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(54) DUAL VENTURI FOR COMBUSTOR

(57) The present invention relates to a dual venturi for a combustor and, more specifically, to a dual venturi for a combustor which can control, in two stages, the amount of gas and air supplied to a burner provided in a water heater, wherein a motor and a damper are combined in such a manner that the damper is rotated by the driving of the motor, and thus the damper simultaneously opens or closes the inlet for secondary air and gas, thereby efficiently controlling the quantity of heat. The dual venturi comprises: a housing which has a first gas inlet and a second gas inlet on one side of the upper part thereof, and which has an interior divided by a partition wall such that a first passage and a second passage are formed; and an opening and closing means which is disposed in the housing, has an upper part connected to the second gas inlet such that gas flows therein, and controls the flow of air and gas by closing or opening the second passage as a damper is rotated by a motor provided on the exterior of the housing.

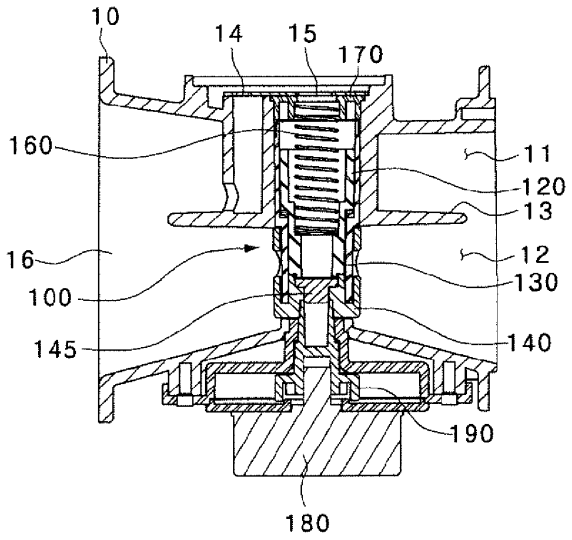

Fig. 1B

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Description

[Technical Field]

[0001] The present invention relates to a dual venturi for a combustion apparatus, and more particularly, to a dual venturi for a combustion apparatus, capable of effectively controlling a heating value since respective amounts of gas and air supplied to a burner provided in a water heater are controlled in a two-step manner and a motor is coupled to a damper so that the damper simultaneously opens or closes inlets for secondary air and gas along with rotation of the damper by driving of the motor.

[Background Art]

[0002] In general, combustion apparatuses such as boilers and water heaters for the purpose of use of heating and hot water are classified into an oil boiler, a gas boiler, an electric boiler and a water heater depending on the fuel it is supplied with, and are variously developed and used according to installation applications.

[0003] In such combustion apparatuses, particularly the gas boiler and the water heater typically use a bunsen burner or a premixed burner to burn gas fuel. The premixed burner among others has a combustion method of mixing gas and air in a mixing ratio for optimal combustion and then supplying a mixture (air + gas) to a flame hole section so that the mixture is burned.

[0004] In addition, the performance of the combustion apparatuses is evaluated as a TDR (Turn-Down Ratio). The TDR refers to "a ratio of maximum gas consumption to minimum gas consumption" in a gas combustion device in which an amount of gas is variably controlled. For example, when the maximum gas consumption is 24,000 kcal/h and the minimum gas consumption is 8,000 kcal/h, the TDR is 3:1. The TDR is constrained by whether flame is stably maintained to some degree under minimum gas consumption.

[0005] In the gas boiler and the water heater, convenience for use of heating and hot water is increased as the TDR becomes greater. That is, when the burner is actuated in a region in which the TDR is small (namely, the minimum gas consumption is high) and loads of heating and hot water are small, the combustion apparatuses are frequently turned on/off. For this reason, variation in temperature control is increased and durability of the apparatuses is deteriorated. Thus, in order to improve these problems, various methods for improving the TDR of the burner applied to the combustion apparatuses have been developed.

[0006] In such a modulating control burner, valves allowing for supply of gas are mainly classified into an electrical modulating gas valve controlled by current values and a pneumatic modulating gas valve controlled by differential pressures generated during supply of air.

[0007] The pneumatic modulating gas valve controls an amount of gas supplied to the burner by differential pressures generated when air required for combustion is supplied to the burner by a blower. In this case, air and gas required for combustion are mixed in a gas-air mixer and then supplied to the burner in a mixture (air + gas) form.

[0008] In the gas-air mixer of the gas burner using the above pneumatic modulating gas valve, the TDR is basically constrained by a factor such as a relation between gas consumption Q and differential pressure ΔP. The relation between flow rate and differential pressure of a fluid is generally as follows.

$$Q = k\sqrt{\Delta P}$$

[0009] That is, as seen in the above relational equation, in order to double the flow rate of the fluid, the differential pressure has to be quadrupled.

[0010] Accordingly, the ratio of pressure differences has to be defined as 9:1 for defining the TDR as 3:1 and the ratio of pressure differences has to be defined as 100:1 for defining the TDR as 10:1. However, there is a problem in that it is impossible to infinitely increase gas supply pressure.

[0011] In order to resolve the problem in which the gas supply pressure may not be infinitely increased, there is disclosed a method which increases the TDR of the gas burner by respectively dividing passages, through which air and gas are supplied, into two or more regions and by opening and closing each passage of gas injected into the burner.

[Disclosure]

[Technical Problem]

[0012] The present invention has been made in view of the above problems, and it is an object of the present invention to provide a dual venturi for a combustion apparatus, capable of achieving high operation durability, easy manufacturing, and a reduction in manufacturing cost while the dual venturi is compact by simplification of a complicated structure.

[Technical Solution]

[0013] In accordance with an aspect of the present invention, a dual venturi for a combustion apparatus includes a housing having a first gas inlet and second gas inlet formed at one side of an upper portion thereof and divided therein by a partition wall to have a first passage and a second passage, and an opening and closing unit provided within the housing, connected to the second gas inlet at an upper portion thereof such that gas is introduced into the opening and closing unit, and control-

ling flows of air and gas by closing or opening the second passage along with rotation of a damper by a motor provided at an outer side of the housing.

[0014] In the aspect, the opening and closing unit may include a tubular guide tube having one or more concave guides formed on an inner wall thereof, a tubular moving body having convex guides formed on an outer wall thereof to correspond to the concave guides so that the moving body moves within the guide tube in a longitudinal direction of the guide tube, a gas outlet formed at a distal end thereof to communicate with the second gas inlet, and a moving body cam having a cam shape formed on an outer surface thereof, a valve body having the damper formed on an outer surface thereof, a gas outlet formed at a side of the damper, and a valve body cam formed at an inner side thereof in a shape corresponding to the moving body cam such that the valve body cam engages with the moving body cam, valve body being coupled to the motor, a spring provided within the moving body to elastically support the moving body, and a cap supporting the spring and coupled to an upper portion of the guide tube.

[0015] In the aspect, when the motor is rotated and the moving body cam formed at the moving body is rotated, respective tip portions of the moving body cam and the valve body cam may come into contact with each other to push the moving body up, with the consequence that the opening and closing unit may open the gas outlet and simultaneously open the second passage by rotation of the damper of the valve body.

[0016] In the aspect, the valve body may further include a sealing member for sealing an inner lower end thereof.

[0017] In the aspect, the motor may be a synchronous motor.

[Advantageous Effects]

[0018] In accordance with the present invention having the above features, the following effects may be obtained.

[0019] First, heating values such as low heating values or high heating values may be selectively generated by a water heater as necessary and a user may control the heating values such as low heating values or high heating values as necessary. Therefore, fuel costs may be reduced.

[0020] Secondly, an inner portion of a housing is divided by a partition wall to form a first passage and a second passage so that only primary air and gas flow in the first passage and only secondary air and gas flow in the second passage. Therefore, it may be possible to easily adjust a TDR by regulating the flows of air and gas in the second passage.

[0021] Thirdly, since a second gas outlet is opened and closed and at the same time the second passage is also opened and closed by rotation of a valve body, a structure may be significantly simplified.

[Description of Drawings]

[0022]

FIG. 1A is a perspective view illustrating a dual venturi for a combustion apparatus according to an embodiment of the present invention.

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

FIG. 2A is a cross-sectional view taken along line B-B of FIG. 1A.

FIG. 2B is a view illustrating a state in which a moving body is moved upward in FIG. 2A.

FIGS. 3A and 3B are perspective views illustrating the moving body of FIG. 1B.

FIG. 4 is a perspective view illustrating a valve body of FIG. 1B.

FIGS. 5A and 5B are perspective views illustrating an opening and closing unit.

FIG. 6 is a cross-sectional view taken along line C-C of FIG. 5A.

FIG. 7 is a view illustrating a position relation between a motor and a limited switch of the motor included in the dual venturi for a combustion apparatus according to the embodiment of the present invention.

[Mode for Invention]

[0023] Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings. The present invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present invention to those skilled in the art. Accordingly, the drawings are not necessarily to scale and in some instances, proportions may have been exaggerated in order to clearly illustrate features of the embodiments. Throughout the disclosure, like reference numerals refer to like parts throughout the various figures and embodiments of the present invention. In addition, detailed descriptions of functions and constructions well known in the art may be omitted to avoid unnecessarily obscuring the gist of the present invention.

[0024] Hereinafter, a dual venturi for a combustion apparatus according to an exemplary embodiment of the present invention will be described in detail with reference to the accompanying drawings.

[0025] FIG. 1A is a perspective view illustrating a dual venturi for a combustion apparatus according to an embodiment of the present invention. FIG. 1B is a cross-sectional view taken along line A-A of FIG. 1A. FIG. 2A is a cross-sectional view taken along line B-B of FIG. 1A. FIG. 2B is a view illustrating a state in which a moving body is moved upward in FIG. 2A. FIGS. 3A and 3B are

perspective views illustrating the moving body of FIG. 1B. FIG. 4 is a perspective view illustrating a valve body of FIG. 1B. FIGS. 5A and 5B are perspective views illustrating an opening and closing unit. FIG. 6 is a cross-sectional view taken along line C-C of FIG. 5A. FIG. 7 is a view illustrating a position relation between a motor and a limited switch of the motor included in the dual venturi for a combustion apparatus according to the embodiment of the present invention.

[0026] Referring to FIGS. 1 to 6, the dual venturi for a combustion apparatus according to the embodiment of the present invention includes a cylindrical housing 10 which has a first gas inlet 14 and second gas inlet 15 formed at one side of an upper portion thereof and is divided therein by a partition wall 13 to have a first passage 11 and a second passage 12.

[0027] In addition, a discharge port 16 formed at the housing 10 is coupled with a turbofan (not shown) for supplying a mixture (gas + air) introduced from the first and second passages 11 and 12 to a burner.

[0028] Meanwhile, the housing 10 is coupled, at an inner central portion thereof, with an opening and closing unit 100 which is connected to the second gas inlet 15 at an upper portion thereof such that gas is introduced into the opening and closing unit 100 and controls the flows of air and gas by closing or opening the second passage 12 along with rotation of a damper 142 by a motor 180 provided at an outer side of the housing 10. In addition, the motor 180 is preferably configured of a synchronous motor. This enables manufacturing costs to be reduced by generally using the cheap synchronous motor.

[0029] The opening and closing unit 100 includes a tubular guide tube 130 having one or more concave guides 131 formed on an inner wall thereof, and a tubular moving body 120 which has convex guides 122 formed on an outer wall thereof to correspond to the concave guides 131 so that the moving body 120 moves within the guide tube 130 in a longitudinal direction of the guide tube 130, a gas outlet 123 formed at a distal end thereof to communicate with the second gas inlet 15, and a moving body cam 121 having a cam shape formed on an outer surface thereof. An inner surface of the guide tube 130 and an outer surface of the moving body 120 are formed in a stepped shape, and a sealing ring 146 is coupled to the stepped portion to prevent leakage of gas.

[0030] In addition, the opening and closing unit 100 includes a valve body 140 which is coupled to a lower portion of the moving body 120, has the damper 142 formed on an outer surface thereof, a gas outlet 143 formed at a side of the damper 142, and a valve body cam 141 formed at an inner side thereof in a shape corresponding to the moving body cam 121 such that the valve body cam 141 engages with the moving body cam 121, and is coupled to the motor 180.

[0031] Furthermore, the opening and closing unit 100 includes a spring 160 formed inside the moving body 120 to elastically support the moving body 120 and a cap 170 which supports the spring 160 and is coupled to an upper portion of the guide tube 130.

[0032] Meanwhile, a connection member 190 is coupled to a lower portion of the valve body 140. The connection member 190 is coupled to a rotary shaft 181 of the motor 180 to transfer driving force generated by the motor 180 to the valve body 140. In addition, a sealing member 145 for sealing an inner lower end of the valve body 140 is inserted into a lower end of the valve body 140.

[0033] Meanwhile, the outer side of the housing 10 is further provided with the motor 180 for rotating the valve body 140 coupled to the connection member 190 by coupling of the rotary shaft 181 and the connection member 190. The motor 180 provides torque to the valve body 140. The rotary shaft 181 has protrusions 182 formed at intervals of 90 degrees and the protrusions 182 operate a limit switch 201 along with rotation of the motor 180 such that a rotation angle of the valve body 140 is controlled. The limit switch 201 is provided inside a switch box 200 and the switch box 200 is interposed between the housing 10 and the motor 180.

[0034] Hereinafter, an operation state of the dual venturi for a combustion apparatus of the present invention having the above configuration will be described.

[0035] First, an operation in which only primary gas and air are supplied from a water heater is performed in such a way that the damper 142 of the valve body 140 is rotated perpendicular to a direction in which air and gas in the second passage 12 flow so that the second passage 12 is blocked, and at the same time a concave portion of the moving body cam 121 and a convex portion of the valve body cam 141 are in contact with a convex portion of the moving body cam 121 and a concave portion of the valve body cam 141, thereby allowing the gas outlet 123 of the moving body 120 to come into contact with the sealing member 145 so that the second gas passage is maintained in a blocked state and the gas outlet 123 is also maintained in a blocked state, as shown in FIGS. 2A and 5A.

[0036] Accordingly, since a mixture of air and gas is introduced into the turbofan only through the first gas inlet 14 and the first passage 11, a combustion apparatus may be actuated by means of a low heating value.

[0037] Meanwhile, in order to actuate the combustion apparatus by means of a high heating value, power is applied to the motor 180 and the motor 180 rotates the valve body 140 by 90 degrees such that the damper 142 is rotated to correspond to a longitudinal direction of the second passage 12, as shown in FIGS. 2B and 5B.

[0038] At the same time, since the valve body 140 is rotated and the valve body cam 141 formed therein is also rotated, the respective convex portions (tip portions) of the valve body cam 141 and the moving body cam 121 come into contact with each other, thereby allowing the moving body cam 121 to be pushed up along with rotation of the valve body cam 141. In this case, since the convex guides 122 are inserted into the concave guides 131, the

moving body 120 is easily moved upward within the guide tube 130.

[0039] Accordingly, since the valve body 140 is rotated in a direction equal to the longitudinal direction of the second passage 12, the second passage 12 is opened and secondary gas is simultaneously introduced through the gas outlet 143 by decoupling of the lower end of the gas outlet 123 of the moving body 120 from the sealing member 145, as shown in FIGS. 2B and 5B. Here, the secondary gas is mixed with the air and gas introduced through the second passage 12 and is then mixed with the air and gas introduced through the first passage 11 and the first gas inlet 14, so that a large amount of mixture is generated and the mixture is introduced into the turbofan. As a result, the combustion apparatus may be actuated by means of a high heating value.

[0040] Subsequently, when the motor 180 rotates the valve body 140 by 90 degrees in order to actuate the combustion apparatus by means of a low heating value again, the valve body 140 is returned to the state shown in FIGS. 1B, 2A, and 5A. Consequently, the second passage 12 and the gas outlet 143 are blocked and, as such, the combustion apparatus is actuated by means of a low heating value. Here, the spring 160 provided in the moving body 120 serves to increase restoration of the moving body 120 when the second passage 12 is closed by rotation of the valve body 140.

[0041] Hereinafter, a description will be given with respect to the limit switch 201 for controlling rotation of the motor 180 driving the damper such that the combustion apparatus is actuated by means of the low heating value or the high heating value.

[0042] Referring to FIG. 7, the rotary shaft 181 of the motor 180 has the protrusions 182 which are protrudingly formed on an outer peripheral surface thereof at intervals of 90 degrees and the limit switch 201 has movable protrusions 202 formed to be located on the same circumference as the protrusions 182. When the protrusions 182 press the movable protrusions 202 while rotating at intervals of 90 degrees, the limit switch 201 causes a short circuit current and, as such, rotation of the motor 180 is stopped.

[0043] Therefore, when the combustion apparatus is actuated, the protrusions 182 are rotated by 90 degrees to press the movable protrusions 202. Then, the limit switch 201 is turned off to stop rotation of the motor 180 and the valve body 140 is also stopped. As a result, the second passage 12 is opened or closed.

[0044] Although the present invention has been described with respect to the illustrative embodiments of the dual venturi for a combustion apparatus, it should be understood that numerous other modifications and applications may be devised by those skilled in the art that will fall within the intrinsic aspects of the embodiments. More particularly, various variations and modifications are possible in concrete constituent elements of the embodiments. In addition, it is to be understood that differences relevant to all variations, equivalents, and alternatives fall within the spirit and scope of the present disclosure defined in the appended claims.

[Description of Reference Numerals]

[0045]

10: housing, 11: first passage
12: second passage, 13: partition wall
14: first gas inlet, 15: second gas inlet
100: opening and closing unit, 120: moving body
121: moving body cam, 122: convex guide
130: guide tube, 131: concave guide
140: valve body, 141: valve body cam
142: damper, 143: gas outlet
145: sealing member, 146: sealing ring
160: spring, 170: cap
180: motor, 181: rotary shaft
182: protrusion, 190: connection member
200: switch case, 201: limit switch
202: movable protrusion

Claims

1. A dual venturi for a combustion apparatus, comprising:

   a housing (10) having a first gas inlet (14) and second gas inlet (15) formed at one side of an upper portion thereof and divided therein by a partition wall (13) to have a first passage (11) and a second passage (12); and
   an opening and closing unit (100) provided within the housing (10), connected to the second gas inlet (15) at an upper portion thereof such that gas is introduced into the opening and closing unit (100), and controlling flows of air and gas by closing or opening the second passage (12) along with rotation of a damper (142) by a motor (180) provided at an outer side of the housing (10).

2. The dual venturi of claim 1, wherein the opening and closing unit (100) comprises:

   a tubular guide tube (130) having one or more concave guides (131) formed on an inner wall thereof;
   a tubular moving body (120) having convex guides (122) formed on an outer wall thereof to correspond to the concave guides (131) so that the moving body (120) moves within the guide tube (130) in a longitudinal direction of the guide tube (130), a gas outlet (123) formed at a distal end thereof to communicate with the second gas inlet (15), and a moving body cam (121) having a cam shape formed on an outer surface thereof;

a valve body (140) having the damper (142) formed on an outer surface thereof, a gas outlet (143) formed at a side of the damper (142), and a valve body cam (141) formed at an inner side thereof in a shape corresponding to the moving body cam (121) such that the valve body cam (141) engages with the moving body cam (121), valve body (140) being coupled to the motor (180);

a spring (160) provided within the moving body (120) to elastically support the moving body (120); and

a cap (170) supporting the spring (160) and coupled to an upper portion of the guide tube (130).

3. The dual venturi of claim 1 or 2, wherein when the motor (180) is rotated and the moving body cam (121) formed at the moving body (120) is rotated, respective convex portions of the moving body cam (121) and the valve body cam (141) come into contact with each other to push the moving body (120) up, with the consequence that the opening and closing unit (100) opens the gas outlet (143) and simultaneously opens the second passage (12) by rotation of the damper (142) of the valve body (140).

4. The dual venturi of claim 2, wherein the valve body (140) further comprises a sealing member (145) for sealing an inner lower end thereof.

5. The dual venturi of claim 1 or 2, wherein the motor (180) is a synchronous motor.

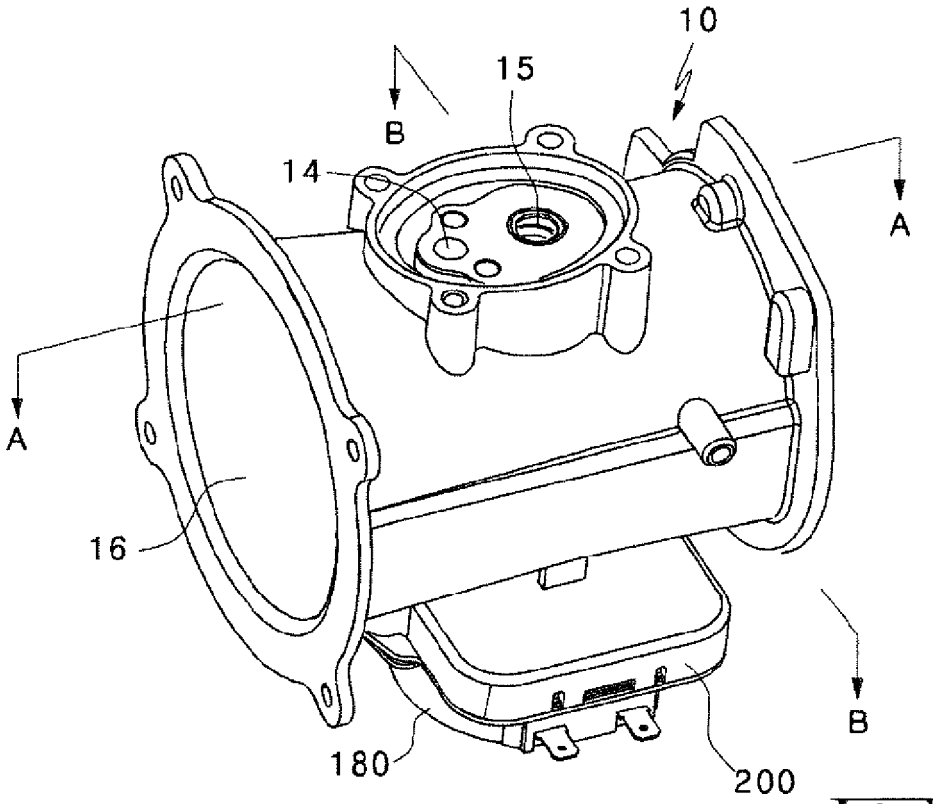
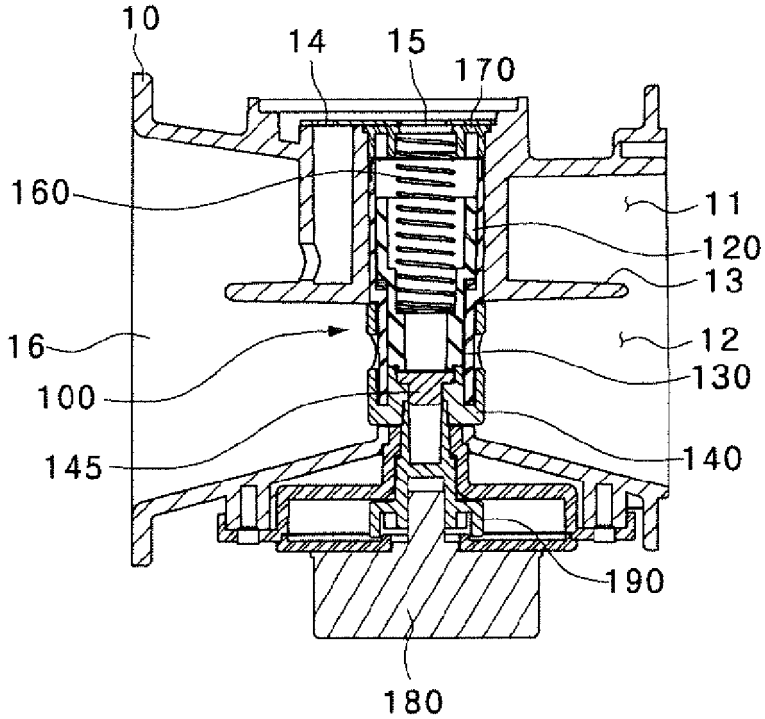

10
15
B
14
A
A
16
B
180
200

Fig. 1A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140
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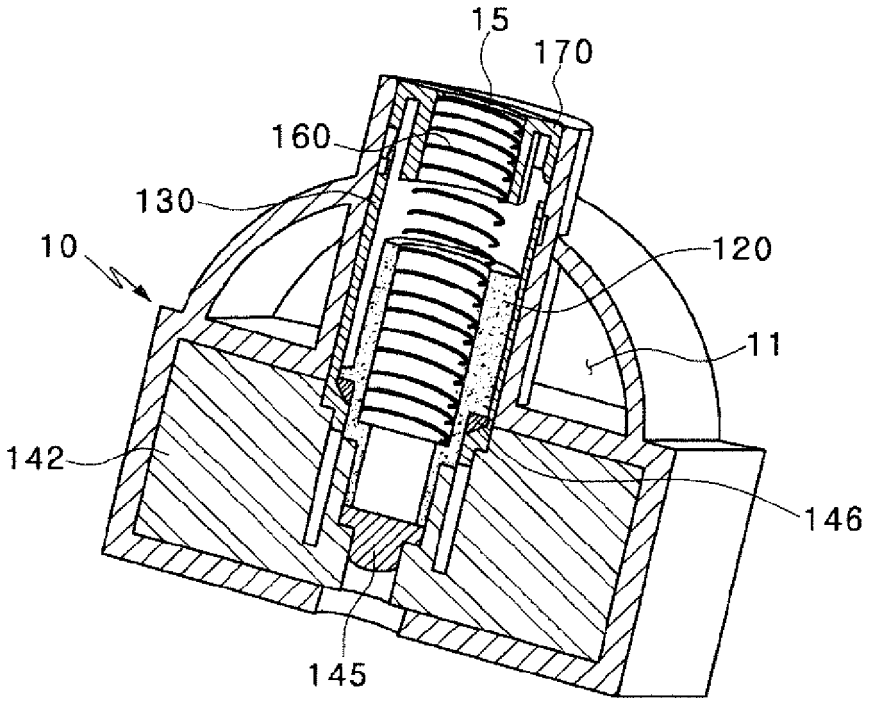
Fig. 1B


15
170
160
130
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142
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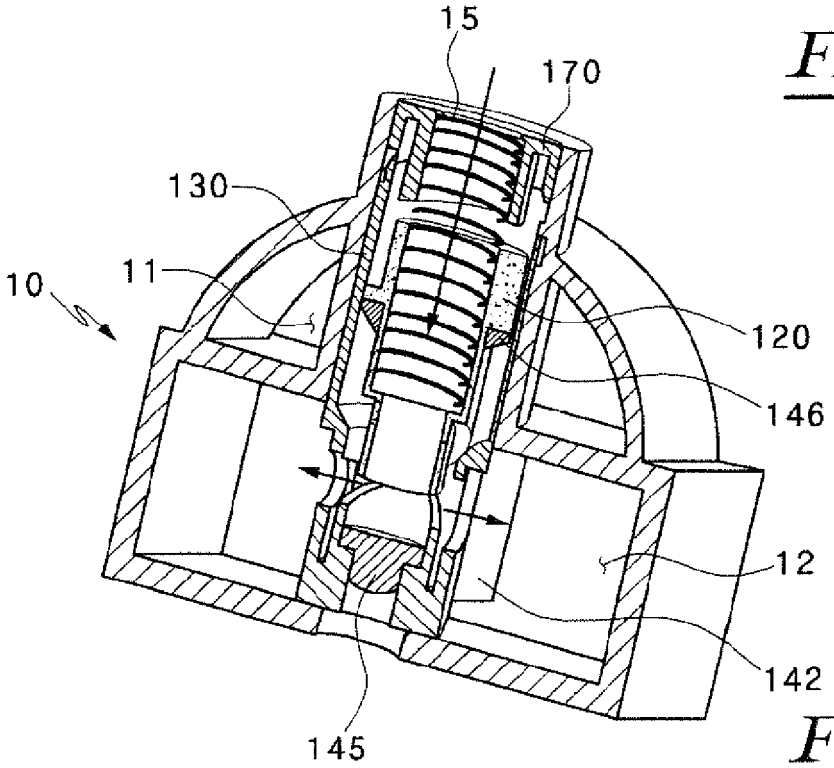
145

Fig. 2A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142
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Fig. 2B

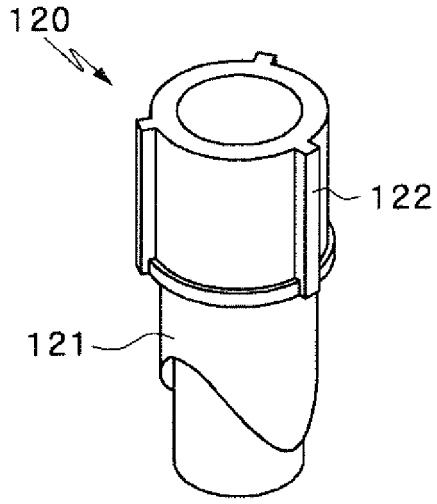

Fig. 3A

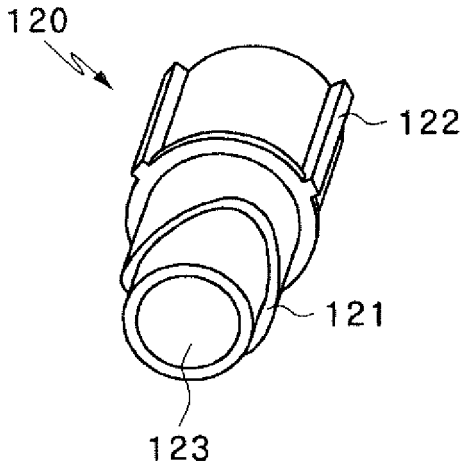

Fig. 3B

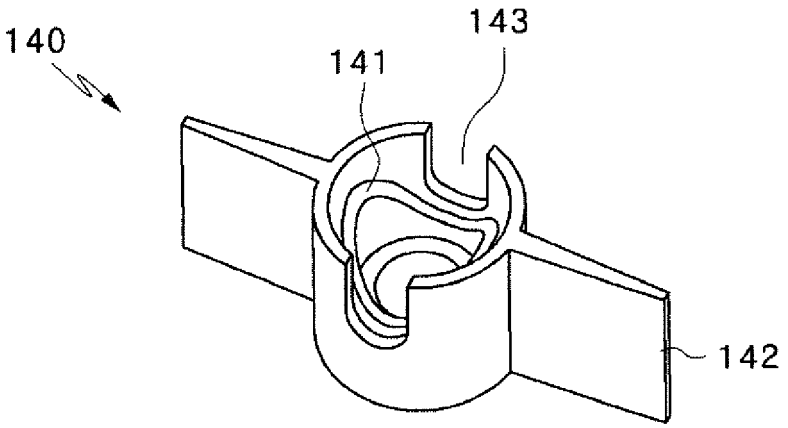

Fig. 4

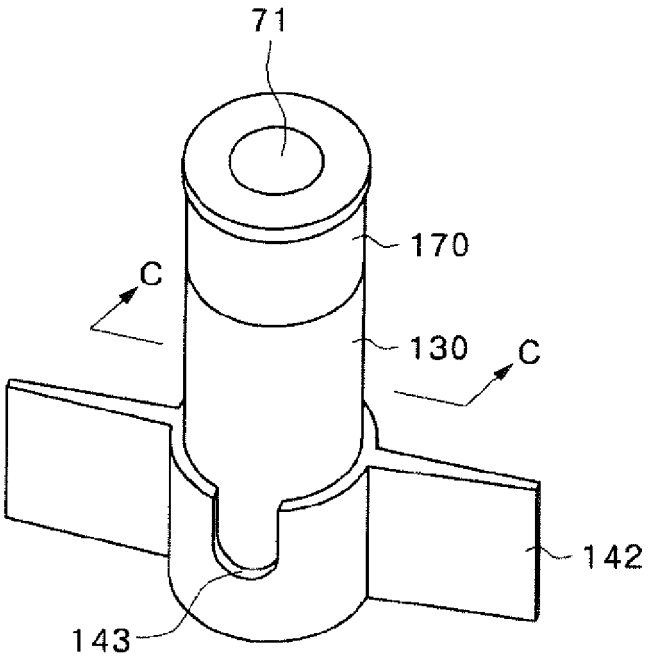

Fig. 5A

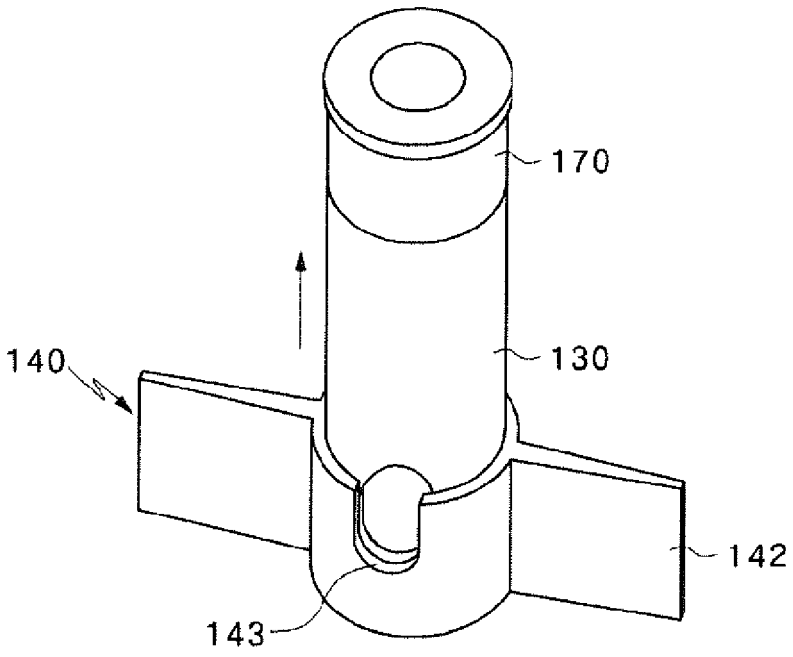

Fig. 5B

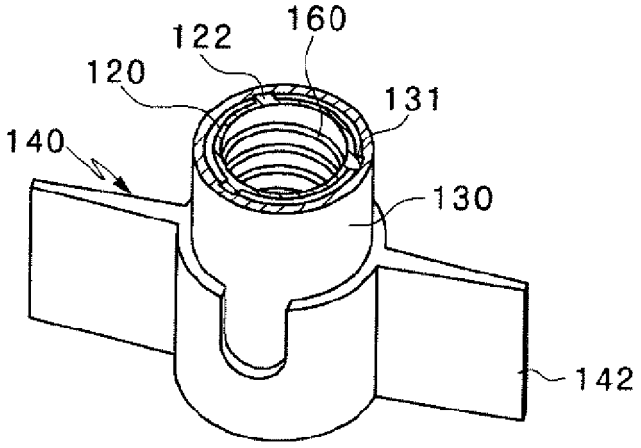

Fig. 6

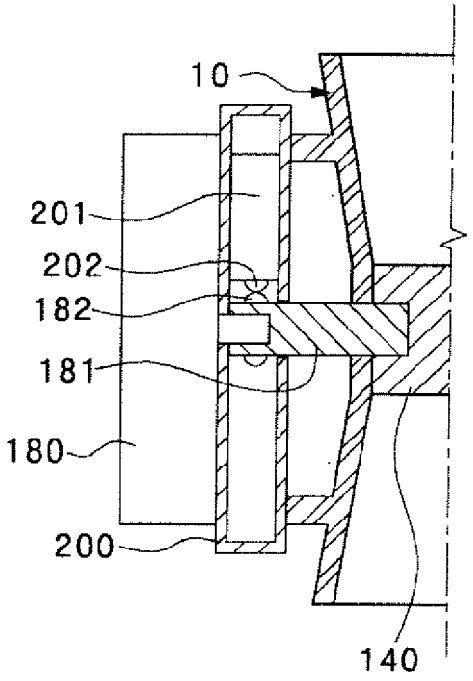

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2013/000443

A. CLASSIFICATION OF SUBJECT MATTER

F23D 14/60(2006.01)i, F23N 1/02(2006.01)i, F23N 5/00(2006.01)i, F23D 14/62(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 14/60; F23N 1/02; F23D 14/64; F23D 14/62; F23N 3/00

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: gas, air, mixer, pre-mixed, venturi, damper, burner

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 2011-0139045 A1 (ZATTI, Claudio et al.) 16 June 2011 See figure 4; paragraphs [0058]-[0066] and [0084]-[0092]	1,5 2-4
A	KR 10-2010-0020084 A (KYUNGDONG NETWORK CO., LTD.) 22 February 2010 See abstract; figure 3	1-5
A	KR 10-0805630 B1 (KYUNGDONG NAVIEN CO., LTD.) 20 February 2008 See abstract; figures 4-5	1-5

☐ 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
15 APRIL 2013 (15.04.2013)	**16 APRIL 2013 (16.04.2013)**
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