BURNER FORMING AND APPLYING MIXED CYCLONE AND COMBUSTION METHOD USING THE BURNER

FIELD OF THE INVENTION

The present invention relates to combustion technology, and more specifically, relates to a method of generating mixed whirling flow, a burner applying such a method, and a combustion method of the energy-efficient burner, which may be used in canteens or kitchens of some guesthouses, hotels, institutions and schools etc.

BACKGROUND OF THE INVENTION

Currently in canteens or kitchens of many guesthouses, hotels, institutions and schools etc., food is heated generally by means of gas furnaces and common burning machines. The conventional gas furnaces and burning machines are incapable to burn fuel fully due to insufficient mixing of fuel gas and air, or may produce flame so long that heat is lost in the air, resulting in low combustion effect and a large amount of carbon monoxide.

SUMMARY OF THE INVENTION

In a first aspect, aimed at the defect of insufficient mixing of fuel gas and air in the prior art, the present invention provides a method of generating mixed whirling flow which is capable of mixing fuel gas and air more sufficiently.

In a second aspect, aimed at the defect of insufficient mixing of fuel gas and air in the prior art, the present invention provides a burner which is capable of mixing fuel gas and air more sufficiently, and a combustion method thereof.

According to the first aspect of the present invention, a method of generating mixed whirling flow is provided, comprising the following steps:

S1 mixing air and fuel gas to form swirly mixed gas;

S2 forming said swirly mixed gas generated in step S1 into a mixed upward

whirling flow with a tiny bottom but a big top end.

Advantageously, the step S1 further comprises the following steps:

S11 mixing air and fuel gas into a rotating mixed gas;

S12 re-mixing the rotating mixed gas into a swirly mixed gas.

According to the second aspect of the present invention, a burner is provided, comprising:

a gas-separating box used to import fuel gas and air respectively;

a mixing device used to mix air and fuel gas from the gas-separating box to form a mixed whirling flow; and

a third mixing device used to reflect the mixed whirling flow so that the mixed whirling flow rushes out of a flame hole and then forms a mixed upward whirling flow with a tiny bottom but a big top end.

In the burner of the present invention, said mixing device comprises a top lid and a mixing box to compose a first mixing device and a second mixing device, wherein said top lid is in a shape of sleeve.

In the burner of the present invention, air from the gas-separating box is formed into a rotating airflow inclined upwardly by said first mixing device, and said second mixing device mixes the rotating airflow from the first mixing device and fuel gas from the gas-separating box into a mixed whirling flow.

In the burner of the present invention, said mixing box is a box having a countersunk hole communicated with said centric hole, on the side wall of the box several grooves are disposed at a distance from each other, whose amount and position are corresponding to that of the fuel gas outlets, and a plurality of first outlets are evenly distributed on the top surface of the gas-separating box。

In the burner of the present invention, air and fuel gas from the gas-separating box are firstly mixed into a rotating mixed flow inclined upwardly by the first mixing device, and the rotating mixed flow from the first mixing device is formed into a mixed whirling flow by the second mixing device.

In the burner of the present invention, said gas-separating box has a centric hole through which air enters and at least one inlet through which fuel gas enters, and on the top surface of the gas-separating box, several fuel gas outlets are provided.

In the burner of the present invention, said mixing box is a box having a countersunk hole communicated with said centric hole, on the side wall of the box several grooves are disposed at a distance from each other, whose amount and position are corresponding to that of the fuel gas outlets, and communicating holes are disposed on the surface of the grooves, communicating with air in said countersunk hole, and the grooves mix air and fuel gas primarily to form a rotating mixed flow inclined upwardly.

In the burner of the present invention, said grooves are inclined upwards.

In the burner of the present invention, an angle between said grooves and the bottom surface of the mixing box is 10 to 80 degree.

In the burner of the present invention, said grooves are at least 50mm long.

In the burner of the present invention, cross section of said grooves is in a shape of square or inverted trapezoidal.

In the burner of the present invention, the flame hole on the top lid for the mixed flow to rush out has a frustoconic surface, which makes the whirly mixed flow be reflected onto a reflecting plate on the mixing box and then rush out of the flame hole to form a mixed whirling flow with a tiny bottom but a big top end.

In the burner of the present invention, size of the flame hole is one fifth to one third the size of the top lid。

In the burner of the present invention, the fuel gas outlets are evenly distributed, while the communicating holes are evenly distributed too.

In the burner of the present invention, diameter of the fuel gas outlets and the communicating holes are 0.5 to 3mm.

In the burner of the present invention, a mounting throughhole is arranged on

the top surface of said mixing box, said mounting throughhole is provided with a insulating sleeve which comprises a round plate mounted within the countersunk hole and a ring matched with the mounting throughhole, on the insulating sleeve a reflecting plate is arranged, which is connected with a zero wire of a ion flame controller, and said mixing box has two pulse ignition rods.

In the burner of the present invention, said top lid is screwed with the gas-separating box.

According to an aspect of the present invention, a combustion method of the burner in accordance with embodiments of the present invention is provided, comprising the following steps:

S01 separating air and flue gas into two flow, wherein a first flow of air enters into the centric hole and then into the grooves through the evenly distributed communicating holes to mix with a second flow of fuel gas, and then goes upwards along the inclined grooves to form a rotating mixed flow inclined upwardly ;

S02 rotating the mixed flow inclined upwardly into a second mixing chamber, and mixing again rotationally to form a swirly mixed flow;

S03 let the rotating mixed flow and the swirly mixed flow collide with each other and flow around, wherein the mixed flow is reflected onto the reflecting plate due to the frustoconic surface of the flame hole and then rush out of the flame hole to form a whirling mixed flow with a tiny bottom and a large top end, which produces a flame looked like hurricane with a small bottom but large head when ignited.

The burner in accordance with the present invention comprises a sleeve-type top lid, a gas-separating box is connected to the bottom of the top lid, and a space is formed between the top lid and the gas-separating box, in which a device for air dispersion and fuel gas mixing is disposed; the gas-separating box has a centric hole through which air enters and at least one inlet through fuel gas enters, on the top surface of the gas-separating box several fuel gas outlets are provided; said

device for air dispersion and fuel gas mixing is a box having a countersunk hole communicated with the centric hole, on the side wall of the box several grooves are disposed at a distance from each other, whose amount and position are corresponding to that of the fuel gas outlets, and communicating holes are disposed on the surface of the grooves, communicating with air in said countersunk hole, and the grooves mix air and fuel gas primarily; said top lid has a frustoconic flame hole used to burn the fuel gas and reflect the mixed gas, the inclined frustoconic surface of flame hole reflects the mixed gas onto the reflecting plate and then rushing onto the flame hole; the top lid and the top surface of the device for air dispersion and gas mixing constitute a second mixing chamber where the mixed gas forms a whirling flow. Such a structure promotes the dispersed fuel gas and air to be sufficiently mixed up in the grooves of the gas mixing device and then flow inclined upwards to the second mixing chamber and the frustoconic flame hole, the inclined frustoconic surface of the flame hole reflects the mixed gas onto the reflecting plate and then to flame hole, and finally a flame like a hurricane with a small bottom but a large top end is produced. Such a flame can be better concentrated and condensed to burn sufficiently outside the top lid with no or less heat conduction with the top lid, and the flame is not extinguished easily and generates less carbon monoxide. Besides, the combustion can be done in a reduced space due to the concentration and condensation of the flame, thus the volume of the whole chamber, and in turn the volume of the burner correspondingly is reduced.

Further, in the burner of the present invention, the ion flame detector does not use a ion detecting pin to detect the flame, but the zero wire of the ion flame detector is connected to the insulated reflecting plate. The detection can be achieved by wire connection of the ion detecting pin to a metal piece of the burner. The burning of the flame produces ions, the flame terminal is zero while the combust flame is positive (i.e., when the zero wire of the ion flame detector is

connected to the insulated reflecting plate, then the ion detecting pin is wired to the metal piece of the burner, then the metal induces the positive ions produced by the combust flame burning the metal, thereby the ion flame detector detects that the burner is on fire.).

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate one or more embodiments of the invention and, together with the written description, serve to explain the principles of the invention, and wherein:

Fig.1 is an exploded view of a first embodiment of the burner in accordance with the present invention;

Fig.2 is an enlarged view of part A as shown in Fig.1;

Fig.3 is a top view of the first embodiment of the burner in accordance with the present invention;

Fig.4 is an exploded view of the B section shown in Fig.3;

Fig.5 is an assembled view of the B section shown in Fig.3;

Fig.6 is a perspective view of the device for air dispersion and fuel gas mixing in the first embodiment of the burner in accordance with the present invention;

Fig.7 is a top view of the mixing device of the burner in the first embodiment of the present invention;

Fig.8 is a front view of the mixing device of the burner in a second embodiment of the present invention;

Fig.9 shows E section of Fig.8;

Fig.10 is an exploded sectional view of the mixing device in the second embodiment of the present invention;

Fig.11 is an exploded perspective diagram of the mixing device in the second embodiment of the present invention;

Fig.12 is a third embodiment of the burner in accordance with the present

invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a method of generating mixed whirling flow through mixing of air and fuel gas, comprising the following steps:

S1 mixing air and fuel gas to form swirly mixed gas;

S2 forming said swirly mixed gas generated in step S1 into a mixed upward whirling flow with a tiny bottom but a big top end;

wherein, the step S1 further comprises the following steps:

S11 mixing air and fuel gas into a rotating mixed gas;

S12 re-mixing the rotating mixed gas into a swirly mixed gas.

The embodiment 1 comprises a overall process of generating the whirling mixed flow, while the embodiment 2 comprises step S1 and S2, but step S1 does not comprise step S11 and S12. More details will be described referring to the drawings.

As shown in Fig.1, the burner of the present invention comprises a gas-separating box 30 used to import fuel gas and air respectively, a mixing device used to mix air and fuel gas from the gas-separating box to form mixed whirling flow, and a third mixing device used to reflect the mixed whirling flow so that it rushes out of a flame hole 11 and then forms a mixed upward whirling flow with a tiny bottom but a big top end, wherein the mixing device comprises a sleeve-type top lid 10 and a mixing box 20 to compose a first mixing device and a second mixing device.

The gas-separating box 30 is a round ring, comprises a centric hole 31 and a box body, wherein the box body is a cylinder, has several fuel gas outlets 37 positioned along a circumference on the top surface to disperse fuel gas, and a fuel gas inlet 32 through which fuel gas enters is provided on the bottom surface of the box body. The centric hole 31 is round with its outer portion as a ring, while the top

39 of said ring is higher than the top surface of the box body, and has external threads on it. The outer portion of the centric hole 31 together with the box body compose a gas-dispersing chamber 38 in a shape of cylinder. In order to disperse fuel gas completely, the fuel gas outlets 37 can be evenly distributed.

The mixing box 20 is a cylinder, and has a countersunk hole 25 communicated with the centric hole 31. On the top of countersunk hole 25 there is a round mounting hole 29. A insulating sleeve 50 arranged on the mounting hole 29 comprises a round plate mounted in the countersunk hole 25 and a round ring 51 matched with the mounting hole 29. A reflecting plate 40 is provided on the insulating sleeve 50, which is connected to the zero wire of the ion flame controller. On the outer surface of the cylinder are positioned several inclined upward projections 22 and grooves 21 spaced with each other. The inclined angle of the projections 22 and the grooves 21 can be 10 to 80 degree. On each grooves 21 are several communicating holes 210 communicated with the countersunk hole 25, and the communicating holes 210 can be 0.5 to 3mm in diameter. Cross section of the grooves 21 can be square or inverted trapezoidal. In order to provide more communicating holes 21 to disperse air better, the length of the grooves 21 is no less than 50mm, and the communicating holes 210 can be evenly distributed on the grooves 21.

The top lid 10 and the top surface of the mixing box 20 compose the second mixing chamber 100 for rotating the mixed gas to form a mixed whirling flow. The top lid 10 comprises a frustoconic flame hole 11 through which the mixed flow rushes out. The inclined frustoconic surface of the flame hole 11 reflects the mixed whirling flow onto the reflecting plate 40 of the mixing box 20, then the mixed whirling flow rushes out of the flame hole 11 and form a rotating mixed gas flow with a tiny bottom but a bid top end.

In the present invention, an ion flame detector is applied. Accessories of the ion flame detector comprise an insulating sleeve 50 and a reflecting plate 40,

wherein the insulating sleeve 50 is made of glass fiber, comprises a round ring 51 mounted onto a round plate, and the reflecting plate 40 is a round plate made of metal.

The operation procedure of the embodiment of the present invention is as follows:

As shown in Fig.5, the insulating sleeve 50 is fixed onto the mixing box 20 through screws 99 screwed into the countersunk hole 25, and then the reflecting plate 40 made of metal is fixed into the round ring 51 of the insulating sleeve 50, the zero wire of the ion flame detector is connected to the insulated reflecting plate 40 by a screw 97, and the positive wire of the ion flame detector is connected to the top lid 10. When a flame burns the metal piece (e.g. a iron pan), the positive wire of the ion flame detector will induce the positive ion produced by the flame, thus the ion flame detector detects that the burner is on fire.

The top lid 10 comprises a circular wall and a top cap on the circular wall, while a frustoconic flame hole 11 is provided on the top cap. In order to combust the fuel gas sufficiently, size of the top surface of the flame hole 11 is selected as one fifth to one third of the size of the top cap. To facilitate igniting, two pulse ignition devices 60 are arranged in the burner of the present invention.

In order to connect the top lid 10 and the gas-separating box 30 together, the top lid is provided with internal thread 12, while the gas-separating box 30 is provided with corresponding external thread 380 on its outer surface.

In order to connect the mixing box 20 and gas-separating box 30 together, engaged threads 250 and 35 are arranged on the inner wall of countersunk hole 25 of the mixing box 20 and on the outer ring of the centric hole 31 of the gas-separating box 30, respectively.

The work process of the burner in the present invention is as follows:

Referring to Figs.1, 4, 5 and 6, firstly, air and fuel gas are separated into two flows, the first flow of air enters the centric hole 31 and then into the grooves 21

through the evenly distributed communicating holes 210, while the second flow of fuel gas enters the gas-dispersing chamber 38 through the inlet 32 and then enters the grooves 21 through the fuel gas outlet 37 to mix with the first flow of air, later, the mixed gas flows along the inclined grooves 21 upwardly to form an inclined upwardly rotating mixed flow; the upwardly inclined mixed flow enters the second mixing chamber 100 and remixes a second time rotationally to form a swirly mixed flow. The swirly mixed flow and the rotating mixed flow collide with each other and flow around. The mixed flow is reflected onto the reflecting plate due to the frustoconic surface of the flame hole 11 and then rush out of the flame hole 11 to form a whirling mixed flow with a tiny bottom and a large top end, which produces a flame looked like hurricane with a small bottom but large head when ignited. Such a flame can be better concentrated and condensed to burn sufficiently outside the top lid with no or less heat conduction with the top lid, and the flame is not extinguished easily and generates less carbon monoxide. The concentration and condensation of the flame reduce the length of the flame, which will help the heat to stay rather than loss, and help the flame to be combust in a small space. Short flame also decrease contact of the flame with the outer air, which can reduce the heat loss, reduce the volume of the burner chamber and in turn reduce the volume of the top lid. What's more, with respect to fuel gas of different density such as fuel gas of light density, the grooves 21 can be made to be at an angle of 80 or even 90 degree with the bottom surface of the mixing box 30, which will contribute sufficient mixing of the mixed gas reflected by the frustoconic surface of the flame hole 11, while fuel gas with high density such as that in present invention can be reflected by the frustoconic surface after two mixing processes.

Additionally, a fan can be used to control the input of air in the centric hole 31 to ensure that there is enough air to mix with fuel gas, thereby production of carbon monoxide as burning is reduced to achieve an effect of energy saving and environment protection.

Figs.8 to 11 show the second embodiment of the present invention, wherein the difference between the first and the second embodiments is: on the top surface of the mixing box 20 are several first outlets 300 evenly distributed along its circumference, while there is no communicating holes 210 between the countersunk hole 25 and the grooves 21. Air enters into the fuel gas outlet 37 from the gas-separating box 30 and into the grooves 21 and then flows upwardly, then forms a rotating air flow. The fuel gas enters into the second mixing chamber 100 through the first outlets 300 evenly distributed on the top surface of the mixing box 20, and then mix with the rotating air flow to form a swirly mixed flow. The swirly mixed flow and the rotating mixed flow collide with each other and flow around. Due to the inclined frustoconic surface of the flame hole, the mixed flow can be reflected onto the reflecting plate and then rushes up to the flame hole to form a whirling mixed gas flow with a tiny bottom but big top end, which when ignited produces a flame like a hurricane which also has a tiny bottom but a big top end. The other aspects are the same as that of the first embodiment, so details are omitted.

Fig.12 shows the third embodiment of this invention which comprises a ignition 220, fuel gas inlets 210, flow dividers 230, and an air inlet 200, wherein the air inlet 200 is a circle pipe of which the center line is non-intersected with that of the burner, the flow dividers 230 are arc plates evenly distributed. The work process is as follows:

Air enters into the burner through the air inlet 200 to form a rotating air flow 900, while a portion of the air flow 900 flows along the circumferential direction and the other portion mixes with fuel gas from the fuel gas inlets 210 to form a whirling flow and then be combust.

While the present invention has been described with reference to certain embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted without departing from the scope

of the present invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the present invention without departing from its scope. Therefore, it is intended that the present invention not be limited to the particular embodiment disclosed, but that the present invention will include all embodiments falling within the scope of the appended claims.

CLAIMS

What is claimed is:

1. A method of generating mixed whirling flow, comprising:

S1 mixing air and fuel gas to form swirly mixed gas;

S2 forming said swirly mixed gas generated in step S1 into a mixed upward whirling flow with a tiny bottom but a big top end.

2. A method of generating mixed whirling flow according to claim 1, wherein the step S1 further comprises the following steps:

S11 mixing air and fuel gas into a rotating mixed gas;

S12 re-mixing the rotating mixed gas into a swirly mixed gas.

3. A burner applied with the method according to claim 1, comprising:

a gas-separating box (30) used to import fuel gas and air respectively;

a mixing device used to mix air and fuel gas from the gas-separating box (30) to form a mixed whirling flow; and

a third mixing device used to reflect the mixed whirling flow so that the mixed whirling flow rushes out of a flame hole (11) and then forms a mixed upward whirling flow with a tiny bottom but a big top end.

4. The burner according to claim 3, wherein said mixing device comprises a top lid (10) and a mixing box (20) to compose a first mixing device and a second mixing device, wherein said top lid (10) is in a shape of sleeve.

5. The burner according to claim 4, wherein air from the gas-separating box (30) is formed into a rotating airflow inclined upwardly by said first mixing device, and said second mixing device mixes the rotating airflow from the first mixing device and fuel gas from the gas-separating box (30) into a mixed whirling flow.

6. The burner according to claim 5, wherein said mixing box (20) is a box having a countersunk hole (25) communicated with said centric hole (31), on the side wall of the box several grooves (21) are disposed at a distance from each other,

whose amount and position are corresponding to that of the fuel gas outlets (37), and a plurality of first outlets (300) are evenly distributed on the top surface of the gas-separating box。

7. The burner according to claim 4, wherein air and fuel gas from the gas-separating box (30) are firstly mixed into a rotating mixed flow inclined upwardly by the first mixing device, and the rotating mixed flow from the first mixing device is formed into a mixed whirling flow by the second mixing device.

8. The burner according to claim 7, wherein said gas-separating box (30) has a centric hole (31) through which air enters and at least one inlet (32) through which fuel gas enters, and on the top surface of the gas-separating box (30), several fuel gas outlets (37) are provided.

9. The burner according to claim 8, wherein said mixing box (20) is a box having a countersunk hole (25) communicated with said centric hole (31), on the side wall of the box several grooves (21) are disposed at a distance from each other, whose amount and position are corresponding to that of the fuel gas outlets (37), and communicating holes (210) are disposed on the surface of the grooves (21), communicating with air in said countersunk hole (25), and the grooves (21) mix air and fuel gas primarily to form a rotating mixed flow inclined upwardly.

10. The burner according to claims 6 or 9, wherein said grooves (21) are inclined upwards.

11. The burner according to claim 10, wherein an angle between said grooves (21) and the bottom surface of the mixing box (20) is 10 to 80 degree.

12. The burner according to claim 11, wherein said grooves (21) are at least 50mm long.

13. The burner according to claim 12, wherein cross section of said grooves (21) is in a shape of square or inverted trapezoidal.

14. The burner according to claim 13, wherein the flame hole (11) on the top lid (10) for the mixed flow to rush out has a frustoconic surface, which makes the

whirly mixed flow be reflected onto a reflecting plate (40) on the mixing box (20) and then rush out of the flame hole (11) to form a mixed whirling flow with a tiny bottom but a big top end.

15. The burner according to claim 14, wherein size of the flame hole (11) is one fifth to one third the size of the top lid。

16. The burner according to claim 9, wherein the fuel gas outlets (37) are evenly distributed, while the communicating holes (210) are evenly distributed too.

17. The burner according to claim 16, wherein diameter of the fuel gas outlets (37) and the communicating holes (210) are 0.5 to 3mm.

18. The burner according to claims 6 or 9, wherein a mounting throughhole (29) is arranged on the top surface of said mixing box (20), said mounting throughhole (29) is provided with a insulating sleeve (50) which comprises a round plate mounted within the countersunk hole (25) and a ring (51) matched with the mounting throughhole (29), on the insulating sleeve (50) a reflecting plate (40) is arranged, which is connected with a zero wire of a ion flame controller, and said mixing box (20) has two pulse ignition rods.

19. The burner according to claim 4, wherein said top lid (10) is screwed with the gas-separating box (30).

20. A combustion method of the burner according to claim 3, comprising the following steps:

S01 separating air and flue gas into two flow, wherein a first flow of air enters into the centric hole (31) and then into the grooves (21) through the evenly distributed communicating holes (210) to mix with a second flow of fuel gas, and then goes upwards along the inclined grooves (21) to form a rotating mixed flow inclined upwardly ;

S02 rotating the mixed flow inclined upwardly into a second mixing chamber (100), and mixing again rotationally to form a swirly mixed flow;

S03 let the rotating mixed flow and the swirly mixed flow collide with each

other and flow around, wherein the mixed flow is reflected onto the reflecting plate due to the frustoconic surface of the flame hole (11) and then rush out of the flame hole (11) to form a whirling mixed flow with a tiny bottom and a large top end, which produces a flame looked like hurricane with a small bottom but large head when ignited.