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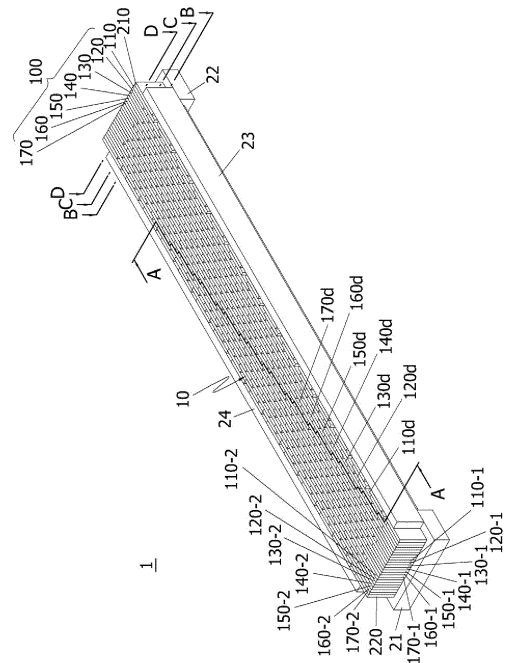
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(54) **PREMIXING BURNER HAVING DOUBLE FIRE PORTS**

(57) Provided is a premixing burner having double fire ports capable of conducting stable combustion regardless of an amount of input of combustible gas. The premixing burner having double fire ports which previously mixes and burns a gas and air is configured so that a plurality of plates, each of which is partly cut out, overlap to form a burner body, so that the plurality of plates are disposed so that cut portions are crossed between the neighboring plates so as to form a flow path of mixed gas and the plurality of fire ports, and so that the fire ports are configured so that the fire ports, each of which has a relatively small cross section through which the mixed gas flows based on a flowing direction of the mixed gas, are serially connected to the fire ports, each of which has a relatively large cross section.

[Fig. 1]



Description

[Technical Field]

5 **[0001]** The present invention relates generally to a premixing burner having double fire ports and, more particularly, to a premixing burner having double fire ports, in which the double fire ports have different sizes so that mixed gas of combustible gas and air is introduced into small fire ports and then is ejected from large fire ports, thereby improving a turn-down ratio (TDR) of the burner to enable stable combustion regardless of whether an amount of input gas is much or little.

[Background Art]

10 **[0002]** In general, gas burners used in combustion apparatuses such as boilers or water heaters can be divided into premixing burners and Bunsen burners according to a method of mixing combustible gas and air.

15 **[0003]** Bunsen burners supply primary air required for combustion from a nozzle section for injecting gas, and supply excessive secondary air to a spot where a flame is formed, thereby realizing complete combustion. The Bunsen burners have an advantage in that combustion stability is excellent, and a disadvantage in that a length of the flame is long because the flame is formed by the secondary air.

20 **[0004]** In contrast, the premixing burners employ a system that burns premixing gas obtained by pre-mixing combustible gas and air in a mixing chamber. The premixing burners can be operated at a low air ratio, provide high-efficiency and high-load combustion, and reduce a length of the entire flame and a temperature of the flame. Thus, the premixing burners can reduce pollutants such as carbon monoxide and nitrogen oxides.

25 **[0005]** Formerly, the Bunsen burners were mainly used. Recently, the premixing burners have been mainly used to reduce an amount of the pollutants and miniaturize a combustion chamber.

30 **[0006]** Such premixing burners are configured so that air supplied from a blower and combustible gas supplied through a gas supply pipe are pre-mixed inside a burner body and are supplied to a burner fire ports section formed at an upper side of the burner body.

35 **[0007]** In the premixing burners, the fire ports section employs a structure in which fire ports are formed in a member having a flat or cylindrical shape. In this structure, a burner combustion plane is deformed by thermal stress. In the worst case, the fire ports are damaged to cause incomplete combustion and flashback. In the event of low-load combustion, heat expansion is accumulated by red heat of a burner surface, and a great force is applied to a structure fixing the burner. Thereby, the structure becomes weak, and thus durability is reduced.

40 **[0008]** Further, in the conventional premixing burners, the fire ports have a constant size.

45 **[0009]** For example, when the fire ports are small, there is no problem when an amount of input gas is little. However, when the amount of input gas is much, an ejection speed of mixed gas becomes excessively high and causes a lifting phenomenon in which the flames fly away or a flame length becomes excessively long.

50 **[0010]** In contrast, when the fire ports are large, there is no problem when an amount of input gas is much. However, when the amount of input gas is little, flashback in which the flames are suctioned into the fire ports occurs. In the worst case, the flames are extinguished.

55 **[0011]** In this way, the conventional premixing burners have a problem in that, due to the structure in which the fire ports have a constant size, steady combustion is not ensured from a high-load range to a low-load range.

[Disclosure]

[Technical Problem]

60 **[0012]** Accordingly, the present invention has been made keeping in mind the above problems occurring in the related art, and the present invention is directed to provide a premixing burner having double fire ports, in which stable combustion is possible regardless of an amount of input of combustible gas.

65 **[0013]** Further, the present invention is directed to provide a premixing burner having double fire ports, which prevents a great force from being applied to a structure fixing the burner even when thermal expansion is accumulated due to red heat of a burner surface, thereby making it possible to prolong durable service life of the burner, to prevent deformation of the fire ports caused by thermal stress, and to improve stability of flames and combustion efficiency.

[Technical Solution]

70 **[0014]** According to an aspect of the present invention, there is provided a premixing burner having double fire ports which previously mixes and burns a gas and air is configured so that a plurality of plates, each of which is partly cut out,

overlap to form a burner body, so that the plurality of plates are disposed so that cut portions are crossed between the neighboring plates so as to form a flow path of mixed gas and the plurality of fire ports, and so that the fire ports are configured so that the fire ports, each of which has a relatively small cross section through which the mixed gas flows based on a flowing direction of the mixed gas, are serially connected to the fire ports, each of which has a relatively large cross section.

[0015] In this case, the fire ports may be formed in a double structure of the first fire ports provided at an inflow side of the mixed gas and the second fire ports having a greater cross section than the first fire ports, and the mixed gas may be ejected from the second fire ports via the first fire ports.

[0016] Further, the burner body may include an inner plates set in which the inner plates, each of which is partly opened to the neighboring plates, repetitively overlap, and outer plates coupled to front and rear of the inner plates set and sealing front and rear of the flow path of the mixed gas.

[0017] Further, each of the inner plates may include end segments located at opposite ends thereof, a plurality of fire ports formation segments disposed between the end segments at predetermined intervals and having the fire ports of different sizes formed in an upper portion thereof, and bridge segments extending between the end segments in a lengthwise direction thereof and connecting the end segments and the plurality of fire ports formation segments.

[0018] Further, the inner plates and the outer plates may be each provided with a plurality of fastening holes at regular intervals, and be mutually coupled by fastening members passing through the fastening holes.

[0019] Further, the fire ports formation segments of each of the inner plates may be disposed so as to cross those of the neighboring inner plates and form internal spaces through which the mixed gas flows.

[0020] Further, the fire ports may be formed by spaces between upper ends of the end segments and the fire ports formation segments adjacent to the end segments, and spaces between the upper ends of the fire ports formation segments.

[0021] Also, positions at which the bridge segments are connected to the fire ports formation segments may be spaced between the neighboring inner plates in a vertical direction. The mixed gas introduced into a mixed gas inlet formed in a lower portion of one of the neighboring inner plates may be subjected to division of the flow path by the bridge segments, and be ejected from the fire ports formed in the upper side of the inner plates via the internal spaces of the neighboring inner plates.

[0022] In addition, the mixed gas inlets may be formed in lower portions of the inner plates at regular intervals and at a constant size, so that the mixed gas is distributed and introduced into the mixed gas inlets at a uniform amount.

[Advantageous Effects]

[0023] According to the premixing burner having double fire ports of the present invention, the dual fire ports having different sizes are provided so that the mixed gas of combustible gas and air is ejected from the second fire ports having a large passing area via the first fire ports having a small passing area. Thereby, the stable combustion can always be conducted regardless of whether an amount of input of the combustible gas is much or little.

[0024] Further, according to the present invention, the plurality of inner plates, each of which is partly cut out, overlap to form a burner fire ports section, and thereby thermal expansion of a burner surface can be absorbed. As a result, a great force can be prevented from being applied to a structure that fixes the burner body, and thus a durable service life of the burner can be prolonged. A degree of deformation of the fire ports caused by thermal stress can be reduced, thereby increasing stability of flames and preventing incomplete combustion. Thus, combustion efficiency can be improved.

[Description of Drawings]

[0025]

FIG. 1 is a perspective view of a premixing burner having double fire ports according to an embodiment of the present invention.

FIG. 2 is a partial exploded view of FIG. 1.

FIG. 3 is a front view of a first inner plate shown in FIG. 2.

FIG. 4 is a front view of a second inner plate shown in FIG. 2.

FIG. 5 is a cross-sectional view taken along line A-A of FIG. 1.

FIG. 6 is a cross-sectional view taken along line B-B of FIG. 1.

FIG. 7 is a cross-sectional view taken along line C-C of FIG. 1.

FIG. 8 is a cross-sectional view taken along line D-D of FIG. 1.

<Description of Symbols>

[0026]

5	1:	premixing burner	10:	burner body
	21, 22:	bottom support frame	23, 24:	side support frame
	100:	inner plate	110:	first inner plate
	120:	second inner plate	130:	third inner plate
10	140:	fourth inner plate	150:	fifth inner plate
	160:	sixth inner plate	170:	seventh inner plate
	111a, 111b, 121a, 121b, 131a, 131b, 141a, 141b:	end segment		
	112, 122, 132, 142, 152, 162, 172:	fire ports formation segment		
	113, 123, 133, 143, 153, 163, 173:	bridge segment		
15	114a, 114b, 114c:	fastening hole		
	115a, 115b, 115c:	fastening member		
	110a, 130a, 150a, 170a:	mixed gas inlet		
	120b, 140b, 160b:	internal space		
20	110c, 120c, 130c, 140c, 150c, 160c, 170c:	first fire ports		
	110d, 120d, 130d, 140d, 150d, 160d, 170d:	second fire ports		
	210, 220:	outer plate		

[Mode for Invention]

[0027] Hereinafter, a configuration and operation of an exemplary embodiment of the present invention will be described in detail with reference to the accompanying drawings.

[0028] FIG. 1 is a perspective view of a premixing burner having double fire ports according to an embodiment of the present invention. FIG. 2 is a partial exploded view of FIG. 1. FIG. 3 is a front view of a first inner plate shown in FIG. 2. FIG. 4 is a front view of a second inner plate shown in FIG. 2. FIG. 5 is a cross-sectional view taken along line A-A of FIG. 1.

[0029] A premixing burner 1 having double fire ports according to an embodiment of the present invention includes a burner body 10, bottom support frames 21 and 22 fixing and supporting the burner body 10, and front and rear side support frames 23 and 24.

[0030] The burner body 10 includes an inner plates 100 made up of a plurality of plates, each of which is partly cut out, and outer plates 210 and 220 disposed in the front and rear of the inner plates 100. The inner plates 100 have a structure in which cut portions are disposed so as to be crossed between the neighboring plates and a flow path for mixed gas of combustible gas and air and a plurality of fire ports communicate with one another.

[0031] In the burner body 10, the inner plates 100 are configured so that a set of plates 110, 120, 130, 140, 150, 160, and 170, each of which is partly open to the neighboring plates, repetitively overlap, and the outer plates 210 and 220 are coupled to the front and rear of the inner plates 100 and seal the front and rear of the mixed gas flow path formed in the inner plates 100.

[0032] The inner plates 110, 120, 130, 140, 150, 160, and 170 and the outer plates 210 and 220 are each provided with a plurality of fastening holes 114a, 114b, and 114c at mutually corresponding positions at regular intervals, and are mutually coupled by fastening members 115a, 115b, and 115c such as bolts, pins, or rivets passing through the fastening holes 114a, 114b, and 114c.

[0033] In FIG. 1, unspecified reference numerals 110-1, 120-1, 130-1, 140-1, 150-1, 160-1, 170-1, 110-2, 120-2, 130-2, 140-2, 150-2, 160-2, and 170-2 represent plates that repetitively overlap like the set of inner plates 110, 120, 130, 140, 150, 160, and 170.

[0034] Meanwhile, the plurality of fire ports, which are a characteristic configuration of the present invention, are formed in an upper portion of the burner body 10 at regular intervals. Among them, the first fire ports 110c, 120c, 130c, 140c, 150c, 160c, and 170c, each of which has a relatively small cross section through which the mixed gas flows on the basis of a flowing direction of the mixed gas, are located at a lower side of the fire ports, and the second fire ports 110d, 120d, 130d, 140d, 150d, 160d, and 170d, each of which has a relatively large cross section, are serially connected to the first fire ports 110c, 120c, 130c, 140c, 150c, 160c, and 170c at an upper side of the fire ports.

[0035] Thus, the mixed gas introduced through mixed gas inlets 110a, 130a, 150a, and 170a formed in a lower portion of the burner body 10 flows through the mixed gas flow path formed in the burner body 10, and then is ejected from the second fire ports 110d, 120d, 130d, 140d, 150d, 160d, and 170d via the first fire ports 110c, 120c, 130c, 140c, 150c,

160c, and 170c.

[0036] In the present invention, the fire ports are formed in a double structure in which they have different cross sections, so that stable combustion can be conducted regardless of whether an amount of input of the combustible gas is much or little.

[0037] In detail, even when the gas input amount is little, an ejection speed of the mixed gas can be maintained above a predetermined speed, because the first fire ports 110c, 120c, 130c, 140c, 150c, 160c, and 170c are configured to have a small cross section. As such, there is no chance of causing flashback or extinguishment. In contrast, even when the gas input amount is much, the ejection speed of the mixed gas can be maintained below the predetermined speed because the second fire ports 110d, 120d, 130d, 140d, 150d, 160d, and 170d are configured to have a large cross section. As such, a lifting phenomenon in which the flames fly away or a flame length is increased can be prevented.

[0038] With this configuration, a turn-down ratio (TDR) indicating a ratio of a maximum amount of consumed gas to a minimum amount of consumed gas in a gas combustion apparatus in which an amount of gas is variably adjusted can be increased. As such, stable combustion can be conducted from a high-load range to a low-load range.

[0039] In the present embodiment, the fire ports are formed in the double structure in which they have different cross sections. However, the present invention is not limited to this configuration. As long as the fire ports having the small and large cross sections have a structure in which they are serially connected to allow the mixed gas to be discharged from the fire ports having the large cross section via the fire ports having the small cross section, the fire ports may be configured in a multiple structure such as a triple structure or a quadruple structure in addition to the double structure or in a structure in which the cross sections thereof are continuously increased.

[0040] Meanwhile, the bottom support frames 21 and 22 support bottom opposite ends of the burner body 10 in a lengthwise direction of the burner body 10 and maintains the overlapping state of the burner body 10. Top surfaces of the bottom support frames 21 and 22 are formed with fitting recesses 21a and 22a corresponding to shapes of the bottom opposite ends of the burner body 10. Thus, the bottom opposite ends of the burner body 10 are placed in and fixed to the fitting recesses 21a and 22a.

[0041] In the present embodiment, the inner plates 100 are configured so that the set of first to seventh inner plates 110, 120, 130, 140, 150, 160, and 170 are repetitively arranged three times. However, the number of sets of inner plates and the number of repetitions are not limited to these. It is apparent that, according to a capacity and an installed environment of the burner, such numbers may be changed.

[0042] Referring to FIG. 2, the first to seventh inner plates 110, 120, 130, 140, 150, 160, and 170 constituting the inner plates 100 have different shapes. In terms of the shape, the first, third, fifth, and seventh inner plates 110, 130, 150, and 170 may have a similar structure, and the second, fourth, and sixth inner plates 120, 140, and 160 disposed among them may have a similar structure.

[0043] Each of the inner plates 110, 120, 130, 140, 150, 160, and 170 communicates with its neighboring plates by cutouts formed by partly cutting segments thereof, so that the flow path for the mixed gas is formed. The flow path for the mixed gas is formed in such a way that the small-sized first fire ports 110c, 120c, 130c, 140c, 150c, 160c, and 170c and the large-sized second fire ports 110d, 120d, 130d, 140d, 150d, 160d, and 170d, both of which are formed upward, communicate with each other.

[0044] Referring to FIG. 3, the first inner plate 110 is made up of end segments 111a and 111b located at opposite ends thereof, a plurality of fire ports formation segments 112 disposed between the end segments 111a and 111b at predetermined intervals, and a bridge segment 113 extending between the end segments 111a and 111b in a lengthwise direction and connecting the end segments 111a and 111b and the fire ports formation segments 112.

[0045] The bridge segment 113 is installed at vertical middle portions of the fire ports formation segments 112 in the lengthwise direction. A plurality of mixed gas inlets 110a are formed at a lower side of the bridge segment 113 at regular intervals in the lengthwise direction. First fire ports 110c and second fire ports 110d, both of which have different sizes, are serially connected at an upper side of the bridge segment 113.

[0046] Here, the end segments 111a and 111b, the fire ports formation segments 112, and the bridge segment 113 constituting the first inner plate 110 are merely given names and reference numerals for convenience of the description, and may be integrally configured.

[0047] Similarly, the third inner plate 130 located at the rear of the first inner plate 110 is also made up of end segments 131a and 131b, fire ports formation segments 132, and a bridge segment 133. The fifth and seventh inner plates 150 and 170 located at the rear of the third inner plate 130 may also be configured in the same pattern as the third inner plate 130.

[0048] Referring to FIG. 4, the second inner plate 120 is made up of end segments 121a and 121b disposed at opposite ends thereof, a plurality of fire ports formation segments 122 disposed between the end segments 121a and 121b at predetermined intervals, and a bridge segment 123 extending between the end segments 121a and 121b in a lengthwise direction and connecting the end segments 121a and 121b and the fire ports formation segments 122. This structure is different from the structure in which the bridge segment 113 of the first inner plate 110 is installed at vertical middle portions of the fire ports formation segments 112 in the lengthwise direction in that the bridge segment 123 is installed

at lower ends of the fire ports formation segments 122 in the lengthwise direction.

[0049] Internal spaces 120b, which become the flow path of the mixed gas, are formed at an upper side of the bridge segment 123 in the lengthwise direction. First fire ports 120c and second fire ports 120d both of which have different sizes, are serially connected at an upper side of the internal spaces 120b.

[0050] Similarly, the fourth inner plate 140 located at the rear of the second inner plate 120 is also made up of end segments 141a and 141b, fire ports formation segments 142, and a bridge segment 143. The sixth inner plate 160 located at the rear of the fourth inner plate 140 may be configured in the same pattern as the fourth inner plate 140.

[0051] The fire ports formation segments constituting each of the first to seventh inner plates 110, 120, 130, 140, 150, 160, and 170 are disposed so as to cross those of the neighboring plates without conforming with those of the neighboring plates. Thereby, the flow path of the mixed gas is configured to be able to be led to the internal spaces of the neighboring plates.

[0052] Further, vertical positions at which the bridge segments 113, 123, 133, 143, 153, 163, and 173 are connected to the fire ports formation segments 112, 122, 132, 142, 152, 162, and 172 constituting the respective inner plates 110, 120, 130, 140, 150, 160, and 170 as described above are configured to alternate with one another in a vertical direction of the inner plates 100. Thereby, as shown in FIG. 5, mixed gas inlets 110a, 130a, 150a, and 170a are formed in lower ends of the first, third, fifth, and seventh inner plates 110, 130, 150, and 170.

[0053] Further, internal spaces 120b, 140b, and 160b are formed in inner middle portions of the second, fourth, and sixth inner plates 120, 140, and 160 so that the flow path of the mixed gas introduced through the mixed gas inlets 110a, 130a, 150a, and 170a is divided into two branches from the internal spaces 120b, 140b, and 160b.

[0054] Further, the first fire ports 110c, 120c, 130c, 140c, 150c, 160c, and 170c, (see FIG. 8) and the second fire ports 110d, 120d, 130d, 140d, 150d, 160d, and 170d, from which the mixed gas whose flow path is divided from the internal spaces 120b, 140b, and 160b is discharged, are serially formed in the upper ends of the first, third, fifth, and seventh inner plates 110, 130, 150, and 170.

[0055] FIG. 6 is a cross-sectional view taken along line B-B of FIG. 1, and shows that the mixed gas inlets 110a, 130a, 150a, and 170a are formed in a lower end of the burner body 10. FIG. 7 is a cross-sectional view taken along line C-C of FIG. 1, and shows that the internal spaces 120b, 140b, and 160b to which the mixed gas moves are formed in an intermediate portion of the burner body 10. FIG. 8 is a cross-sectional view taken along line D-D of FIG. 1, and shows that the first fire ports 110c, 120c, 130c, 140c, 150c, 160c, and 170c and the second fire ports 110d, 120d, 130d, 140d, 150d, 160d, and 170d are formed in an upper end of the burner body 10.

[0056] Here, the mixed gas inlets 110a, 130a, 150a, and 170a shown in FIG. 6 are preferably formed at regular intervals and at a constant size so that the mixed gas can be distributed and introduced at a uniform amount. In this case, the flames are uniformly formed throughout the whole load range of the burner so that combustion stability can be improved.

[0057] As described above, according to the premixing burner having double fire ports of the present invention, the dual fire ports having different cross sections are provided. Thereby, the stable combustion can always be conducted regardless of whether an amount of input of the combustible gas is much or little.

[0058] The plurality of plates, each of which is partly cut out, overlap to form the burner body, and the flow path of the mixed gas is provided in the burner body, and communicates with the double fire ports provided at the upper side of the burner body. Due to this structure, even when the plates constituting the burner body are subjected to thermal expansion by accumulation of combustion heat generated during the combustion, volume expansion is absorbed by the spaces between the overlapping plates. As a result, a great force can be prevented from being applied to a structure that fixes the burner body, and thus the durable service life of the burner can be prolonged.

[0059] In addition, in the present invention, the plurality of plates overlap to constitute the burner body in which the mixed gas flow path and the fire ports are formed. The burner body is assembled by fastening members, and then is fixedly placed on the bottom support frames. The side support frames are coupled to the burner body. Thereby, a process of installing the burner is completed, so that the burner can be manufactured with ease and at a low cost.

Claims

1. A premixing burner having double fire ports which previously mixes and burns a gas and air, in which:

a plurality of plates, each of which is partly cut out, overlap to form a burner body;

the plurality of plates are disposed so that cut portions are crossed between the neighboring plates so as to form a flow path of mixed gas and the plurality of fire ports; and

the fire ports are configured so that the fire ports, each of which has a relatively small cross section through which the mixed gas flows based on a flowing direction of the mixed gas, are serially connected to the fire ports, each of which has a relatively large cross section.

2. A premixing burner having double fire ports according to claim 1, wherein the fire ports are formed in a double structure of the first fire ports provided at an inflow side of the mixed gas and the second fire ports having a greater cross section than the first fire ports, and the mixed gas is ejected from the second fire ports via the first fire ports.

3. A premixing burner having double fire ports according to claim 1 or 2, wherein the burner body includes:

an inner plates set in which the inner plates, each of which is partly opened to the neighboring plates, repetitively overlap; and
outer plates coupled to front and rear of the inner plates set and sealing front and rear of the flow path of the mixed gas.

4. A premixing burner having double fire ports according to claim 3, wherein each of the inner plates includes end segments located at opposite ends thereof;
a plurality of fire ports formation segments disposed between the end segments at predetermined intervals and having the fire ports of different sizes formed in an upper portion thereof; and
bridge segments extending between the end segments in a lengthwise direction thereof and connecting the end segments and the plurality of fire ports formation segments.

5. A premixing burner having double fire ports according to claim 3, wherein the inner plates and the outer plates are each provided with a plurality of fastening holes at regular intervals, and are mutually coupled by fastening members passing through the fastening holes.

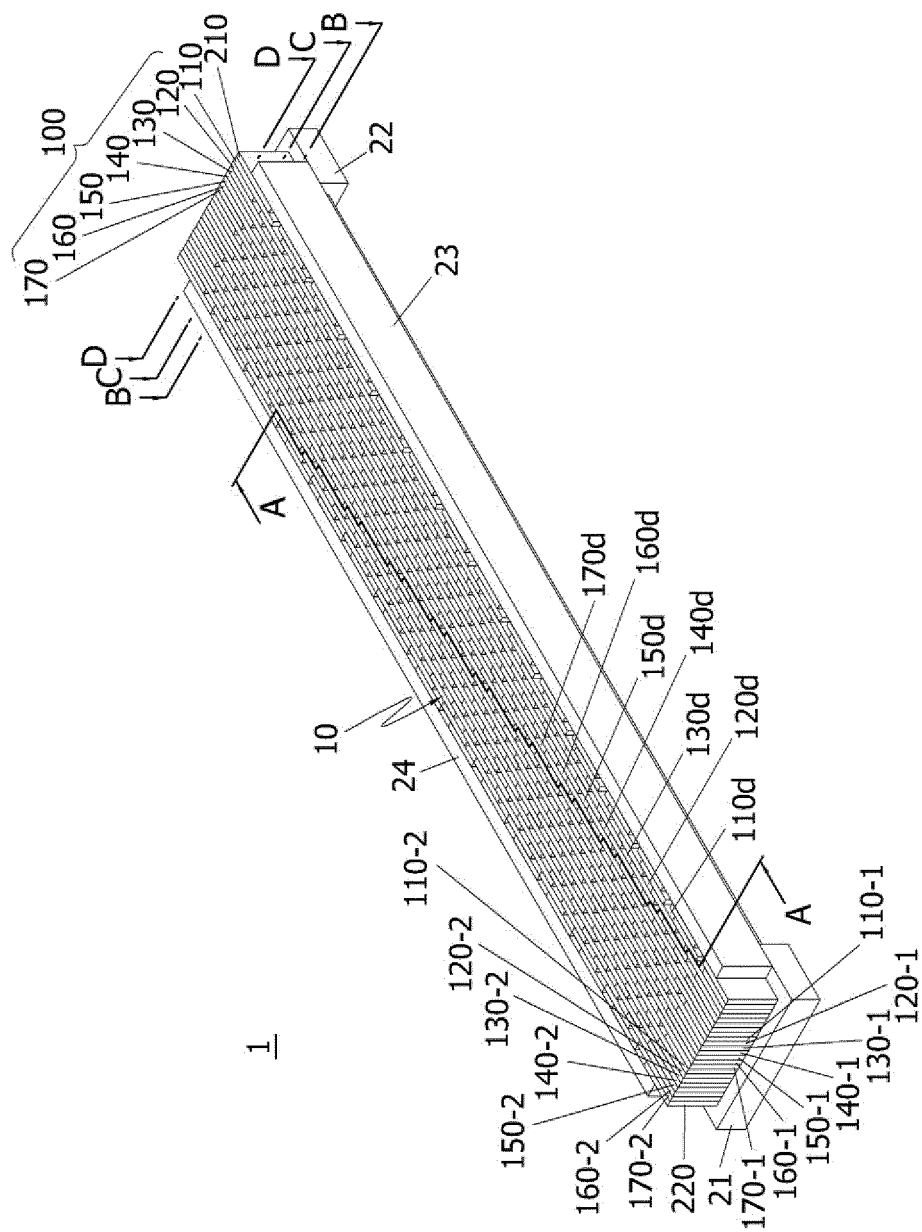
6. A premixing burner having double fire ports according to claim 4, wherein the fire ports formation segments of each of the inner plates are disposed so as to cross those of the neighboring inner plates and form internal spaces through which the mixed gas flows.

7. A premixing burner having double fire ports according to claim 4, wherein the fire ports are formed by spaces between upper ends of the end segments and the fire ports formation segments adjacent to the end segments, and spaces between the upper ends of the fire ports formation segments.

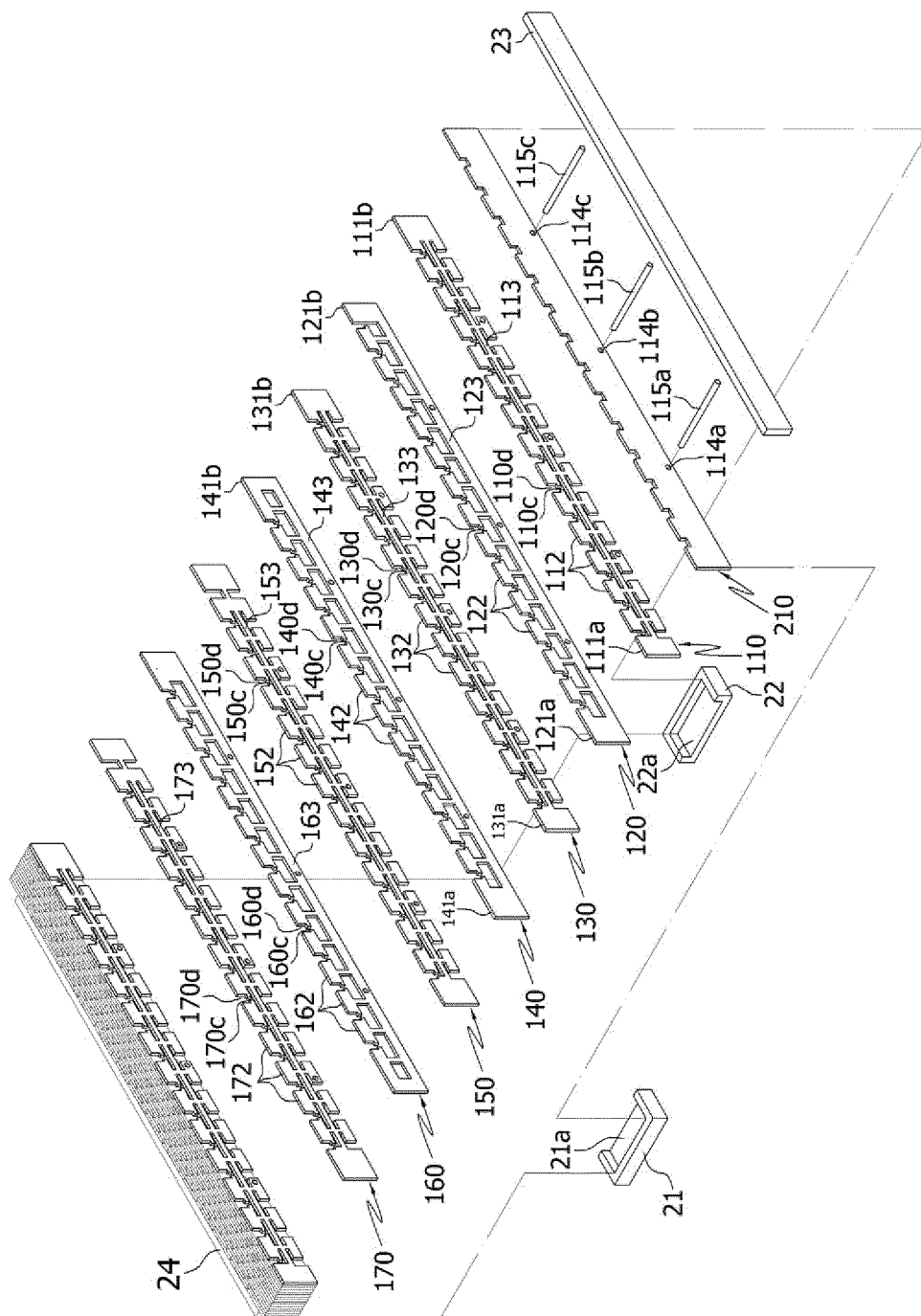
8. A premixing burner having double fire ports according to claim 4, wherein positions at which the bridge segments are connected to the fire ports formation segments are spaced between the neighboring inner plates in a vertical direction, and the mixed gas introduced into a mixed gas inlet formed in a lower portion of one of the neighboring inner plates is subjected to division of the flow path by the bridge segments, and is ejected from the fire ports formed in the upper side of the inner plates via the internal spaces of the neighboring inner plates.

9. A premixing burner having double fire ports according to claim 8, wherein the mixed gas inlets are formed in lower portions of the inner plates at regular intervals and at a constant size, so that the mixed gas is distributed and introduced into the mixed gas inlets at a uniform amount.

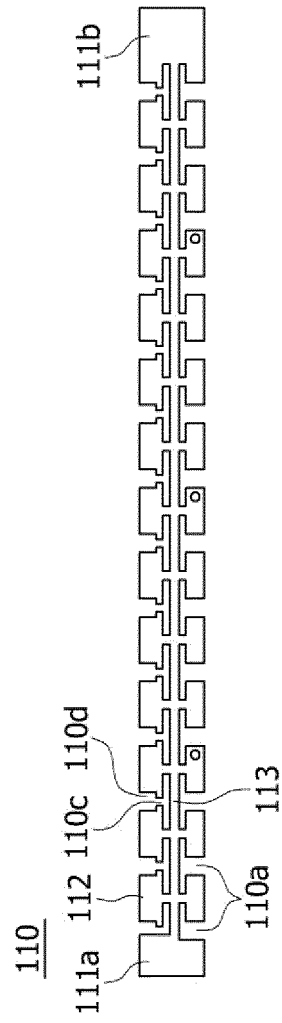
【Fig. 1】



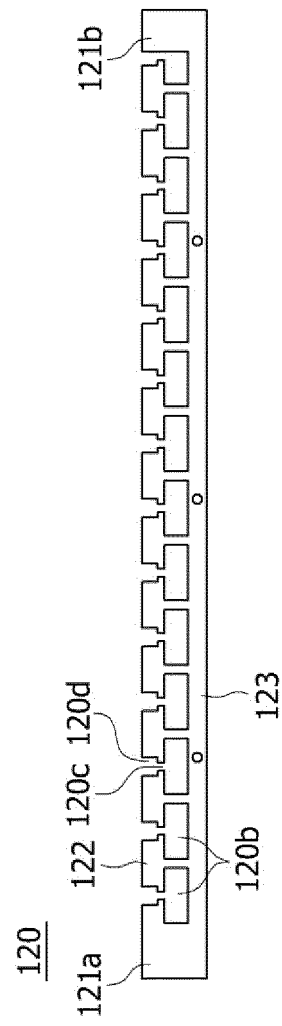
【 Fig. 2】



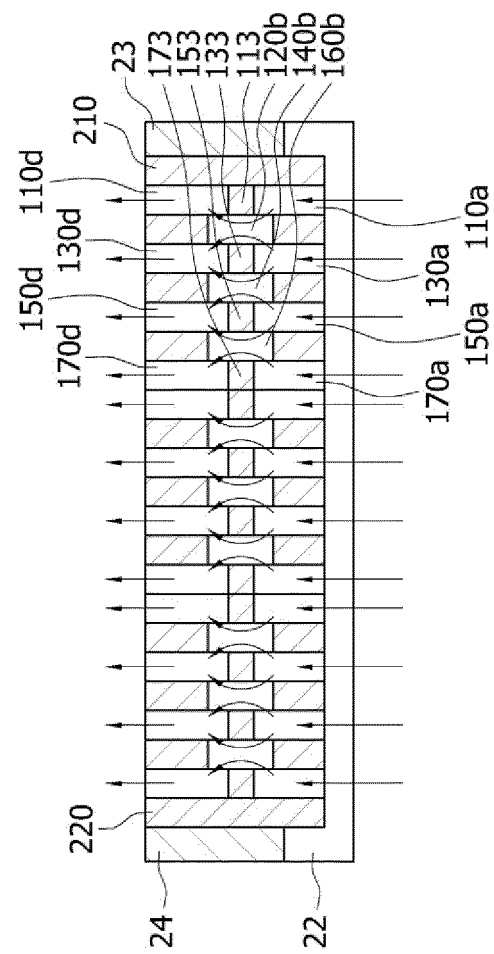
【 Fig. 3】



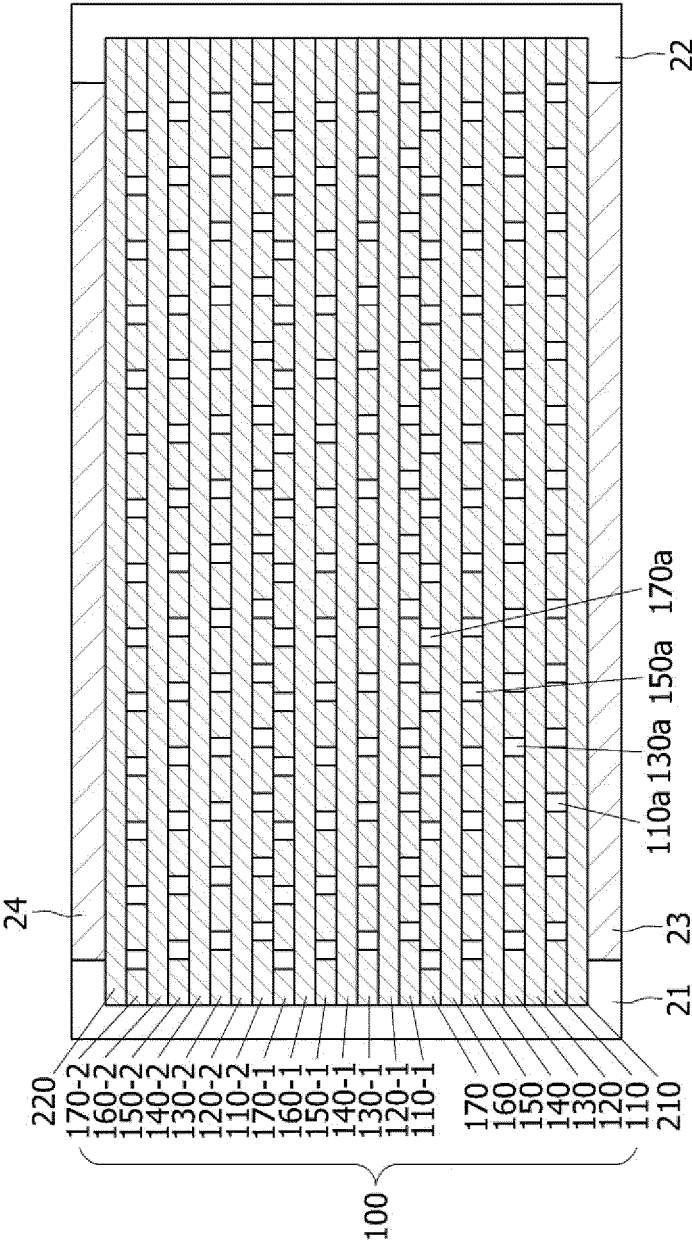
【 Fig. 4】



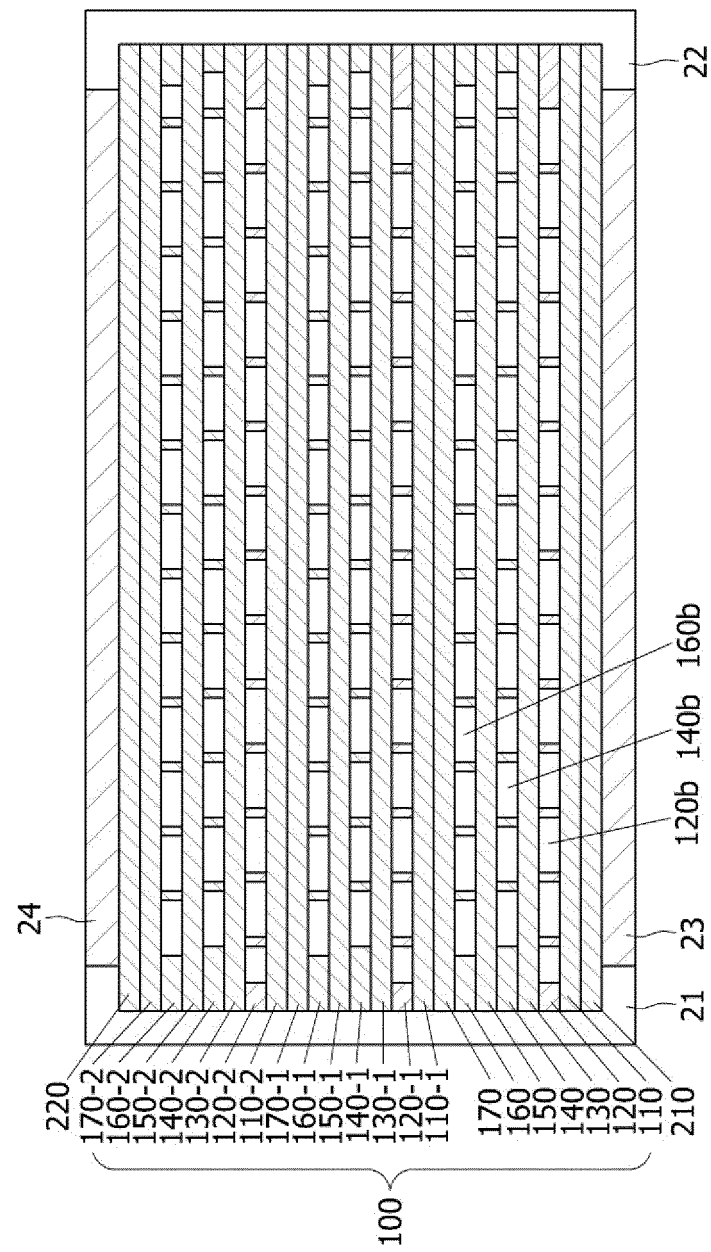
【 Fig. 5】



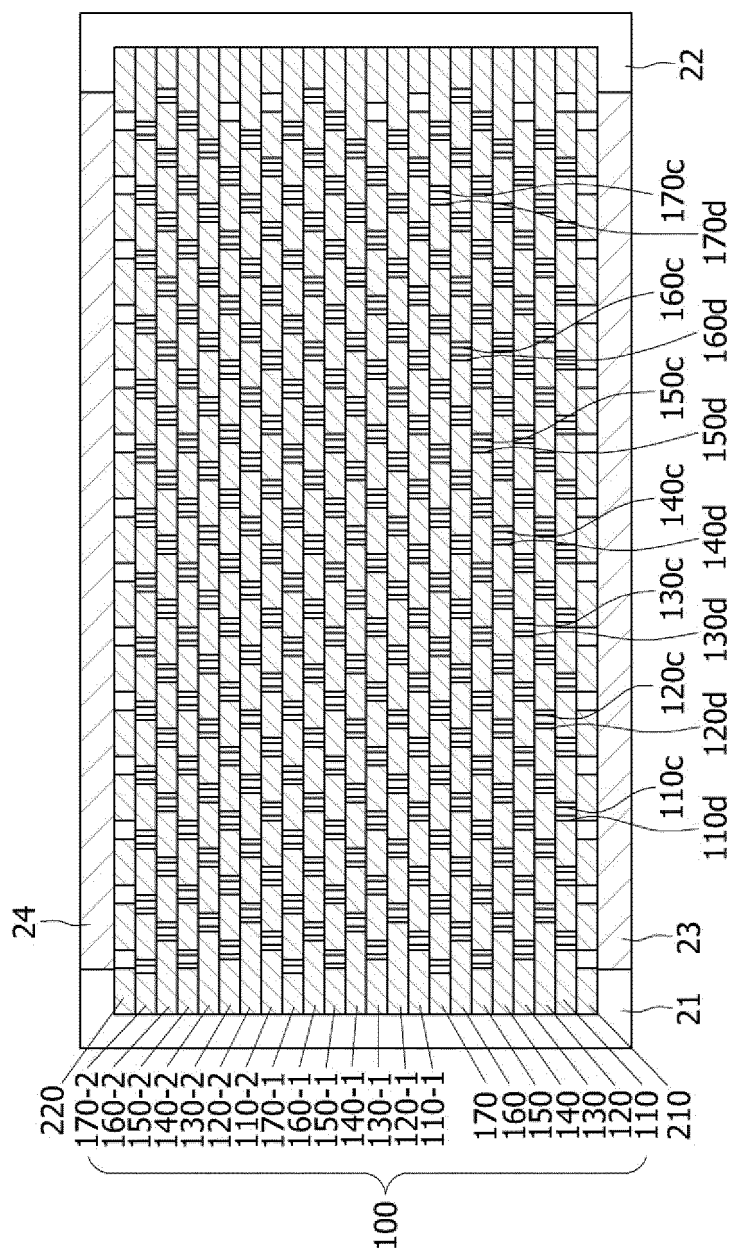
【 Fig. 6】



【 Fig. 7】



【 Fig. 8】



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2011/003618**A. CLASSIFICATION OF SUBJECT MATTER*****F23D 14/14(2006.01)i, F23D 14/58(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)

F23D 14/14; F23C 11/00; F23D 14/04; F23D 14/82; F23D 14/46; F23D 14/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
 Korean Utility models and applications for Utility models: IPC as above
 Japanese Utility models and applications for Utility models: IPC as above

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

eKOMPASS (KIPO internal) & Keywords: lamination, fire hole, overlapping, pre-mixed**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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