffusion flame **49** plays a role of stabilizing this premixed flame **59**.

[0083] The combustor **31** of the present embodiment has eight of the main burners **53**, as illustrated in FIG. **4**. Of the eight main burners **53**, three of the main burners **53**, which are disposed on a side closer to the axis Ar of the gas turbine rotor **28** and adjacent to each other in the circumferential direction, form a main burner A group **53A**. Further, the remaining five of the main burners **53** form a main burner B group **53B**. The main nozzles **54** in the three main burners **53**, which form the main burner A group **53A**, form a main nozzle A group **54A**, and the main nozzles **54** in the five main burners **53**, which form the main burner B group **53B**, form a main nozzle B group **54B**.

[0084] A space between the inner circumferential side of the external cylinder **32** and the outer circumferential side of the combustor basket **42** forms a compressed air channel **52** that guides the compressed air Ac from the compressor **11** into the combustor basket **42**. The top hat nozzle **51** sprays a top hat fuel Ft into this compressed air channel **52**. Thus, when the top hat fuel Ft is sprayed into the compressed air channel **52**, the top hat fuel Ft is mixed into the main air Am and the pilot air Ap. Thus, the top hat nozzles **51** of the present embodiment are also premixing nozzles.

[0085] As illustrated in FIG. **1**, FIG. **2**, and FIG. **4**, the gas turbine plant of the present embodiment further includes: a fuel main line **60** through which the fuel F supplied to the combustor **31** flows; a pilot fuel line **61** that supplies the pilot fuel Fp to the pilot nozzle **44**; a main A fuel line **62***a* that supplies a main A fuel Fma to the main nozzle A group **54A**; a main B fuel line **62***b* that supplies a main B fuel Fmb to the main nozzle B group **54B**; a top hat fuel line **63** that supplies the top hat fuel Ft to the top hat nozzles **51**; a pilot fuel valve **65** that adjusts a flow rate of the pilot fuel Fp; a main A fuel valve **66***a* that adjusts a flow rate of the main A fuel Fma; a main B fuel valve **66***b* that adjusts a flow rate of the main B fuel Fmb; and a top hat fuel valve **67** that adjusts a flow rate of the top hat fuel Ft.

[0086] The pilot fuel line **61**, the main A fuel line **62***a,* the main B fuel line **62***b*, and the top hat fuel line **63** are all lines branching out from the fuel main line **60**. The pilot fuel valve **65** is provided in the pilot fuel line **61**. The main A fuel line **62***a* includes a main line and a plurality of diverging lines that branch out from the main line. The plurality of diverging lines are provided respectively for the three main nozzles **54** that form the main nozzle A group **54A**. The main A fuel valve **66***a* is provided in the main line of the main A fuel line **62***a*. The main B fuel line **62***b* includes a main line and a plurality of diverging lines that branch out from the main line. The plurality of diverging lines are provided respectively for the five main nozzles **54** that form the main nozzle B group **54B**. The main B fuel valve **66***b* is provided in the main line of the main B fuel line **62***b*. The top hat fuel line **63** includes a main line and a plurality of diverging lines that branch out from the main line. The plurality of diverging lines are provided respectively for the plurality of top hat

nozzles **51**. The top hat fuel valve **67** is provided in the main line of the top hat fuel line **63**.

[0087] As illustrated in FIG. **1**, the gas turbine plant of the present embodiment further includes a control device (a fuel flow rate setting device) **100**, a rotational frequency gauge **71**, an output gauge **72**, an intake temperature gauge **73**, an intake pressure gauge **74**, a blade path temperature gauge **75**, and an exhaust gas temperature gauge **76**. The control device **100** controls operations and the like of the above-described fuel valves **65**, **66a**, **66b**, and **67**. The rotational frequency gauge **71** detects a rotational frequency N of the gas turbine rotor **28**. The output gauge **72** detects an output PW of the generator **29**. The intake temperature gauge **73** detects an intake temperature Ti that is a temperature of air A taken in by the compressor **11**.

[0088] The intake pressure gauge **74** detects an intake pressure (atmospheric pressure) Pi that is a pressure of the air taken in by the compressor **11**. The blade path temperature gauge **75** detects a blade path temperature Tb that is a temperature of the combustion gas that has just passed through the final stage of the turbine **21**. The exhaust gas temperature gauge **76** detects a temperature Te of the exhaust gas inside the exhaust duct, further to the downstream side than the final stage of the turbine **21**.

[0089] As illustrated in FIG. **5**, the control device **100** includes a combustion load command generator (a parameter generator) **110**, a total fuel flow rate generator **130**, a pilot flow rate computing unit **141**, a top hat flow rate computing unit **142**, a main flow rate computing unit (a total premixed fuel computing unit) **143**, a nozzle group flow rate ratio computing unit (simply, a flow rate ratio computing unit) **160**, a correction value computing unit **170**, a corrector **179**, a nozzle group flow rate computing unit (simply, a flow rate computing unit) **180**, and a valve controller **190**.

[0090] The combustion load command generator **110** generates a combustion load command value CLCSO (a parameter generating step). The total fuel flow rate generator **130** generates a total fuel flow rate command value CSO. The pilot flow rate computing unit **141** determines a pilot flow rate command value PLCSO, which is a flow rate of the pilot fuel Fp supplied to the pilot nozzle **44**. The top hat flow rate computing unit **142** determines a top hat flow rate THCSO, which is a flow rate of the top hat fuel Ft supplied to all the top hat nozzles **51**. The main flow rate computing unit **143** determines a main flow rate MCSO, which is a flow rate of the main fuel Fm supplied to all the main nozzles **54**. The nozzle group flow rate ratio computing unit **160** determines a nozzle group flow rate ratio KMB_{01}, which is a flow rate ratio between the main A fuel Fma supplied to the main nozzle A group **54A** and the main B fuel Fmb supplied to the main nozzle B group **54B**. The correction value computing unit **170** determines a correction value KMBc of the nozzle group flow rate ratio KMB_{01} determined by the nozzle group flow rate ratio computing unit **160**. The corrector **179** corrects the nozzle group flow rate ratio KMB_{01} determined by the nozzle group flow rate ratio computing unit **160**, using the correction value KMBc determined by the correction value computing unit **170**. The nozzle group flow rate computing unit **180** determines a main A flow rate MACSO of the main A fuel Fma supplied to the main nozzle A group **54A** and a main B flow rate MBCSO of the main B fuel Fmb supplied to the main nozzle B group **54B**, in accordance with the nozzle group flow rate ratio KMB corrected by the corrector **179**. The valve controller **190** determines an open-

ing amount for each of the fuel valves **65**, **66a**, **66b**, and **67** in accordance with the flow rate of the fuel valves **65**, **66a**, **66b**, and **67** determined by each of the flow rate computing units **141**, **142**, and **180**, and specifies the opening amount for each of the fuel valves **65**, **66a**, **66b**, and **67**.

[0091] The combustion load command value CLCSO is a parameter that is an inlet temperature of the combustion gas in the turbine **21** when the inlet temperature is made dimensionless, and is a parameter having a positive correlation with the inlet temperature. Further, the combustion load command value CLCSO is also a parameter having a correlation with a gas turbine output. The combustion load command value CLCSO is set to be 0% when the inlet temperature is at a lower limit value and to be 100% when the inlet temperature is at an upper limit value. For example, when the lower limit value of the inlet temperature is 700° C. and the upper limit value of the inlet temperature is 1500° C., the combustion load command value CLCSO is expressed by Equation (1) below.

$$\text{CLCSO (\%)} = \{(\text{Measured value of generator output} - 700° \text{ C.MW})/(1500° \text{ C.MW} - 700° \text{ C.MW})\} \times 100 \qquad (1)$$

[0092] Note that 700° C.MW is the generator output when the inlet temperature is the lower limit value of 700° C. Further, 1500° C.MW is the generator output when the inlet temperature is the upper limit value of 1500° C.

[0093] As illustrated in FIG. **6**, the combustion load command generator **110** includes a first output computing unit **111a**, a second output computing unit **111b**, a standard atmospheric pressure generator **112**, a first divider **113**, a first multiplier **114a**, a second multiplier **114b**, a first subtractor **115a**, a second subtractor **115b**, a second divider **116**, and a limiter **117**. The first output computing unit **111a** determines the generator output 700° C.MW occurring when the inlet temperature is at its lower limit of 700° C. The second output computing unit **111b** determines the generator output 700° C.MW occurring when the inlet temperature is at its upper limit value of 1500° C. The standard atmospheric pressure generator **112** generates a preset standard atmospheric pressure Ps. The first divider **113** determines an intake pressure ratio Pr, which is a ratio of the intake pressure Pi detected by the intake pressure gauge **74** to the standard atmospheric pressure (standard intake pressure) Ps. The first multiplier **114a** multiplies the generator output 700° C.MW determined by the first output computing unit **111a**, by the intake pressure ratio Pr. The second multiplier **114b** multiplies the generator output 1500° C.MW determined by the second output computing unit **111b**, by the intake pressure ratio Pr. The first subtractor **115a** subtracts the multiplication result obtained by the first multiplier **114a** from a measured output PW of the generator **29** detected by the output gauge **72**. The second subtractor **115b** subtracts the multiplication result obtained by the first multiplier **114a** from the multiplication result obtained by the second multiplier **114b**. The second divider **116** divides the subtraction result obtained by the first subtractor **115a** by the subtraction result obtained by the second subtractor **115b**. The limiter **117** limits an increase/decrease rate of the output from the second divider **116**.

[0094] The first output computing unit **111a** determines the generator output 700° C.MW occurring when the inlet temperature is 700° C., using a function H1x with the intake temperature Ti and an IGV opening amount command value serving as fluctuating parameters. Further, the second output computing unit **111b** determines the generator output 700°

C.MW occurring when the inlet temperature is 1500° C., using a function H2x with the intake temperature Ti and the IGV opening amount command value serving as fluctuating parameters. Here, the IGV opening amount command value is a command value given to the driver 16 of the IGV 14 by the control device 100. This IGV opening amount command value is determined, for example, on the basis of the atmospheric pressure Pi, which is a pressure at an inlet of the compressor 11, a pressure at an outlet of the compressor 11, and the like. The output computing units 111a and 111b change the known values of 700° C.MW and 1500° C.MW, obtained when the intake temperature and the IGV opening amount command value are reference values, respectively, to values corresponding to the measured intake temperature Ti and IGV opening amount command value, and output the changed values as 700° C.MW and 1500° C.MW.

[0095] Those 700° C.MW and 1500° C.MW are further corrected on the basis of the measured value Pi of the intake pressure (atmospheric pressure). Specifically, the first divider 113 determines the intake pressure ratio Pr, which is a ratio of the intake pressure (atmospheric pressure) Pi detected by the intake pressure gauge 74 to the standard intake pressure (standard atmospheric pressure) Ps from the standard atmospheric pressure generator 112. The first multiplier 114a multiplies the 700° C.MW from the first output computing unit 111a by the intake pressure ratio Pr, and corrects the 700° C.MW to be a value corresponding to the intake pressure ratio Pr. The second multiplier 114b multiplies the 1500° C.MW from the second output computing unit 111b by the intake pressure ratio Pr, and corrects the 1500° C.MW to be a value corresponding to the intake pressure ratio Pr. In other words, in the configuration described above, the known values of 700° C.MW and 1500° C.MW, obtained when the intake temperature and the IGV opening amount command value are the reference values, are corrected to be the values corresponding to the measured intake temperature Ti and IGV opening amount command value, and the measured intake pressure ratio Pr.

[0096] The first subtractor 115a subtracts the 700° C.MW corrected by the intake pressure ratio Pr from the measured output PW of the generator 29 detected by the output gauge 72. In other words, the first subtractor 115a determines a value of the numerator in the above-described equation. The second subtractor 115b subtracts the 700° C.MW corrected by the intake pressure ratio Pr from the 1500° C.MW corrected by the intake pressure ratio PE In other words, the second subtractor 115b determines a value of the denominator in the above-described equation.

[0097] The second divider 116 divides the value of the numerator in the above-described equation, which has been determined by the first subtractor 115a, by the value of the denominator in the above-described equation, which has been determined by the second subtractor 115b, and outputs the resulting value as the combustion load command value. The limiter 117 limits the increase/decrease rate of the combustion load command value, which is an amount of change of the combustion load command value from the second divider 116 per unit time, such that the increase/decrease rate becomes equal to or less than a predetermined value.

[0098] In the description above, the lower limit value of the inlet temperature of the combustion gas in the turbine 21 is set to 700° C., and the upper limit value of the same is set to 1500° C. However, depending on the model type of the combustor 31 and the like, the lower limit value and the upper limit value of the inlet temperature of the combustion gas in the turbine 21 may be set to different values from those used in the above-described example.

[0099] The total fuel flow rate command value CSO is a command value indicating a total flow rate of the fuel F supplied to the combustor 31. As illustrated in FIG. 7, the total fuel flow rate generator 130 includes a governor controller 131, a load controller 132, a first temperature controller 133, a second temperature controller 134, a low value selector 135, and a limiter 136. The governor controller 131 outputs a command value GVCSO for adjusting the total fuel flow rate command value CSO such that the rotational frequency N of the gas turbine rotor 28 becomes a target rotational frequency. The load controller 132 outputs a command value LDCSO for adjusting the total fuel flow rate command value CSO such that the generator output PW matches a generator output command value. The first temperature controller 133 outputs a command value BPCSO for adjusting the total fuel flow rate command value CSO such that the blade path temperature Tb of the gas turbine does not exceed its upper limit value. The second temperature controller 134 outputs a command value EXCSO for adjusting the total fuel flow rate command value CSO such that the exhaust gas temperature Te does not exceed its upper limit value. The low value selector 135 outputs the lowest command value among the command values from the controllers 131 to 134. The limiter 136 limits the increase/decrease rate of the command from the low value selector 135.

[0100] The governor controller 131 receives the rotational frequency N of the gas turbine rotor 28 from the rotational frequency gauge 71 and outputs a command value GVCSO for adjusting the total fuel flow rate command value CSO such that the rotational frequency N of the gas turbine rotor 28 matches the target rotational frequency. Specifically, the governor controller 131 compares the measured rotational frequency N of the gas turbine rotor 28 with a preset GV setting value, and outputs a proportional control signal as the command value GVCSO.

[0101] The load controller 132 receives the measured output PW of the generator 29 from the output gauge 72 and the generator output command value from a host control device 90 (see FIG. 1). The load controller 132 outputs a command value LDCSO for adjusting the total fuel flow rate command value CSO such that the measured output PW matches the generator output command value. Specifically, the load controller 132 compares the measured output PW with the generator output command value, computes a proportional integral, and outputs the result thereof as the command value LDCSO.

[0102] The first temperature controller 133 receives the blade path temperature Tb from the blade path temperature gauge 75, and outputs a command value BPCSO for adjusting the total fuel flow rate command value CSO such that the blade path temperature Tb does not exceed its upper limit value. Specifically, the first temperature controller 133 compares the measured blade path temperature Tb with the upper limit value thereof, computes a proportional integral, and outputs the result thereof as the command value BPCSO.

[0103] The second temperature controller 134 receives the exhaust gas temperature Te from the exhaust gas temperature gauge 76, and outputs a command value EXCSO for adjusting the total fuel flow rate command value CSO such

that the exhaust gas temperature Te does not exceed its upper limit value. Specifically, the second temperature controller **134** compares the measured exhaust gas temperature Te with the upper limit value thereof, computes a proportional integral, and outputs the result thereof as the command value EXCSO.

[0104] The low value selector **135** selects the lowest command value among the command values from the controllers **131** to **134** and outputs the selected command value. The limiter **136** limits the increase/decrease rate of the command from the low value selector **135**, and outputs this as the total fuel flow rate command value CSO.

[0105] The pilot flow rate computing unit **141** has a function Fxp that specifies the relationship between the total fuel flow rate command value CSO and the pilot flow rate command value PLCSO, as illustrated in FIG. **8**. Using this function Fxp, the pilot flow rate computing unit **141** determines the pilot flow rate command value PLCSO corresponding to the total fuel flow rate command value CSO generated by the total fuel flow rate generator **130**. The top hat flow rate computing unit **142** has a function Fxt that specifies the relationship between the total fuel flow rate command value CSO and the top hat flow rate THCSO. Using this function Fxt, the top hat flow rate computing unit **142** determines the top hat flow rate THCSO corresponding to the total fuel flow rate command value CSO output by the total fuel flow rate generator **130**. As shown by Equation (2) below, the main flow rate computing unit **143** determines the main flow rate MCSO by subtracting the pilot flow rate command value PLCSO and the top hat flow rate THCSO from the total fuel flow rate command value CSO.

$$MCSO=CLO-PLCSO-THCSO \qquad (2)$$

[0106] As illustrated in FIG. **9**, the nozzle group flow rate ratio computing unit **160** includes a nozzle group flow rate ratio generator **161** that generates a nozzle group flow rate ratio KMB_0, a correction value generator **162** that generates a correction value KMB_{co} for the nozzle group flow rate ratio KMB_0, and a corrector **163** that corrects the nozzle group flow rate ratio KMB_0 by the correction value KMB_{co} generated by the correction value generator **162**.

[0107] The nozzle group flow rate ratio generator **161** has a function Fx1 (a flow rate ratio relationship) that specifies the relationship between the combustion load command value CLCSO and the nozzle group flow rate ratio (fuel flow rate ratio) KMB_0. As shown by Equation (3) below, the nozzle group flow rate ratio KMB is a value obtained by dividing the main B flow rate MBCSO, which is the flow rate of the main B fuel Fmb supplied to the main nozzle B group **54B**, by a value obtained by adding the main A flow rate MACSO, which is the flow rate of the main A fuel Fmb supplied to the main nozzle A group **54A**, and the main B flow rate MBCSO.

$$KMB=MBCSO/(MACSO+MBCSO) \qquad (3)$$

[0108] In a case that the fuel is supplied at the same flow rate to each of the three main nozzles **54** forming the main nozzle A group **54A** and the five main nozzles **54** forming the main nozzle B group **54B**, the nozzle group flow rate ratio KMB becomes 0.625 as shown by Equation (4) below.

$$KMB=5/(3+5)=0.625 \qquad (4)$$

[0109] This value 0.625 is used as a reference value for the nozzle group flow rate ratio KMB_0, which is specified by the function Fx1 with respect to the combustion load command value CLCSO.

[0110] As illustrated in FIG. **10**, a combustion oscillation region CVR may occur in a region in which the combustion load command value CLCSO is within a predetermined range and the nozzle group flow rate ratio KMB is also within a predetermined range. Here, it is assumed that the combustion oscillation region CVR occurs when the combustion load command value CLCSO is within the range of x1 to x2 (x1<x2) and the nozzle group flow rate ratio KMB is within the range of y1 to y2 (y1<0.625<y2), for example. Note that the combustion oscillation region CVR is identified in advance, using the actual combustor **31** or a simulator that simulates a combustion state of the combustor **31**.

[0111] The function Fx1 is a function that is formulated so as to avoid the combustion oscillation region CVR, in which a combustion oscillation occurs, among regions defined by the combustion load command value CLCSO and the nozzle group flow rate ratio KMB, as illustrated in FIG. **10**. Specifically, this function Fx1 is a function in which the nozzle group flow rate ratio KMB_0 is an almost constant value greater than 0.625 when the combustion load command value CLCSO is smaller than x1. Further, this function Fx1 is a function in which, when the combustion load command value CLCSO is within the range of x1 to x2, the nozzle group flow rate ratio KMB_0 changes along a bottom side (a side on which the nozzle group flow rate ratio KMB is smaller) of the outer edge of the combustion oscillation region CVR as the combustion load command value CLCSO becomes greater. More specifically, this function Fx1 is a function in which, when the combustion load command value CLCSO is within the range of x1 to x2 and is a value closer to x1, the nozzle group flow rate ratio KMB_0 becomes smaller along the bottom side of the outer edge of the combustion oscillation region CVR as the combustion load command value CLCSO becomes greater. Further, this function Fx1 is a function in which, when the combustion load command value CLCSO is within the range of x1 to x2 and is a value closer to x2, the nozzle group flow rate ratio KMB_0 becomes greater along the bottom side of the outer edge of the combustion oscillation region CVR as the combustion load command value CLCSO becomes greater. Further, this function Fx1 is a function in which, when the combustion load command value CLCSO is greater than x2, the nozzle group flow rate ratio KMB_0 is almost 0.625, regardless of the combustion load command value CLCSO.

[0112] As described above, this function Fx1 is a function in which, when the combustion load command value CLCSO is within a certain range, the nozzle group flow rate ratio KMB_0 becomes smaller as the combustion load command value CLCSO becomes greater, when the combustion load command value CLCSO is within another range, the nozzle group flow rate ratio KMB_0 becomes greater as the combustion load command value CLCSO becomes greater, and when the combustion load command value CLCSO is within yet another range, the nozzle group flow rate ratio KMB_0 becomes constant regardless of the changes in the combustion load command value CLCSO. However, this function Fx1 is a function in which the nozzle group flow rate ratio KMB_0 changes continuously as the combustion load command value CLCSO changes, regardless of the range of the combustion load command value CLCSO.

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[0113] Using this function Fx1, the nozzle group flow rate ratio generator 161 generates the nozzle group flow rate ratio KMB_0 corresponding to the combustion load command value CLCSO generated by the combustion load command generator 110.

[0114] The correction value generator 162 of the nozzle group flow rate ratio computing unit 160 has a function Fx2 that specifies the relationship between the main flow rate MCSO and the correction value KMB_0 as illustrated in FIG. 9. Using this function Fx2, the correction value generator 162 generates the correction value KMB_{co} corresponding to the main flow rate MCSO determined by the main flow rate computing unit 143. Generally, a valve does not have a linear relationship between the opening amount of the valve and the flow rate of a fluid flowing through the valve. Thus, here, the correction value KMB_{co} is determined while taking into account valve characteristics of the main A fuel valve 66a and the main B fuel valve 66b, such that the actual nozzle group flow ratio becomes a target nozzle group flow rate ratio KMB, as a result of the valve controller 190 instructing the main A fuel valve 66a and the main B fuel valve 66b to apply specific opening amounts. The corrector 163 of the nozzle group flow rate ratio computing unit 160 corrects this nozzle group flow rate ratio KMB_0 by adding the correction value KMB_{co} generated by the correction value generator 162 to the nozzle group flow rate ratio KMB_0 generated by the nozzle group flow rate ratio generator 161. This post-correction nozzle group flow rate ratio KMB_{01} becomes an output from the nozzle group flow rate ratio computing unit 160.

[0115] As illustrated in FIG. 9, the correction value computing unit 170 includes: a first correction value generator 171 that generates a first correction value KMBc1, which is a correction value applied when the output is increasing; a second correction value generator 172 that generates a second correction value KMBc2, which is a correction value applied when the output is decreasing; an output change detector 173 that detects a change in the total fuel flow rate command value CSO, which is correlated to a change in the gas turbine output; and a switching unit 177. The switching unit 177 outputs, to the corrector 179, one of the first correction value KMBc1, the second correction value KMBc2, and a correction value "0".

[0116] When the gas turbine output changes, a region of the combustion oscillation region CVR changes, as illustrated in FIG. 10. The change in the region of the combustion oscillation region CVR is different between when the gas turbine output is increasing and when the gas turbine output is decreasing. A combustion oscillation region CVR1 that occurs when the output is increasing, is a region in which the bottom side (the side on which the nozzle group flow rate ratio KMB is smaller) of the outer edge of the combustion oscillation region CVR that occurs when the gas turbine output is not changing, is expanded downward, for example. A combustion oscillation region CVR2 that occurs when the output is decreasing, is a region in which the bottom side of the outer edge of the combustion oscillation region CVR that occurs when the gas turbine output is not changing, is expanded further downward than the bottom side of the outer edge of the combustion oscillation region CVR1 that occurs when the output is increasing. Note that the combustion oscillation region CVR1 that occurs when the output is increasing and the combustion oscillation region CVR2 that occurs when the output is decreasing are

also identified in advance, using the actual combustor 31 or the simulator that simulates the combustion state of the combustor 31.

[0117] The first correction value generator 171 and the second correction value generator 172 each generate a correction value for correcting the nozzle group flow rate ratio KMB_{01} determined by the nozzle group flow rate ratio computing unit 160, in order to respond to the change in the combustion oscillation region CVR, which is caused by the change in the gas turbine output in the above-described manner. The first correction value generator 171 has a function Fup (a correction value relationship) that specifies the relationship between the combustion load command value CLCSO and the first correction value KMBc1, which is the correction value applied when the output is increasing. The second correction value generator 172 has a function Fdown (a correction value relationship) that specifies the relationship between the combustion load command value CLCSO and the second correction value KMBc2, which is the correction value applied when the output is decreasing.

[0118] As illustrated in FIG. 10 and FIG. 11, the function Fup is a function that is formulated so as to avoid the combustion oscillation region CVR1 that occurs when the output is increasing. As described above, the combustion oscillation region CVR1 that occurs when the output is increasing is the region in which the bottom side (the side on which the nozzle group flow rate ratio KMB is smaller) of the outer edge of the combustion oscillation region CVR that occurs when the gas turbine output is not changing, is expanded downward, for example. In this case, the function Fup associates a negative first correction value KMBc1 with the combustion load command value CLCSO so as to cause the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit 160 to be smaller.

[0119] Further, the function Fdown is a function that is formulated so as to avoid the combustion oscillation region CVR2 that occurs when the output is decreasing. As described above, the combustion oscillation region CVR2 that occurs when the output is decreasing is the region in which the bottom side of the outer edge of the combustion oscillation region CVR that occurs when the gas turbine output is not changing, is expanded further downward than the bottom side of the outer edge of the combustion oscillation region CVR1 that occurs when the output is increasing. In this case, the function Fdown associates a negative second correction value KMBc2, which is even smaller than the first correction value KMBc1 applied when the output is increasing, with the combustion load command value CLCSO so as to cause the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit 160 to be even smaller than the ratio applied when the output is increasing.

[0120] Using the function Fup, the first correction value generator 171 generates the first correction value KMBc1 corresponding to the combustion load command value CLCSO. Further, using the function Fdown, the second correction value generator 172 generates the second correction value KMBc2 corresponding to the combustion load command value CLCSO.

[0121] As described above, in the present embodiment, both the first correction value KMBc1 generated by the first correction value generator 171 and the second correction value KMBc2 generated by the second correction value generator 172 are correction values that cause the nozzle

group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit **160** to be smaller. In other words, given the definition of the nozzle group flow rate ratio KMB shown by Equation (3), the first correction value KMBc1 and the second correction value KMBc2 according to the present embodiment are both values that decrease the main B flow rate MBCSO supplied to the main nozzle B group **54B**, which, of the main nozzle A group **54A** and the main nozzle B group **54B**, has a greater number of the main nozzles **54**.

[0122] As illustrated in FIG. **9**, the output change detector **173** includes: a delay unit **174** that outputs the total fuel flow rate command value CSO from the total fuel flow rate generator **130** after a predetermined amount of time elapses; a subtractor **175** that determines a difference between the total fuel flow rate command value CSO from the total fuel flow rate generator **130** and the total fuel flow rate command value CSO from the delay unit **174**; and a change determiner **176** that determines whether the total fuel flow rate command value CSO is increasing by a predetermined value or greater or decreasing by a predetermined value or greater on the basis of the subtraction result. When the subtraction result from the subtractor **175** is a positive value and the value is equal to or greater than the predetermined value, the change determiner **176** outputs "1", which indicates that the gas turbine output is increasing. When the subtraction result from the subtractor is a negative value and the value is equal to or less than the predetermined value, the change determiner **176** outputs "2", which indicates that the gas turbine output is decreasing, and in other cases, the change determiner **176** outputs "0", which indicates that the gas turbine output is not changing.

[0123] When the output change detector **173** outputs "1" that indicates that the gas turbine output is increasing, the switching unit **177** selects the first correction value KMBc1 from the first correction value generator **171**, and outputs the first correction value KMBc1. When the output change detector **173** outputs "2" that indicates that the gas turbine output is decreasing, the switching unit **177** selects the second correction value KMBc2 from the second correction value generator **172**, and outputs the second correction value KMBc2. When the output change detector **173** outputs "0" that indicates that the gas turbine output is not changing, the switching unit **177** outputs the correction value "0". The output from the switching unit **177** becomes an output from the correction value computing unit **170**.

[0124] The corrector **179** corrects the nozzle group flow rate ratio KMB_{01} by adding the correction value KMBc from the correction value computing unit **170** to the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit **160**. Specifically, when the gas turbine output is increasing, the corrector **179** adds the first correction value KMBc1 to the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit **160**. When the gas turbine output is decreasing, the corrector **179** adds the second correction value KMBc2 to the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit **160**. When the gas turbine output is not changing, the corrector **179** adds the correction value "0" to the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit **160**. In other words, the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit **160** is not corrected.

[0125] Similarly to the nozzle group flow rate ratio KMB_{01} output from the nozzle group flow rate ratio computing unit **160**, the nozzle group flow rate ratio KMB output from the corrector **179** changes continuously as the combustion load command value CLCSO changes.

[0126] The nozzle group flow rate computing unit **180** has a main A flow rate computing unit **181** that determines the main A flow rate MACSO and a main B flow rate computing unit **182** that determines the main B flow rate MBCSO. The main A flow rate computing unit **181** determines the main A flow rate MACSO by subtracting from "1" the nozzle group flow rate ratio KMB from the corrector **179**, and multiplying the resulting value by the main flow rate MCSO determined by the main flow rate computing unit **143**. The main B flow rate computing unit **182** determines the main B flow rate MBCSO by multiplying the nozzle group flow rate ratio KMB from the corrector **179** by the main flow rate MCSO determined by the main flow rate computing unit **143**.

[0127] As illustrated in FIG. **5**, the valve controller **190** determines the opening amount for the pilot fuel valve **65** corresponding to the pilot flow rate command value PLCSO determined by the pilot flow rate computing unit **141**, and instructs the pilot fuel valve **65** to apply this opening amount. The valve controller **190** determines the opening amount for the top hat fuel valve **67** corresponding to the top hat flow rate THCSO determined by the top hat flow rate computing unit **142**, and instructs the top hat fuel valve **67** to apply this opening amount. The valve controller **190** determines the opening amount for the main A fuel valve **66a** corresponding to the main A flow rate MACSO determined by the nozzle group flow rate computing unit **180**, and instructs the main A fuel valve **66a** to apply this opening amount. The valve controller **190** determines the opening amount for the main B fuel valve **66b** corresponding to the main B flow rate MBCSO determined by the nozzle group flow rate computing unit **180**, and instructs the main B fuel valve **66b** to apply this opening amount.

[0128] Next, operations of the gas turbine plant of the present embodiment will be described.

[0129] As illustrated in FIG. **1**, the compressor of the gas turbine **10** generates the compressed air Ac by compressing the air A. This compressed air Ac flows into the combustor **31**. The fuel F is supplied to the combustor **31**. The fuel F is combusted in the compressed air Ac inside the combustor **31** to generate the high-temperature, high-pressure combustion gas. This combustion gas is supplied from the combustor **31** into the combustion gas channel in the turbine **21** to rotate the turbine rotor **23**, With the rotation of this turbine rotor **23**, the generator **29** connected to the gas turbine **10** generates power.

[0130] The fuel F from a fuel supply source flows in the fuel main line **60**. A portion of the fuel F is supplied, as the pilot fuel Fp, to the pilot nozzle **44** via the pilot fuel line **61** and the pilot fuel valve **65**. The pilot fuel Fp supplied to the pilot nozzle **44** is sprayed from the pilot nozzle **44** into the combustion liner **33**, as illustrated in FIG. **2** and FIG. **3**. Further, a portion of the compressed air Ac from the compressor **11** passes through the pilot air tube **45** as the pilot air Ap and is sprayed from the pilot air tube **45** into the combustion liner **33**. The pilot fuel Fp is combusted through diffusion combustion in the pilot air Ap to form the diffusion flame **49**.

[0131] A portion of the fuel F that has flowed through the fuel main line **60** is supplied, as the main A fuel Fma, to the

plurality of main nozzles **54** forming the main nozzle A group **54**A via the main A fuel line **62***a* and the main A fuel valve **66***a*. Further, a portion of the fuel F that has flowed through the fuel main line **60** is supplied, as the main B fuel Fb, to the plurality of main nozzles **54** forming the main nozzle B group **54**B via the main B fuel line **62***b* and the main B fuel valve **66***b*. The main fuel Fm that has been supplied to those main nozzles **54** is sprayed from the main nozzles **54** into the main air channel **58**, as illustrated in FIG. **2** and FIG. **3**. Further, a portion of the compressed air Ac from the compressor **11** flows into the main air channel **58** as the main air Am. Inside the main air channel **58**, the main air Am and the main fuel Fm are mixed to form the premixed gas. This premixed gas is sprayed from the main air channel **58** into the combustion liner **33**. The premixed gas sprayed from the main air channel **58** is combusted through premixed combustion and forms the premixed flame **59**.

[0132] A portion of the fuel F that has flowed through the fuel main line **60** is supplied, as the top hat fuel Ft, to the plurality of top hat nozzles **51** via the top hat fuel line **63** and the top hat fuel valve **67**, as illustrated in FIG. **2**. The top hat fuel Ft that has been supplied to the top hat nozzles **51** is sprayed into the compressed air channel **52** provided between the inner circumferential side of the external cylinder **32** of the combustor **31** and the outer circumferential side of the combustor basket **42** of the combustor **31**. This top hat fuel Ft is mixed into the main air Am and the pilot air Ap. Thus, a portion of the top hat fuel Ft is included in the gas sprayed from the pilot burner **43** and is combusted as a result of the combustion of the gas. Further, a portion of the remaining top hat fuel Ft is included in the gas sprayed from the main burners **53** and is combusted as a result of the combustion of the gas.

[0133] Each of the fuel valves **65**, **66***a*, **66***b*, and **67** are controlled by the control device **100**.

[0134] As described above, the total fuel flow rate generator **130** of the control device **100** generates the total fuel flow rate command value CSO in accordance with the generator output command value, and the like. The pilot flow rate computing unit **141** determines the pilot flow rate command value PLCSO corresponding to the total fuel flow rate command value CSO. The valve controller **190** accepts the pilot flow rate command value PLCSO and determines the opening amount for the pilot fuel valve **65** corresponding to the pilot flow rate command value PLCSO, and instructs the pilot fuel valve **65** to apply this opening amount. The pilot fuel valve **65** accepts this instruction and applies the instructed opening amount. As a result, the pilot flow rate at the time of passing though the pilot fuel valve **65** becomes the pilot flow rate command value PLCSO generated by the pilot flow rate computing unit **141**. The top hat flow rate computing unit **142** determines the top hat flow rate THCSO corresponding to the total fuel flow rate command value CSO. The valve controller **190** accepts the top hat flow rate THCSO and determines the opening amount for the top hat fuel valve **67** corresponding to the top hat flow rate THCSO, and instructs the top hat fuel valve **67** to apply this opening amount. The top hat fuel valve **67** accepts this instruction and applies the instructed opening amount. As a result, the top hat flow rate at the time of passing through the top hat fuel valve **67** becomes the top hat flow rate THCSO generated by the top hat flow rate computing unit **142**. The main

flow rate computing unit **143** determines the main flow rate MCSO corresponding to the total fuel flow rate command value CSO.

[0135] Next, control of the main A fuel valve **66***a* and the main B fuel valve **66***b* by the control device **100** will be described with reference to a flowchart illustrated in FIG. **12**.

[0136] The nozzle group flow rate ratio computing unit **160** determines the nozzle group flow rate ratio KMB_{01} corresponding to the combustion load command value CLCSO and the main flow rate MCSO (S1: a flow rate ratio computing step). As illustrated in FIG. **9**, using the function Fx1, the nozzle group flow rate ratio generator **161** of the nozzle group flow rate ratio computing unit **160** generates the nozzle group flow rate ratio KMB_0 corresponding to the combustion load command value CLCSO generated by the combustion load command generator **110**. Using the function Fx2, the correction value generator **162** of the nozzle group flow rate ratio computing unit **160** determines the correction value KMB_{co} corresponding to the main flow rate MCSO. The corrector **163** of the nozzle group flow rate ratio computing unit **160** corrects the nozzle group flow rate ratio KMB_0 by adding the correction value KMB_{co} determined by the correction value generator **162** to the nozzle group flow rate ratio KMB_0 generated by the nozzle group flow rate ratio generator **161**. This post-correction nozzle group flow rate ratio KMB_{01} becomes an output from the nozzle group flow rate ratio computing unit **160**.

[0137] In parallel with the flow rate ratio computing step (S1) performed by the nozzle group flow rate ratio computing unit **160**, the correction value computing unit **170** determines the correction value KMBc for the nozzle group flow rate ratio KMB_{01} corresponding to the change in the output of the gas turbine **10** (S2: a correction value computing step). Using the function Fup, the first correction value generator **171** of the correction value computing unit **170** generates the first correction value KMBc1 corresponding to the combustion load command value CLCSO (S2*a*). This first correction value KMBc1 is the correction value KMBc applied when the gas turbine output is increasing. Further, using the function Fdown, the second correction value generator **172** of the correction value computing unit **170** generates the second correction value KMBc2 corresponding to the combustion load command value CLCSO (S2*b*). This second correction value KMBc2 is the correction value KMBc applied when the gas turbine output is decreasing. On the basis of the total fuel flow rate command value CSO, the output change detector **173** of the correction value computing unit **170** determines whether the gas turbine output is increasing, the gas turbine output is decreasing, or the gas turbine output is not changing (S2*c*). When the output change detector **173** determines that the gas turbine output is increasing, the output change detector **173** outputs "1", which indicates that the output is increasing. When the output change detector **173** determines that the gas turbine output is decreasing, the output change detector **173** outputs "2", which indicates that the output is decreasing. When the output change detector **173** determines that the gas turbine output is not changing, the output change detector **173** outputs "0", which indicates that the output is not changing. When "1" is output from the output change detector **173**, the switching unit **177** of the correction value computing unit **170** outputs, to the corrector **179**, the first correction value KMBc1 applied when the gas turbine output is increasing as

the correction value KMBc. When "2" is output from the output change detector 173, the switching unit 177 outputs, to the corrector 179, the second correction value KMBc2 applied when the gas turbine output is decreasing as the correction value KMBc. When "0" is output from the output change detector 173, the switching unit 177 outputs, to the corrector 179, the correction value "0" as the correction value KMBc.

[0138] The corrector 179 corrects the nozzle group flow rate ratio KMB_{01} by adding the correction value KMBc from the correction value computing unit 170 to the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit 160 (S3: a correcting step). When the corrector 179 accepts the first correction value KMBc1 applied when the gas turbine output is increasing from the correction value computing unit 170, the corrector 179 adds the first correction value KMBc1 to the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit 160 (S3a). When the corrector 179 accepts the second correction value KMBc2 applied when the gas turbine output is decreasing from the correction value computing unit 170, the corrector 179 adds the second correction value KMBc2 to the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit 160 (S3b). When the corrector 179 accepts the correction value "0" from the correction value computing unit 170, the corrector 179 adds the correction value "0" to the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit 160 (S3c). Specifically, at step S3c, the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit 160 is not corrected in actuality.

[0139] The nozzle group flow rate computing unit 180 determines the main A flow rate MACSO and the main B flow rate MBCSO, using the main flow rate MCSO determined by the main flow rate computing unit 143 and the nozzle group flow rate ratio KMB from the corrector 179 (S4: a flow rate computing step). The main A flow rate computing unit 181 of the nozzle group flow rate computing unit 180 determines the main A flow rate MACSO by subtracting from "1" the nozzle group flow rate ratio KMB from the corrector 179, and multiplying the resulting value by the main flow rate MCSO determined by the main flow rate computing unit 143. The main B flow rate computing unit 182 of the nozzle group flow rate computing unit 180 determines the main B flow rate MBCSO by multiplying the nozzle group flow rate ratio KMB from the corrector 179 by the main flow rate MCSO determined by the main flow rate computing unit 143.

[0140] The valve controller 190 accepts the main A flow rate MACSO, determines the opening amount for the main A fuel valve 66a corresponding to the main A flow rate MACSO, and instructs the main A fuel valve 66a to apply this opening amount. Further, the valve controller 190 accepts the main B flow rate MBCSO, determines the opening amount for the main B fuel valve 66b corresponding to the main B flow rate MBCSO, and instructs the main B fuel valve 66b to apply this opening amount (S5: a valve controlling step). The main A fuel valve 66a accepts this instruction and applies the instructed opening amount. As a result, the main A flow rate, which passes through the main A fuel valve 66a and is supplied to all the main nozzles 54 forming the main nozzle A group 54A, becomes the main A flow rate MACSO determined by the nozzle group flow rate

computing unit 180. Further, the main B fuel valve 66b accepts this instruction and applies the instructed opening amount. As a result, the main B flow rate, which passes through the main B fuel valve 66b and is supplied to all the main nozzles 54 forming the main nozzle B group 54B, becomes the main B flow rate MBCSO determined by the nozzle group flow rate computing unit 180.

[0141] As described above, the combustion oscillation region CVR may occur in the region in which the gas turbine output is within the predetermined range and the nozzle group flow rate ratio KMB is within the predetermined range. In the present embodiment, as described above, the occurrence of the combustion oscillation in the course of combusting the fuel is suppressed by changing the nozzle group flow rate ratio KMB in accordance with the combustion load command value CLCSO having a correlation with the gas turbine output. Further, in the present embodiment, the function Fx1 that specifies the relationship between the combustion load command value CLCSO and the nozzle group flow rate ratio KMB_0 is the function in which the nozzle group flow rate ratio KMB_0 changes continuously as the combustion load command value CLCSO changes. Thus, in the present embodiment, the nozzle group flow rate ratio KMB does not suddenly change significantly. As a result, in the present embodiment, the combustion stability of the fuel F can be improved.

[0142] Further, as described above, when the gas turbine output is changing, the combustion oscillation region CVR changes in accordance with the change in the gas turbine output. Thus, in the present embodiment, when the gas turbine output is changing, the combustion oscillation in the course of combusting the fuel F is avoided by correcting the nozzle group flow rate ratio KMB_{01}, and the combustion stability of the fuel F is achieved.

Modified Example

[0143] In the above-described embodiment, the function Fx1 that specifies the relationship between the combustion load command value CLCSO and the nozzle group flow rate ratio KMB_0 is the function in which, in order to avoid the combustion oscillation region CVR, the nozzle group flow rate ratio KMB_{01} changes along the bottom side (the side on which the nozzle group flow rate ratio KMB is smaller) of the outer edge of the combustion oscillation region CVR as the combustion load command value CLCSO changes. However, as illustrated in FIG. 13, depending on the form of the combustor, the type of the fuel and the like, in order to avoid the combustion oscillation region CVR, a function, in which the nozzle group flow rate ratio KMB_{01} changes along an upper side (on a side in which the nozzle group flow rate ratio MB is greater) of the outer edge of the combustion oscillation region CVR as the combustion load command value CLCSO changes, may be used as the function Fx1.

[0144] The combustion oscillation regions CVR1 and CVR2 that respectively occur when the gas turbine output is increasing and when the gas turbine output is decreasing may become a region in which the upper side (the side on which the nozzle group flow rate ratio KMB is greater) of the outer edge of the combustion oscillation region CVR that occurs when the gas turbine output is not changing, is expanded upward, as illustrated in FIG. 13. In a case that the function illustrated in FIG. 13 is used as the function Fx1, in order to avoid the combustion oscillation region CVR that occurs when the gas turbine output is changing, it is pref-

erable that both the first correction value KMBc1 applied when the output is increasing and the second correction value KMBc2 applied when the output is decreasing be positive values that cause the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit 160 to be greater, as illustrated in FIG. 13 and FIG. 14.

[0145] Thus, the correction value KMBc that corrects the nozzle group flow rate ratio KMB_{01} from the nozzle group flow rate ratio computing unit 160 may be a value that causes the nozzle group flow rate ratio KMB_{01} to be greater or a value that causes the nozzle group flow rate ratio KMB_{01} to be smaller in accordance with the changes of the combustion oscillation region CVR that occurs when the gas turbine output is changing.

[0146] In the above-described embodiment, the eight main nozzles 54 are divided into the main nozzle A group 54A formed by the three main nozzles 54 and the main nozzle B group 54B formed by the five main nozzles 54. However, the eight nozzles may be divided into a main nozzle group formed by one of the main nozzles 54 and a main nozzle group formed by seven of the main nozzles. Further, the eight nozzles may be divided into a main nozzle group formed by two of the main nozzles 54 and a main nozzle group formed by six of the main nozzles, or may be divided into a main nozzle group formed by four of the main nozzles 54 and a main nozzle group formed by four of the main nozzles.

[0147] Further, the number of the main nozzles 54 need not necessarily be eight, and may be less than or more than eight.

[0148] Furthermore, in the above-described embodiment, the plurality of main nozzles 54 are divided into two main nozzle groups, but they may be divided into three or more nozzle groups.

[0149] In the above-described embodiment, the relationship between two parameters is specified using a function. However, the relationship between two parameters may be specified using a map indicating a value of one parameter for each of various values of the other parameter.

[0150] In the above-described embodiment, the combustion load command value CLCSO is used as a parameter having a correlation with the gas turbine output. However, another parameter may be used as long as it is a parameter having a correlation with the gas turbine output. Examples of the parameter having a correlation with the gas turbine output include the generator output and the total fuel flow rate command value CSO, for example.

[0151] In the above-described embodiment, the top hat nozzles 51 are also premixing nozzles. Thus, similarly to the above-described embodiment, the plurality of top hat nozzles 51 according to the present embodiment may also be divided into a plurality of nozzle groups, and a nozzle group flow rate ratio between the nozzle groups may be changed in accordance with a parameter having a correlation with the gas turbine output.

INDUSTRIAL APPLICABILITY

[0152] According to an aspect of the present invention, combustion stability of a fuel can be improved in a gas turbine provided with a plurality of premixing nozzles that spray the fuel to be combusted through premixed combustion.

REFERENCE SIGNS LIST

[0153] 10 Gas turbine
[0154] 11 Compressor
[0155] 14 IGV
[0156] 21 Turbine
[0157] 31 Combustor
[0158] 33 Combustion liner (or transition piece)
[0159] 43 Pilot burner
[0160] 44 Pilot nozzle
[0161] 51 Top hat nozzle (premixing nozzle)
[0162] 53 Main burner
[0163] 53A Main burner A group
[0164] 53B Main burner B group
[0165] 54 Main nozzle (premixing nozzle)
[0166] 54A Main nozzle A group
[0167] 54B Main nozzle B group
[0168] 58a Gas channel frame
[0169] 60 Fuel main line
[0170] 61 Pilot fuel line
[0171] 62a Main A fuel line
[0172] 62b Main B fuel line
[0173] 63 Top hat fuel line
[0174] 65 Pilot fuel valve
[0175] 66a Main A fuel valve
[0176] 66b Main B fuel valve
[0177] 67 Top hat fuel valve
[0178] 71 Rotational frequency gauge
[0179] 72 Output gauge
[0180] 73 Intake temperature gauge
[0181] 74 Intake pressure gauge
[0182] 75 Blade path temperature gauge
[0183] 76 Exhaust gas temperature gauge
[0184] 100 Control device (fuel flow rate setting device)
[0185] 110 Combustion load command generator (parameter generator)
[0186] 130 Total fuel flow rate generator
[0187] 141 Pilot flow rate computing unit
[0188] 142 Top hat flow rate computing unit
[0189] 143 Main flow rate computing unit (total premixed fuel computing unit)
[0190] 160 Nozzle group flow rate ratio computing unit (flow rate ratio computing unit)
[0191] 161 Nozzle group flow rate ratio generator
[0192] 162 Correction value generator
[0193] 163 Corrector
[0194] 170 Correction value computing unit
[0195] 171 First correction value generator
[0196] 172 Second correction value generator
[0197] 173 Output change detector
[0198] 176 Change determiner
[0199] 177 Switching unit
[0200] 179 Corrector
[0201] 180 Nozzle group flow rate computing unit (flow rate computing unit)
[0202] 181 Main A flow rate computing unit
[0203] 182 Main B flow rate computing unit
[0204] 190 Valve controller

1-21. (canceled)

22. A fuel flow rate setting device of a gas turbine provided with a plurality of premixing nozzle groups each formed by at least one premixing nozzle that sprays a fuel to be combusted through premixed combustion, the fuel flow rate setting device comprising:

a flow rate ratio computing unit configured to accept a parameter having a correlation with a gas turbine output and to determine, using a predetermined flow rate ratio relationship between the parameter and a fuel flow rate ratio between the plurality of premixing nozzle groups, the fuel flow rate ratio corresponding to the accepted parameter;

a flow rate computing unit configured to determine a flow rate of the fuel to be supplied to each of the plurality of premixing nozzle groups, using the fuel flow rate ratio determined by the flow rate ratio computing unit;

a correction value computing unit configured to determine a correction value in relation to the fuel flow rate ratio applied when the gas turbine output is changing; and

a corrector configured to correct the fuel flow rate ratio determined by the flow rate ratio computing unit, using the correction value determined by the correction value computing unit,

the flow rate ratio relationship being a relationship in which the fuel flow rate ratio changes continuously as the parameter changes,

the flow rate computing unit determining the fuel flow rate for each of the plurality of premixing nozzle groups, using the fuel flow rate ratio corrected by the corrector, when the gas turbine output is changing.

23. The fuel flow rate setting device according to claim 22, wherein

the correction value computing unit accepts the parameter and determines the correction value corresponding to the accepted parameter, using a predetermined correction value relationship between the parameter and the correction value.

24. The fuel flow rate setting device according to claim 23, wherein

the correction value computing unit determines whether the change in the gas turbine output is an output increase or an output decrease,

when the change in the gas turbine output is the output increase, the correction value computing unit determines the correction value using, as the correction value relationship, a correction value relationship applied at a time of the output increase, and

when the change in the gas turbine output is the output decrease, the correction value computing unit determines the correction value using, as the correction value relationship, a correction value relationship applied at a time of the output decrease.

25. The fuel flow rate setting device according to claim 23, wherein

the correction value relationship is the fuel flow rate ratio corrected by the corrector and is a relationship determined so as to be able to avoid a combustion oscillation region in which combustion oscillation occurs when the gas turbine output is changing among regions defined by the parameter and the correction value.

26. The fuel flow rate setting device according to claim 23, wherein,

among the plurality of premixing nozzle groups, one of the premixing nozzle groups has a greater number of premixing nozzles than the other premixing nozzle groups, and

the correction value determined by the correction value relationship is a value that decreases the flow rate of the fuel to be supplied to the one of the premixing nozzle groups.

27. The fuel flow rate setting device according to claim 22, further comprising:

a valve controller configured to specify an opening amount for a fuel flow rate adjustment valve provided for each of the plurality of premixing nozzle groups that adjusts a flow rate of the fuel to be supplied to the premixing nozzle group, wherein

the valve controller determines the opening amount for the fuel flow rate adjustment valve provided for each of the plurality of premixing nozzle groups, using the fuel flow rate for each of the plurality of premixing nozzle groups.

28. The fuel flow rate setting device according to claim 22, wherein

the flow rate ratio relationship is a relationship determined so as to avoid a combustion oscillation region in which combustion oscillation occurs among regions defined by the parameter and the fuel flow rate ratio.

29. The fuel flow rate setting device according to claim 22, further comprising:

a parameter generator configured to generate, as the parameter, an inlet temperature-correlated value having a positive correlation with a temperature of a turbine inlet, inside a turbine of the gas turbine, into which combustion gas from a combustor of the gas turbine flows.

30. The fuel flow rate setting device according to claim 22, further comprising:

a total premixed fuel computing unit configured to determine a flow rate of the fuel to be supplied to all of the plurality of premixing nozzle groups, wherein

the flow rate computing unit determines a fuel flow rate for each of the plurality of premixing nozzle groups, using the fuel flow rate determined by the total premixed fuel computing unit and the fuel flow rate ratio determined by the flow rate ratio computing unit.

31. A gas turbine plant, comprising:

the fuel flow rate setting device according to claim 22; and

the gas turbine,

the gas turbine including:

a compressor that compresses air;

a combustor that combusts a fuel in the air compressed by the compressor to generate combustion gas; and

a turbine that is driven by the combustion gas,

the combustor including:

a combustion liner in which the fuel is combusted; and

a plurality of main burners that spray premixed gas which is formed by mixing a fuel and air into the combustion liner,

each of the plurality of main burners including:

one main nozzle as the premixing nozzle; and

a gas channel frame that generates the premixed gas by mixing the fuel sprayed from the one main nozzle and the air compressed by the compressor and sprays the premixed gas into the combustion liner,

the combustor including a plurality of main burner groups each formed by at least one of the main burners,

the fuel flow rate setting device determining a fuel flow rate for each of the plurality of main burner groups.

32. A gas turbine plant, comprising:

the fuel flow rate setting device according to claim **22**; and

the gas turbine,

the gas turbine including:

a compressor that compresses air;

a combustor that combusts a fuel in the air compressed by the compressor to generate combustion gas; and

a turbine that is driven by the combustion gas,

the combustor including:

a combustion liner in which the fuel is combusted;

a plurality of main burners that spray premixed gas which is formed by mixing a fuel and the air from the compressor into the combustion liner; and

a plurality of top hat nozzles, as the premixing nozzles, which spray the fuel into the air from the compressor, the air flowing into the main burners,

the combustor including a plurality of top hat nozzle groups each formed by at least one of the top hat nozzles,

the fuel flow rate setting device determining a fuel flow rate for each of the plurality of top hat nozzle groups.

33. A fuel flow rate setting method of a gas turbine provided with a plurality of premixing nozzle groups each formed by at least one premixing nozzle that sprays a fuel to be combusted through premixed combustion, the fuel flow rate setting method comprising:

a flow rate ratio computing step of accepting a parameter having a correlation with a gas turbine output and determining, using a predetermined flow rate ratio relationship between the parameter and a fuel flow rate ratio between the premixing nozzle groups, the fuel flow rate ratio corresponding to the accepted parameter;

a flow rate computing step of determining a flow rate of the fuel to be supplied to each of the plurality of premixing nozzle groups, using the fuel flow rate ratio determined at the flow rate ratio computing step;

a correction value computing step of determining a correction value in relation to the fuel flow rate ratio applied when the gas turbine output is changing; and

a correcting step of correcting the fuel flow rate ratio determined at the flow rate ratio computing step, using the correction value determined at the correction value computing step, the flow rate ratio relationship being a relationship in which the fuel flow rate ratio changes continuously as the parameter changes,

at the flow rate computing step, a fuel flow rate for each of the plurality of premixing nozzle groups being determined using the fuel flow rate ratio corrected at the correcting step, when the gas turbine output is changing.

34. The fuel flow rate setting method according to claim **33**, wherein,

at the correction value computing step, the parameter is accepted and the correction value corresponding to the accepted parameter is determined using a predetermined correction value relationship between the parameter and the correction value.

35. The fuel flow rate setting method according to claim **34**, wherein,

at the correction value computing step, whether the change in the gas turbine output is an output increase or an output decrease is determined,

when the change in the gas turbine output is the output increase, the correction value is determined using, as the correction value relationship, a correction value relationship applied at a time of the output increase, and

when the change in the gas turbine output is the output decrease, the correction value is determined using, as the correction value relationship, a correction value relationship applied at a time of the output decrease.

36. The fuel flow rate setting method according to claim **34**, wherein

a combustion oscillation region in which combustion oscillation occurs when the gas turbine output is changing among regions defined by the parameter and the correction value is identified in advance, and

the correction value relationship is a relationship determined such that the fuel flow rate ratio after the correcting step is able to avoid the combustion oscillation region.

37. The fuel flow rate setting method according to claim **34**, wherein,

among the plurality of premixing nozzle groups, one of the premixing nozzle groups has a greater number of premixing nozzles than the other premixing nozzle groups, and

the correction value determined by the correction value relationship is a value that decreases the flow rate of the fuel to be supplied to the one of the premixing nozzle groups.

38. The fuel flow rate setting method according to claim **33**, further comprising:

a valve controlling step of specifying an opening amount for a fuel flow rate adjustment valve provided for each of the plurality of premixing nozzle groups that adjusts a flow rate of the fuel to be supplied to the premixing nozzle group, wherein,

at the valve controlling step, the opening amount for the fuel flow rate adjustment valve provided for each of the plurality of premixing nozzle groups is determined, using the fuel flow rate for each of the plurality of premixing nozzle groups.

39. The fuel flow rate setting method according to claim **33**, wherein

a combustion oscillation region in which combustion oscillation occurs among regions defined by the parameter and the fuel flow rate ratio is identified in advance, and

the flow rate ratio relationship is a relationship determined such that the fuel flow rate ratio corresponding to the parameter avoids the combustion oscillation region.

40. The fuel flow rate setting method according to claim **33**, further comprising:

a parameter generating step of generating, as the parameter, an inlet temperature-correlated value having a positive correlation with a temperature of a turbine inlet, inside a turbine of the gas turbine, into which combustion gas from a combustor of the gas turbine flows.

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