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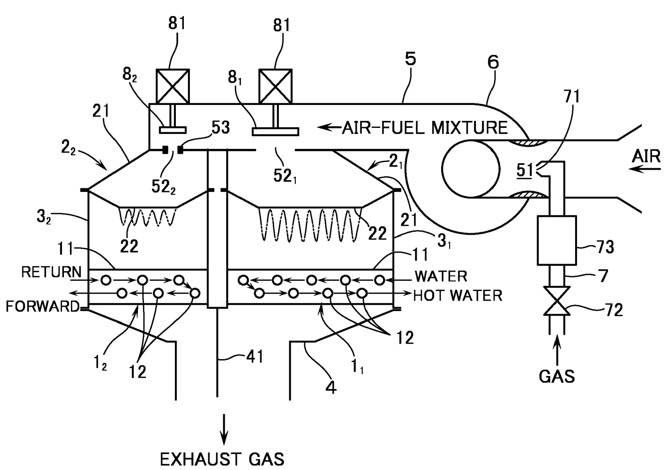
(54) COMPLEX HEAT SOURCE APPARATUS

(57) In a complex heat source apparatus having first and second, i.e., a total of two, burners (2_1, 2_2), and a fan (6) is interposed in an air supply passage (5) connected to both the burners. Downstream end of a gas supply passage (7) having interposed therein a flow control means (73) is connected to that portion of the air supply passage which is on an upstream side or a downstream side of the fan (6). It is thus so arranged that air-fuel mixture of the primary air and the fuel gas is supplied to both the burners (2_1, 2_2) through the air supply passage (5). Downsizing of the fan (6) and the reduction of noises can be attained at the time of simultaneous operation in which both the first and the second burners (2_1, 2_2) are combusted. An on-off valve (8_1, 8_2) is respectively disposed at a connection portion (52_1) between the first burner 2_1 and the air supply passage (5) and at a connection portion (52_2) between the second burner (2_2) and the air supply passage (5). The air flow resistance in the connection portion (52_2) between the second burner (2_2) and the air supply passage (5) is set, in a state in which the amount of air-fuel mixture supplied to the first burner (2_1) at the time of simultaneous operation becomes maximum corresponding to a rated combustion amount of the first burner (2_1), to be such that the amount of air-fuel mixture supplied to the second burner (2_2) becomes smaller than a maximum amount corresponding to a rated combustion amount of the second burner (2_2).

FIG.1



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Description

BACKGROUND OF THE INVENTION

1. Technical Field

[0001] The present invention relates to a complex heat source apparatus which is made up of: first and second, i.e., a total of two, heat exchangers; a first burner for heating the first heat exchanger; and a second burner for heating the second heat exchanger, wherein the first burner has a larger rated burning capacity than the second burner.

2. Background Art

[0002] As this kind of complex heat source apparatus, there is known, e.g., in JP-A-2006-38423, a complex heat source apparatus in which both the first and the second burners are constituted by Bunsen burners such as rich and lean combustion burners and the like, and in which combustion air (primary air and secondary air) is supplied by a fan which is common to both the burners.

[0003] According to this arrangement, by making the fan to commonly serve both the burners, the costs can be reduced, but the following disadvantages exist. That is, at the time of a single operation in which only one of the first burner and the second burner is combusted to heat one of the heat exchangers corresponding to the said one burner, the air is supplied also to the other of the burners. This air passes, as it is, through the other heat exchanger corresponding to the other of the burners and, as a result, this heat exchanger is cooled. The thermal efficiency of this heat exchanger therefore becomes lower when the heat exchanger is heated again.

[0004] By the way, although not a complex heat source apparatus, there is known, e.g., in JP-A-2010-151395 the following heat source apparatus. That is, in a heat source apparatus having a plurality of burners for heating a single heat exchanger, the plurality of burners are constituted by totally aerated combustion burners (or "fully primary aerated burners"). In a common air supply passage connected to these burners there is interposed a single fan which supplies primary air. The downstream end of the fuel gas supply passage is connected to that portion of the air supply passage which is on an upstream side or a downstream side of the fan. It is thus so arranged that the mixture of the primary air and the fuel gas can be supplied to the plurality of burners through the air supply passage. The gas supply passage has interposed therein a flow control means which enables to vary the fuel gas feed amount in proportion to the amount of primary air supply so as to make the air-fuel ratio of the air-fuel mixture constant. Also the connection portions between each of the burners and the air supply passage are provided with on-off valves.

[0005] By applying this art to a complex heat source apparatus, the following arrangement is conceivable. That is, each of the first and the second burners to respectively heat each of the first and the second heat exchangers is constituted by a totally aerated combustion burner. The air-fuel mixture is supplied to both the first and the second burners through an air supply passage in which a single fan is interposed. Also, the first and the second on-off valves are respectively provided at a first connection portion connecting the first burner and the air supply passage and at a second connection portion connecting the second burner and the air supply passage. At the time of simultaneous operation in which both the first and the second burners are combusted, both the first and the second on-off valves are opened. At the time of single operation, on the other hand, in which only one of the first and the second burners is combusted, only one of the on-off valves corresponding to the valve in question is opened. According to this arrangement, the other heat exchanger corresponding to the burner that is not combusted at the time of single operation can be prevented from being cooled by the air flow from the fan.

[0006] In this case, ordinarily setting is made at the time of simultaneous operation such that, in a state in which the amount of the air-fuel mixture supply to the first burner becomes maximum corresponding to the rated amount of combustion in the first burner, the amount of the air-fuel mixture supply to the second burner also becomes maximum corresponding to the rated combustion amount of the second burner. In this arrangement, however, in order to enable the maximum amounts of air-fuel mixture supply respectively to the first burner and to the second burner at the time of simultaneous operation, the fan must be made larger in capacity. Furthermore, the fan noises at the time of simultaneous operation become large.

SUMMARY

Problems that the Invention is to Solve

[0007] In view of the above-mentioned points, this invention has a problem of providing a complex heat source apparatus which supplies air-fuel mixture through an air supply passage common to the first and the second burners and in which downsizing of the fan as well as reduction in the noises at the time of the simultaneous operation is possible.

Means for Solving the Problems

[0008] In order to solve the above-mentioned problems, this invention has an advantage in providing a complex heat source apparatus comprising: first and second, i.e., a total of two, heat exchangers; a first burner for heating the first heat exchanger; a second burner for heating the second heat exchanger in which the first burner is larger in rated amount of combustion than the second burner, both the first and the second burners being constituted by totally aerated combustion burners; a single fan for supplying primary air, the fan being interposed in a common air supply passage connected to both the first and the second burners, a downstream end of a gas supply passage for supplying fuel gas being connected to that portion of the air supply passage which is on an upstream side or a downstream side of the fan, whereby a mixture of the primary air and the fuel gas is supplied through the gas supply passage to both the first and the second burners. A flow control means is interposed in the gas supply passage, the flow control means serving to vary the amount of fuel gas supply in proportion to the amount of primary air supply so that the air-fuel ratio of the air-fuel mixture becomes constant. The complex heat source apparatus is characterized in: that a first on-off valve is disposed at a first connection portion for connecting the air supply passage and the first burner and a second on-off valve is disposed at a second connection portion for connecting the air supply passage and the second burner such that, at a time of simultaneous operation in which both the first and the second burners are combusted, both the first and the second on-off valves are opened and that, at a time of single operation in which only one of the first and the second burners is combusted, only one of the first and the second on-off valves corresponding to said one burner is opened; and that an airflow resistance at the second connection portion is set such that, in a state in which the amount of air-fuel mixture supply to the first burner, at the time of simultaneous operation, becomes a maximum amount corresponding to the rated combustion amount of the first burner, the amount of air-fuel mixture supply to the second burner becomes smaller than the maximum amount corresponding to the rated combustion amount of the second burner.

[0009] According to this invention, in a state in which the amount of the air-fuel mixture supply to the first burner, at the time of simultaneous operation, becomes the maximum amount, the amount of the air-fuel mixture supply to the second burner becomes smaller than the maximum amount. Therefore, the maximum value of the total amount of air-fuel mixture supply will decrease. Accordingly, the fan can be downsized and the noises at the time of simultaneous operation can be reduced.

[0010] Further, in this invention, at the time of simultaneous operation, when a required combustion amount of the second burner has fallen below a minimum amount of combustion capable of continuous combustion of the second burner, an on-off control is preferably performed in which the second on-off valve is opened or closed to thereby intermittently perform combustion of the second burner. According to this arrangement, even if the upper limit amount of combustion of the second burner is limited below the rated amount of combustion at the time of simultaneous operation, the lower limit amount of combustion of the second burner can be made lower, by the on-off control, than the minimum amount of combustion that is capable of continuous combustion. The reduction in the turndown ratio can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a schematic sectional view showing the complex heat source apparatus according to an embodiment of this invention.

FIG. 2 is a graph showing variable ranges of amounts of combustion of the first burner and the second burner at the time of respective operations.

PREFERRED EMBODIMENTS

FOR CARRYING OUT THE INVENTION

[0012] A complex heat source apparatus according to an embodiment of this invention as shown in FIG. 1 is made up of: a first heat exchanger 1_1 for hot water supply; a second heat exchanger 1_2 for space heating; a first burner 2_1 for heating the first heat exchanger 1_1; and a second burner 2_2 for heating the second heat exchanger 1_2.

[0013] Each of the first and the second burners 2_1, 2_2 is constituted by a totally aerated combustion burner which ejects and combusts air-fuel mixture of fuel gas and primary air through a multiplicity of flame holes (not illustrated) formed in a combustion plate 22 that covers one surface of a box-shaped burner body 21, and is disposed in a posture facing downward with the combustion plate 22 lying on the lower side. Each of first and second combustion boxes 3_1, 3_2 that enclose the combustion space at the lower side of each of the first and second burners 2_1, 2_2 is disposed so as to house therein each of the first and second heat exchangers 1_1 ,1_2, respectively. Further, there is provided an exhaust duct 4 which is in communication with the lower ends of both the first and second combustion boxes 3_1, 3_2. It is thus so arranged that the combustion exhaust gases from each of the first and second burners 2_1, 2_2 can flow through each of the first and second heat exchangers 1_1, 1_2 to the exhaust duct 4.

[0014] By the way, since hot water supply requires a larger heating capacity than space heating, the first burner 2_1 is arranged to be a large burner having a larger rated combustion amount (maximum combustion amount) than the second burner 2_2. Further, the exhaust duct 4 is partitioned by a partition plate 41 disposed therein into a duct portion through which the combustion exhaust gases from the first burner 2_1 flow and the other duct portion through which the combustion exhaust gases from the second burner 2_2 flow.

[0015] Each of the first and second heat exchangers 1_1, 1_2 is made up of: a multiplicity of heat absorbing fins 11 which are laminated with one another in the direction perpendicular to the paper surface of FIG. 1; and a snaking heat absorbing tube 12 which penetrates through these heat absorbing fins 11. Although not illustrated, the heat absorbing tube 12 of the first heat exchanger 1_1 has connected thereto a water supply pipe on an upstream side and a hot water delivery pipe on the downstream side. It is thus so arranged that, when a hot water faucet on the downstream side of the hot water delivery pipe is opened to let the water flow to the first heat exchanger 1_1, the first burner 2_1 is combusted, so that hot water at a set temperature is delivered from the hot water faucet. Although not illustrated, the heat absorbing tube 12 of the second heat exchanger 1_2 is connected to the heating circuit of floor heating, and the like through a forward tube and a return tube. Space heating can thus be performed by circulating hot water to the heating circuit through the second heat exchanger 1_2.

[0016] Further, the first and second burners 2_1, 2_2 have connected thereto a common air supply passage 5. This air supply passage 5 has interposed therein a single fan 6 which supplies primary air. To that portion of the air supply passage 5 which is on an upstream side of the fan 6 is connected a gas outlet 71 which is on a downstream end of a gas supply passage 7 for supplying fuel gas. That portion of the of the air supply passage 5 to which the gas outlet 71 is connected is arranged to constitute a venturi portion 51 having a constricted sectional area.

[0017] The gas supply passage 7 has interposed therein a main valve 72, and a zero governor 73, as a flow control means, which controls the secondary gas pressure to a pressure equivalent to the atmospheric pressure. It means that the amount of fuel gas supply varies with a differential pressure between the atmospheric pressure which is the secondary gas pressure and that suction negative pressure of the fan 6 which operates on the venturi portion 51. Since the suction negative pressure of the fan varies in proportion to the rotational speed of the fan. Therefore, the amount of fuel gas supply varies in proportion to the rotational speed of the fan, i.e., the amount of the primary air supply. The air-fuel ratio of the air-fuel mixture becomes constant.

[0018] Further, the first connection portion 52_1 connecting the first burner 2_1 and the air supply passage 5 together is provided with a first on-off valve 8_1. The second connection portion 52_2 connecting the second burner 2_2 and the air supply passage 5 together is provided with a second on-off valve 8_2. The first on-off valve 8_1 and the second on-off valve 8_2 are respectively driven by an actuator 81 such as an electromagnetic solenoid, and the like.

[0019] At the time of single operation of hot water supply in which only the first burner 2_1 is combusted to thereby heat the first heat exchanger 1_1, the first on-off valve 8_1 is opened to feed the air-fuel mixture to the first burner 2_1 and, at the same time, the second on-off valve 8_2 is closed to stop the air-fuel mixture supply to the second burner 2_2. Further, in order for the amount of the air-fuel mixture supply to the first burner 2_1 to become a value corresponding to the hot water demand combustion amount (amount of combustion required for supplying the hot water of a set temperature), adjustment is made by the rotational speed of the fan 6. In addition, at the time of single operation of space heating in which only the second burner 2_2 is combusted to thereby heat the second heat exchanger 1_2, the second on-off valve 8_2 is opened to feed the air-fuel mixture to the second burner 2_2 and, at the same time, the first on-off valve 8_1 is closed to stop the air-fuel mixture supply to the first burner 2_1. Further, in order for the amount of the air-fuel mixture supply to the second burner 2_2 to become a value corresponding to the space heating demand combustion amount (amount of combustion required for supplying the hot water of a set temperature to the heating circuit), adjustment is made by the rotational speed of the fan 6.

[0020] With reference to FIG. 2, at the time of single operation of hot water supply, the amount of combustion of the first burner 2_1 is made variable with the hot water demand combustion amount between the rated combustion amount $Qmax_1$ of the first burner 2_1 and the minimum combustion amount capable of performing continuous combustion thereof (lower limit of combustion amount free from back firing) $Qmini_1$. At the time of single operation of space heating, the amount of combustion of the second burner 2_2 is made variable with the space heating demand combustion amount between the rated combustion amount $Qmax_2$ of the second burner 2_2 and the minimum combustion amount $Qmini_1$ capable of continuous combustion.

[0021] At the time of simultaneous operation of hot water supply and space heating by combusting the first burner 2_1 to heat the first heat exchanger 1_1 and also by combusting the second burner 2_2 to heat the second heat exchanger 1_2 respectively, priority is given to the hot water supply in a state in which both the first and the second on-off valves 8_1, 8_2 are left open. In this manner, adjustment is made by the number of rotation of the fan 6 so that the amount of the air-fuel mixture supply to the first burner 2_1 becomes the value corresponding to the hot water demand combustion amount. Here, at the time of simultaneous operation, if setting is made such that the amount of the air-fuel mixture supply to the second burner 2_2 becomes a maximum amount corresponding to the rated combustion amount $Qmax_2$ of the second burner 2_2 in a state in which the amount of air-fuel mixture supply to the first burner 2_1 becomes a maximum amount corresponding to the rated combustion amount $Qmax_1$ of the first burner 2_1, it becomes necessary to enlarge the size of the fan 6 so as to correspond to the maximum value of a total amount of the air-fuel mixture supply. In addition, the noises of the fan at the time of simultaneous operation become larger.

[0022] As a solution, in this embodiment, the following arrangement has been made. That is, the second connection portion 52_2 is provided with a resistance portion 53. In a state in which, at the time of simultaneous operation, the amount of the air-fuel mixture supply to the first burner 2_1 becomes a maximum amount, setting is made so that the amount of air-fuel mixture supply to the second burner 2_2 becomes smaller than the maximum amount corresponding to the rated combustion amount $Qmax_2$. According to this arrangement, since the maximum value of the amount of the total air-fuel mixture supply is reduced, the size reduction of the fan 6 as well as the reduction in the noises at the time of simultaneous operation can be attained.

[0023] The second on-off valve 8_2 may be arranged to be of a needle-valve construction so that, even in an opened state of the second on-off valve 8_2, the second connection portion 52_2 can be adequately throttled, whereby the flow resistance through the second connection portion 52_2 can be set as described above.

[0024] In case the flow resistance through the second connection portion 52_2 is set in the above-mentioned manner, as shown in FIG. 2, the upper limit combustion amount $Qmax_2$' of the second burner 2_2 at the time of simultaneous operation becomes lower than the rated combustion amount $Qmax_2$. As a result, the turn down ratio of the second burner 2_2 at the time of simultaneous operation will become smaller if no measure is taken.

[0025] As a solution, in this embodiment, in case the required amount of combustion of the second burner 2_2 at the time of simultaneous operation falls below the minimum amount of combustion $Qmin_2$ that is capable of continuous combustion of the second burner 2_2, an on-off control is performed in which the second on-off valve 8_2 is opened or closed so that the second burner 2_2 is intermittently combusted in an amount of combustion above the minimum amount of combustion $Qmin_2$. According to this arrangement, even if the upper-limit amount of combustion $Qmax_2$' of the second burner 2_2 is limited below the rated combustion amount $Qmax_2$ at the time of simultaneous combustion, the lower limit combustion amount of combustion $Qmin_2$' of the second burner 2_2 can be made lower, by means of the on-off control, than the minimum amount of combustion $Qmin_2$ that is capable of continuous combustion. As a result, the turn down ratio of the second burner 2_2 can be prevented from becoming small.

[0026] Description has so far been made of the embodiment of this invention with reference to the drawings. This invention, however, shall not be limited to the above, but the following arrangement may be employed. For example, a venturi portion is provided in that portion of the air supply passage 5 which is on the downstream side of the fan 6. The downstream end of the gas supply passage 7 is connected to the venturi portion. Then a zero governor, which adjusts the secondary gas pressure to an equal pressure as the outlet pressure of the fan 6, may be interposed in the gas supply passage 7 as the flow amount adjusting means. In this case, the differential pressure between the outlet pressure of the fan 6 and the venturi portion is proportional to the amount of the primary air supply by the fan 6. The amount of the fuel gas supply will also be proportional to the amount of the primary air supply.

[0027] Further, it is also possible to interpose a proportional valve, as the flow control means, in the gas supply passage 7 in order to make adjustments with the proportional valve so that the amount of the fuel gas supply is proportional to the amount of the primary air supply. In this case, the downstream end of the gas supply passage may be connected to either of an upstream portion and a downstream portion of the fan in the air supply passage 5. Further, the above embodiment is a complex heat source apparatus of serving the dual purpose of hot water supply and space heating in which the first heat exchanger 1_1 is for supplying hot water, and the second heat exchanger 1_2 is for space heating. However, this invention can similarly be applicable to the one in which the second heat exchanger 1_2 is used other than for space heating such as for reheating a bath tab.

EXPLANATION OF MARKS

[0028]

1_1	first heat exchanger
1_2	second heat exchanger
2_1	first burner
2_2	second burner
5	air supply passage
52_1	first connection portion
52_2	second connection portion
6	fan
7	gas supply passage
71	gas outlet (downstream end of the gas supply passage)
73	zero governor (flow control means)
8_1	first on-off valve
8_2	second on-off valve

Claims

1. A complex heat source apparatus comprising:

first and second, i.e., a total of two, heat exchangers (1_1, 1_2);
a first burner (2_1) for heating the first heat exchanger (1_1);
a second burner (2_2) for heating the second heat exchanger (2_1) in which the first burner (2_1) is larger in rated amount of combustion than the second burner (2_2), both the first and the second burners (2_1, 2_2) being constituted by totally aerated combustion burners;
a single fan (6) for supplying primary air, the fan (6) being interposed in a common air supply passage (5) connected to both the first and the second burners, a downstream end of a gas supply passage (7) for supplying fuel gas being connected to that portion of the air supply passage (5) which is on an upstream side or a downstream side of the fan (6), whereby a mixture of the primary air and the fuel gas is supplied

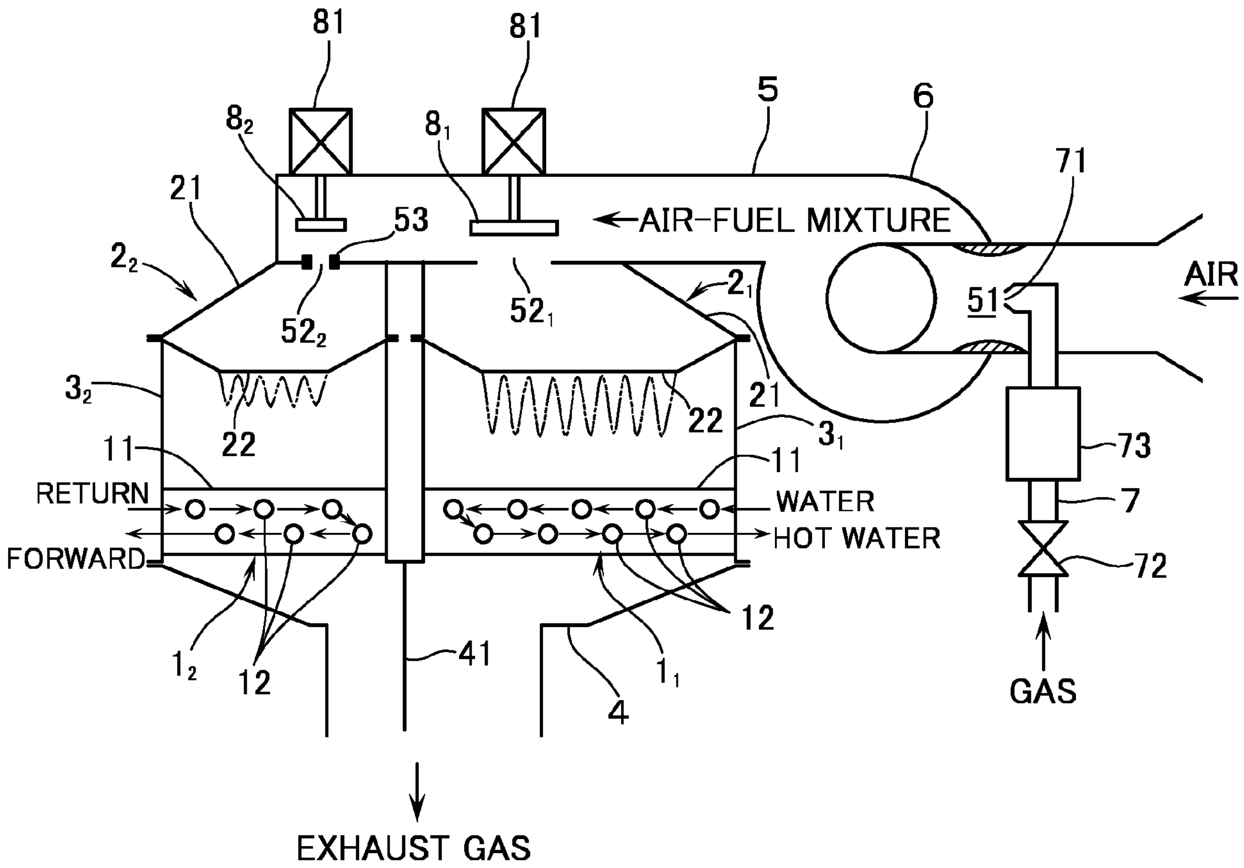
through the gas supply passage (7) to both the first and the second burners (2_1, 2_2),
a flow control means (73) interposed in the gas supply passage (7), said flow control means (73) serving to vary the amount of fuel gas supply in proportion to the amount of primary air supply so that the air-fuel ratio of the air-fuel mixture becomes constant,

characterized in:

that a first on-off valve (8_1) is disposed at a first connection portion (52_1) for connecting the air supply passage (5) and the first burner (2_1) and a second on-off valve (8_2) is disposed at a second connection portion (52_2) for connecting the air supply passage (5) and the second burner (2_2) such that, at a time of simultaneous operation in which both the first and the second burners (2_1, 2_2) are combusted, both the first and the second on-off valves (8_1, 8_2) are opened and that, at a time of single operation in which only one of the first and the second burners (2_1, 2_2) is combusted, only one of the first and the second on-off valves (8_1, 8_2) corresponding to said one burner is opened; and
that an air-flow resistance at the second connection portion (52_2) is set such that, in a state in which the amount of air-fuel mixture supply to the first burner (2_1), at the time of simultaneous operation, becomes a maximum amount corresponding to the rated combustion amount of the first burner (2_1), the amount of air-fuel mixture supply to the second burner (2_2) becomes smaller than the maximum amount corresponding to the rated combustion amount of the second burner (2_2).

2. The complex heat source apparatus according to claim 1, wherein, at the time of simultaneous operation, when a required combustion amount of the second burner (2_2) has fallen below a minimum amount of combustion capable of continuous combustion of the second burner (2_2), an on-off control is performed in which the second on-off valve (8_2) is opened or closed to thereby intermittently perform combustion of the second burner (2_2).

FIG.1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11
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HOT WATER
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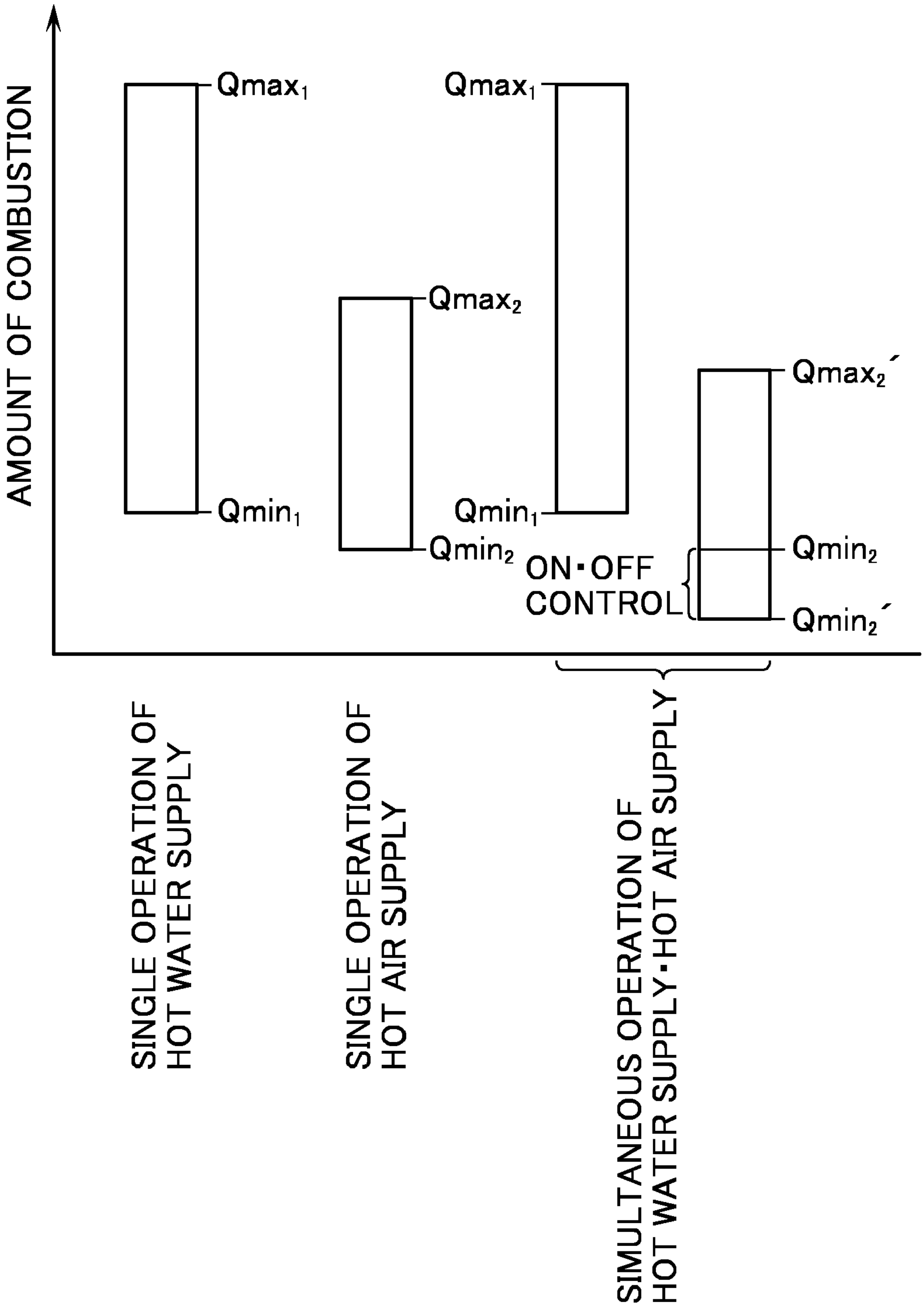
4
GAS
EXHAUST GAS

FIG.2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Qmin1
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Qmin2
Qmin2´
ON・OFF CONTROL
SINGLE OPERATION OF HOT WATER SUPPLY
SINGLE OPERATION OF HOT AIR SUPPLY
SIMULTANEOUS OPERATION OF HOT WATER SUPPLY・HOT AIR SUPPLY

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EUROPEAN SEARCH REPORT

Application Number
EP 16 19 1573

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F23N
F23D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 January 2017	Gavriliu, Costin

1

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18-01-2017

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REFERENCES CITED IN THE DESCRIPTION

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