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(54) COMBUSTION CHAMBER CAPABLE OF FORCIBLY RETURNING FLAME

(57) Burners, such as all kinds of fuel oil, gas and powdered coal, have combustion chambers for stabilizing combustion and air distribution. The invention discloses a forced reversal combustion chamber (3), which comprises a combustion chamber body, configured as a hollow cavity which is similar to a arcing shape formed by folding fingers towards palm and symmetrically configured around center of palm; a plurality of swirl vanes for delivering combustion air into the combustion chamber (3), correspondingly provided on interior side of flame outlet end of the combustion chamber (3); in the middle of inner end of the combustion chamber (3), a fuel nozzle (2) is provided, which inserts into interior wall of the combustion chamber (3) and outlet of which extends through the interior wall of the combustion chamber (3); outlet end of the combustion chamber (3) after mixing air and fuel is flame outlet. The forced reversal combustion chamber (3) of the invention could overcome defects in the prior art, such as bad flame stabilization, low burn-off rate of fuel and poor environmental protection property, and achieve advantages of good flame stabilization, high burn-off rate of fuel and good environmental protection property.

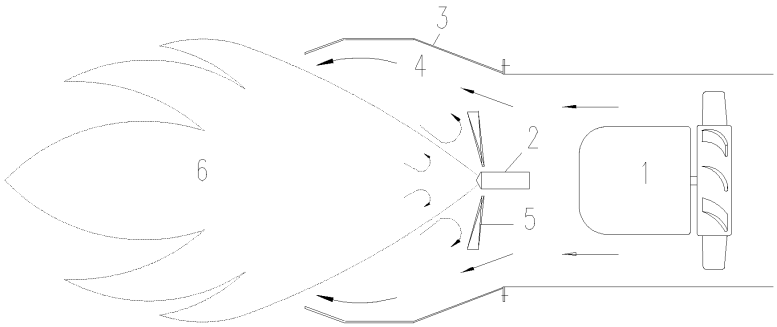

FIG. 1
PRIOR ART

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to technical field of burners, in particular, relates to a forced reversal combustion chamber.

BACKGROUNG OF THE INVENTION

[0002] Combustion chambers of conventional burners for fuel oil, gas and powdered coal all have forward air distribution (moving direction of air is same with that of the flame); as shown in Fig. 1, when secondary air flowing through outer side of swirl vanes (also known as, flame plates, or diffusion vanes) at high speed, partial negative pressure area is formed in front of flame plates that flame is passively reversed and igniting continually ejected fuel. For achieving effect of flame stabilization, the method usually has about 20% of primary air that 80% remainder air of secondary air mixes with fuel at outlet of the combustion chamber and fiercely blazes.

[0003] Conventional burners, as shown in Fig. 1, comprises combustion chamber (e.g. combustion chamber 3), wherein side wall of the combustion chamber is arcing structure projecting outward, one end of the combustion chamber is flame outlet for emitting flame, a fuel nozzle (e.g. fuel nozzle 2) is provided opposite the flame outlet on center of inner end of the combustion chamber, a pair of swirl vanes (e.g. swirl vanes 5) are disposed at opposite sides of the fuel nozzle inside the combustion chamber, a horizontally set air delivery channel is disposed on the other end of the combustion chamber, an air blower (e.g. air blower 1) for delivering secondary air (e.g. secondary air 4) into the combustion chamber is provided inside the air delivery channel, air outlet of which is opposite periphery of fuel nozzle.

[0004] The defects of this forward air distribution are:

(1) For small combustion chamber or nonflammable fuel with higher ignition point, since passively reversal of flame is weak because of the partial negative pressure, and temperatures of both initial phases of air and fuel are low, it is usually hard to ignite and easily blowing-off that leads to instability of burning;
(2) Since primary air has small air quantity and slow flow speed, burning of the fuel mainly happens outside the combustion chamber; when fuel is high viscosity oil or other nonflammable fuel, burn-off rate would obviously decline that leads to huge increase of energy consumption and emission pollution;
(3) For big combustion chamber or flammable fuel, since temperature inside the combustion chamber is high and temperature of secondary air is already very high before mixing with fuel, which leads to partial of oxygen reacting with nitrogen, it increases emission of nitric oxide.

SUMMARY OF THE INVENTION

[0005] Regarding to above problems, the object of the invention is to provide a forced reversal combustion chamber, to achieve advantages of good flame stabilization, high burn-off rate of fuel and good environmental protection property.

[0006] To achieve above object, technical solution of the invention is: a forced reversal combustion chamber comprises a combustion chamber body, configured as a hollow cavity which is similar to a arcing shape formed by folding fingers towards palm and symmetrically configured around center of palm; and a plurality of swirl vanes for delivering combustion air into the combustion chamber, correspondingly provided on interior side of the end of the combustion chamber; said plurality of swirl vanes comprises a plurality of secondary air swirl vanes (or air vents) for radially delivering secondary air into the combustion chamber, provided on interior side of flame outlet of the combustion chamber.

[0007] Furthermore, said plurality of swirl vanes comprises a plurality of tertiary air swirl vanes for delivering tertiary air to the combustion chamber, provided on interior side of the end of the combustion chamber.

[0008] Furthermore, , a fuel nozzle is provided in the middle of the combustion chamber, which inserts into interior wall of the combustion chamber and outlet of which extends through interior wall of the combustion chamber; outlet end after mixing the air and fuel is flame outlet of combustion chamber.

[0009] Furthermore, an air delivery channel is provided on the side of the hollow arcing cavity of the combustion chamber away from the flame outlet; an air blower for delivering combustion air into combustion chamber is provided inside said air delivery channel, air outlet of which is opposite cavity wall of hollow arcing cavity of the combustion chamber.

[0010] Forced reversal combustion chamber in embodiments of the invention comprises a combustion chamber body, configured as a hollow cavity which is similar to a arcing shape formed by folding fingers towards palm and symmetrically configured around center of palm; a plurality of swirl vanes for delivering secondary air into the combustion chamber, correspondingly provided on interior side of the end of the combustion chamber; a fuel nozzle is provided in the middle of the combustion chamber, which inserts into interior wall of the combustion chamber and outlet of which extends through interior wall of the combustion chamber; outlet end after mixing the air and fuel is flame outlet of the combustion chamber. Since air distribution of secondary air forced reversal is used, flame and high temperature air could be forced to flow to fuel nozzle to quickly ignite the fuel, which overcomes disadvantages of bad flame stabilization, low burn-off rate of fuel and poor environmental protection property in the prior art and achieves advantages of good flame stabilization, high burn-off rate of fuel and good environmental protection property.

[0011] Other features and advantages of the invention will be illustrated in following description, and partially be obvious from the description or understood by carrying out the invention.

[0012] There will be described embodiments of this invention, with reference to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Drawings are used for further understanding of the invention, which is also a part of the description for explanation of the invention, with reference to embodiments of the invention, but not for limitation. In the drawings:

Fig. 1 is working schematic diagram of forward air distribution of a conventional combustion chamber;
Fig. 2 is working schematic diagram of air distribution of forced reversal combustion chamber of the invention.

[0014] Figure references of embodiments of the invention, with reference of Fig. 1, are as follow:

1 - air blower ; 2 - fuel nozzle; 3 - combustion chamber; 4 - secondary air; 5 - swirl vanes; 6 - flame.

[0015] Figure references of embodiments of the invention, with reference of Fig. 2, are as follow:

1 - air blower ; 2 - fuel nozzle; 3 - combustion chamber; 4 - secondary air swirl vanes; 5 - tertiary air swirl vanes; 6 - flame.

DETAILED DESCRIPTION OF THE INVENTION

[0016] Preferred embodiments of the invention are further explained as follow; it should be understood that description herein of preferred embodiments is only used for explanation and illustration of the invention, not for limitation of the invention.

[0017] According to embodiment of the invention, as shown in Fig. 2, it provides a forced reversal combustion chamber.

[0018] Forced reversal combustion chamber of the embodiment comprises a combustion chamber body (e.g. combustion chamber 3), configured as a hollow cavity which is similar to a arcing shape formed by folding fingers towards palm and symmetrically configured around center of palm; a plurality of swirl vanes for delivering combustion air into the combustion chamber, correspondingly provided on interior side of the end of the combustion chamber, which comprise a plurality of secondary air swirl vanes (e.g. secondary air swirl vanes 4) for delivering secondary air into the combustion chamber provided on interior side of flame outlet of the combustion chamber, and comprise a plurality of tertiary air swirl vanes (e.g. tertiary air swirl vanes 5) for delivering tertiary air into the combustion chamber, provided on interior side of flame outlet of the combustion chamber; a fuel nozzle (e.g. fuel nozzle 2) is provided in the middle of the combustion chamber, which inserts into interior wall of the combustion chamber and outlet of which extends through interior wall of the combustion chamber; common outlet end of combustion chamber fuel nozzle is flame (e.g. flame 6) outlet.

[0019] In foresaid embodiment, an air delivery channel is provided on the side of the hollow arcing cavity of the combustion chamber away from the flame; an air blower (e.g. air blower 1) for delivering combustion air into the combustion chamber is provided inside the air delivery channel, air outlet of which is opposite cavity wall of hollow arcing cavity of the combustion chamber.

[0020] As shown in Fig. 2, the forced reversal combustion chamber of foresaid embodiment uses air distribution of secondary air forced reversal, cancels primary air swirl vanes in the back of conventional combustion chamber, and adds swirl vanes of secondary air and tertiary air on forepart of the combustion chamber. When using the forced reversal combustion chamber for air distribution, proportion of primary air for providing oxygen in flame center in the center is very small; proportion of radial forced reversal secondary air is bigger, it turns back when reaching inner end of the combustion chamber to form inner spin flow that flows to flame outlet; remainder air tangentially rotatably emits when flowing through tertiary air swirl vanes, and sufficiently mixes with the inner spin flow to ensure burning out of the fuel. The air distribution of the forced reversal combustion chamber could at least achieve following beneficial effects:

(1) Backwards outer spinning reversal secondary air, wrapping outer flame of the flame, flows to fuel nozzle; since temperature of the flow is high, it could effectively ignite continually emitted high ignition point fuel or nonflammable fuel, and form inner spin flame which turns back at outlet of the combustion chamber so that flame stabilization effect of nonflammable fuel would be great;
(2) Air quantity of secondary air is big, its angular kinetic energy could rapidly break fuel flow and mix with it; since fuel emits in a high temperature and oxygen-enriched environment, it blazes immediately, which is very important for burn-off rate of high viscosity or nonflammable fuel;
(3) Air temperature of outlet of secondary air swirl vanes is low; secondary air is continuously heated when flowing to fuel nozzle, while temperature of inner spin flame is declined that is good for reducing generation of high-temperature nitric oxide;
(4) Coefficient of excess air in combustion chamber is controlled at about 0.7 to 0.8; oxygen-deficient environment is good for reduction of fuel type nitric oxide and for reducing generation of high-temperature nitric oxide;
(5) Tertiary air swirl vanes is configured at outlet of

combustion chamber, adding low temperature tertiary air not only ensures burn-off rate of fuel, but also lowers flame temperature and reduces generation of high-temperature nitric oxide.

[0021] There have been described a preferred embodiment of this invention, of which the contents of disclosure should be construed illustrative, not restrictive to the invention. Artisan may perceive a modification to technical solution of foresaid embodiments, or an equal substitution to partial technical features therein. Without departing from the spirit and scope of the invention, any modification, equal substitution, and improvement shall be comprised in protection scope of the invention.

Claims

1. A forced reversal combustion chamber (3), wherein the combustion chamber comprising
a combustion chamber body, configured as a hollow cavity which is similar to a arcing shape formed by folding fingers towards palm and symmetrically configured around center of palm; and
a plurality of swirl vanes for delivering combustion air into the combustion chamber, correspondingly provided on interior side of flame outlet end of the combustion chamber;
said plurality of swirl vanes comprises a plurality of secondary air swirl vanes (4), or air vents, for delivering radial secondary air into the combustion chamber (3), provided on interior side of flame outlet end of the combustion chamber (3).

2. A forced reversal combustion chamber (3) in accordance with claim 1, wherein in the middle of inner end of the combustion chamber (3), a fuel nozzle (2) is provided, which inserts into interior wall of the combustion chamber (3) and outlet of which extends through the interior wall of the combustion chamber (3); outlet end of the combustion chamber (3) after mixing air and fuel is flame outlet.

3. A forced reversal combustion chamber (3) in accordance with claim 2, wherein said plurality of swirl vanes comprises a plurality of tertiary air swirl vanes (6) for delivering tangential tertiary air to the flame, provided on interior side of the flame outlet of the combustion chamber (3).

4. A forced reversal combustion chamber (3) in accordance with anyone of claims 1 to 3, wherein an air delivery channel is provided on the side of the hollow arcing cavity of the combustion chamber (3) away from the flame; an air blower (1) for delivering combustion air into combustion chamber (3) is provided inside the air delivery channel, air outlet of which is opposite cavity wall of hollow arcing cavity of the combustion chamber (3).

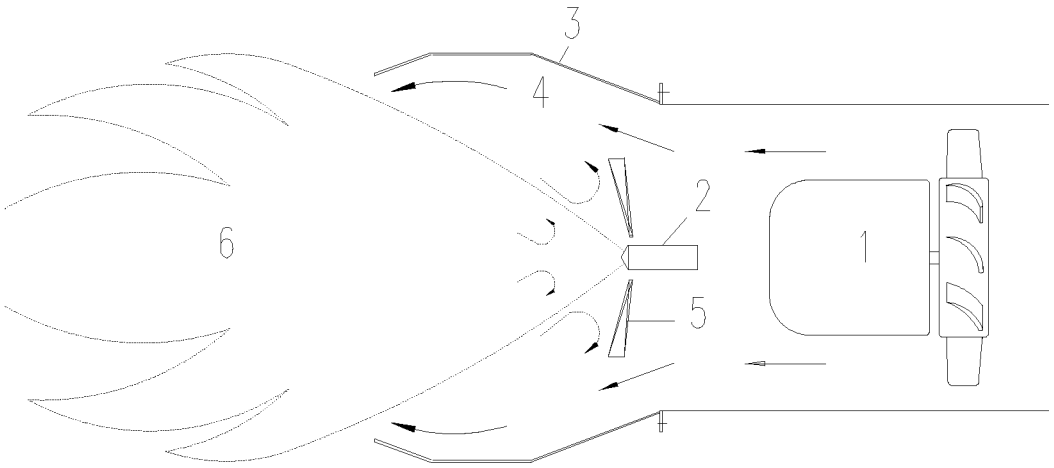

FIG. 1
PRIOR ART

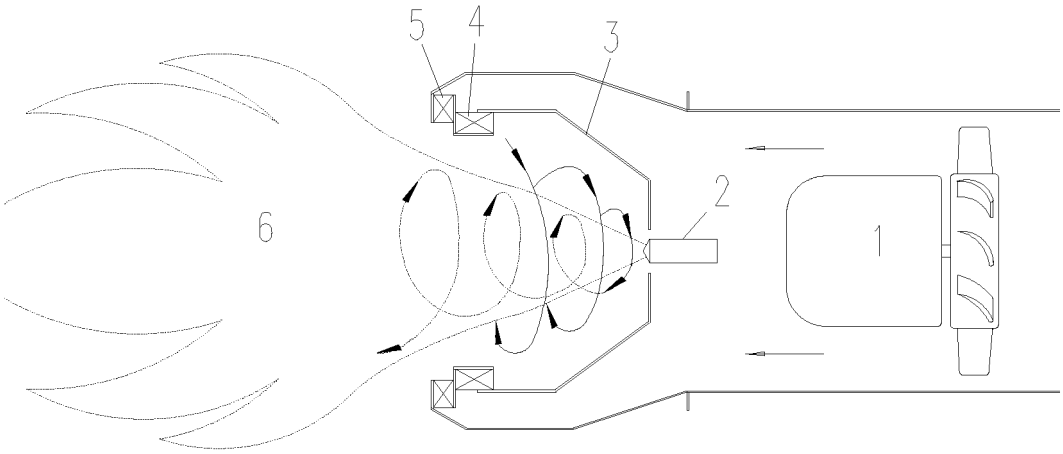

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2014/000371

A. CLASSIFICATION OF SUBJECT MATTER

F23C 3/00 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F23C, F23D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, CNPAT, CNKI: combustion chamber, back flame, secondary air, tertiary air, swirling flow, combustion, chamber, nozzle?, arc, curved, back, flame, recirculat+, secondary, air, tertiary, swirl+, rotat+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 639483 A (POYVER JETS RES & DEV LTD.), 28 June 1950 (28.06.1950), description, page 7, line 120 to page 8, line 111, and figures 1-5	1-4
A	CN 103148477 A (LI, Yanxin), 12 June 2013 (12.06.2013), the whole document	1-4
A	JP H1038222 A (SANYO ELECTRIC CO., LTD.), 13 February 1998 (13.02.1998), the whole document	1-4
A	US 4688496 A (ENATECH CORP.), 25 August 1987 (25.08.1987), the whole document	1-4
A	EP 0233680 A1 (HITACHI LTD. et al.), 26 August 1987 (26.08.1987), the whole document	1-4

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 December 2014 (08.12.2014)	**05 January 2015 (05.01.2014)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **CHANG, Mengyuan** Telephone No.: (86-10) **62084961**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2014/000371

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
GB 639483 A	28 June 1950	None	
CN 103148477 A	12 June 2013	None	
JP H1038222 A	13 February 1998	None	
US 4688496 A	25 August 1987	None	
EP 0233680 A1	26 August 1987	EP 0233680 B1	28 November 1990
		EP 0233680 B2	27 October 1993
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		JP S62158906 A	14 July 1987
		JP H0454125 B2	28 August 1992
		JP H0792214 B2	09 October 1995
		JP H63108107 A	13 May 1988

Form PCT/ISA/210 (patent family annex) (July 2009)