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(71) Applicant: **Ito Koki Co., Ltd.**
Higashiosaka-shi, Osaka 579-8038 (JP)

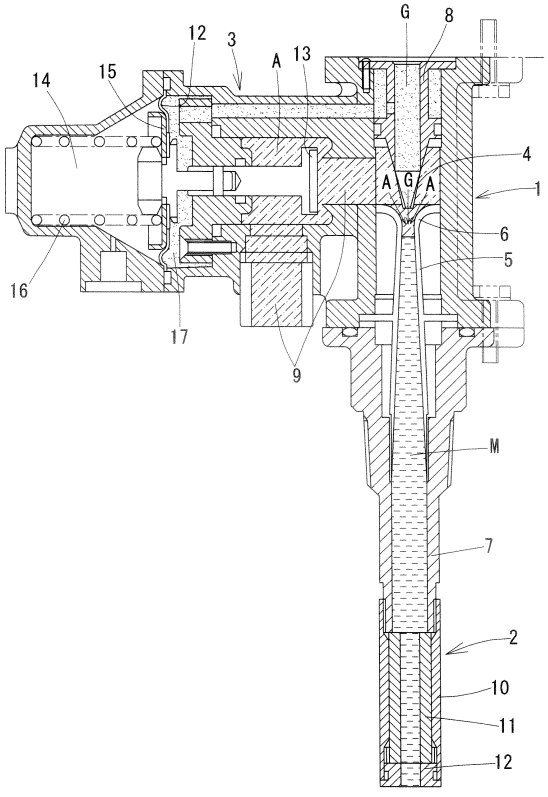
(72) Inventors:
- **HIRAYAMA Akihiro**
  Higashiosaka-shi
  Osaka 579-8038 (JP)
- **SHINPO Toshiya**
  Higashiosaka-shi
  Osaka 579-8038 (JP)

(74) Representative: **Grünecker, Kinkeldey,**
Stockmair & Schwanhäusser
Leopoldstrasse 4
80802 München (DE)

(54) MIXED GAS PRODUCTION DEVICE

(57) A gas-air mixture production device is proposed which can reduce noise produced while the device is operating without affecting the ability of the venturi mixer to produce a gas-air mixture. The gas-air mixture (M) is produced in a venturi mixer (1) by mixing raw material gas (G) with combustion air (A). A parallel portion (7) having an inner diameter which is constant in the flow direction of the gas-air mixture (M) is connected to the outlet of a throat (5) of the venturi mixer (1). A noise suppressor (2) is provided on the parallel portion (7) which includes a pipe (10), and a tubular noise suppressing member (11) made of foamed polyethylene. By passing the gas-air mixture (M) through the noise suppressing member (11), it is possible to effectively reduce noise generated when raw material gas (G) and combustion air (A) are mixed together without affecting the flow of the gas-air mixture (M).

Fig.1



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Description

TECHNICAL FIELD

[0001] This invention relates to a gas-air mixture production device including a venturi mixer having a nozzle through which raw material gas (such as propane) is blown toward a throat, in which combustion air is taken in under a negative pressure generated when raw material gas is blown through the nozzle, thereby producing a gas-air mixture, and in which the gas-air mixture production device further includes a noise suppressor in the gas flow passage for reducing noise produced while gas and air are being mixed together.

BACKGROUND ART

[0002] As shown in the below-identified Patent document 1, a gas-air mixture production device typically includes a raw material gas tank and an air compressor and is adapted to mix raw material gas supplied from the raw material gas tank with combustion air and deliver the thus produced gas-air mixture to users. This device is used e.g. in areas struck by disasters such as earthquakes or when the supply of city gas has to be temporarily stopped for nighttime facility maintenance. The calorie of the gas-air mixture is adjusted so as to conform to the calorie of city gas which the users are normally using (such as 12A or 13A) by adjusting the gas-air ratio of the gas-air mixture.

[0003] Gas and air are ordinarily mixed together using a venturi mixer shown in Patent document 1. A venturi mixer includes a nozzle through which raw material gas is blown toward a throat provided in the gas flow passage and having a restricted portion such that combustion air is taken in under a negative pressure generated when raw material gas is blown through the restricted portion, thereby mixing together the raw material gas and combustion air. By changing the shape of the restricted portion of the throat or the raw material gas blowing pressure, it is possible to change the ratio of the raw material gas and combustion air of the gas-air mixture.

[0004] When mixing raw material gas and combustion air in such a venturi mixer to produce a gas-air mixture, noise tends to be generated. Such noise is generated mainly (1) due to change in flow rates of the raw material gas and the combustion air when they pass through the restricted portion, and (2) due to collision of the material gas flow and the combustion air flow when the gas and air are mixed together. One way to prevent such noise would be to cover the entire device with a foamed member made of e.g. urethane. But this solution is too costly to be practical.

[0005] Thus, as an alternative, the below-identified Patent document 2 proposes the following arrangement, particularly in order to reduce noise due to the latter cause (2). That is, holes are formed in the restricting member (restricted portion) of the throat through which raw material gas are introduced, and a peel member is provided upstream of these holes to guide the flow of combustion air supplied from upstream of the throat toward the center axis of the throat such that the flow of raw material gas supplied through the holes does not directly cross the flow of the combustion air (see especially Fig. 2 of Patent document 2). With this arrangement, it is possible to minimize the degree of collision between these two flows when raw material gas and combustion air are mixed together, thereby reducing noise produced when gas and air are mixed together.

[0006] The arrangement of Patent document 1 differs from that of Patent document 2 in that in the former arrangement, raw material gas is blown through the nozzle to suck combustion air into the throat, while in the latter arrangement, raw material gas is sucked in by feeding combustion air through the throat. But they are identical in that the function of a venturi mixer is used, in which one of two different gasses is fed through the throat to suck in the other gas.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0007]

Patent document 1: JP Patent 4604113B
Patent document 2: JP Patent Publication 8-296812A

SUMMARY OF THE INVENTION

OBJECT OF THE INVENTION

[0008] With the arrangement of Patent document 2, while it is possible to reduce noise while mixing raw material gas and combustion air (the above-mentioned cause (2)), noise due to the above-mentioned cause (1) could increase, rather than decrease. This is because the peel member decrease the flow area where there is the peel member, thus sharply increasing the flow speed of combustion air when the air flows along the peel member. Thus, as a whole, this arrangement can scarcely reduce noise.

[0009] Also, since combustion air flows at a location slightly spaced apart from the holes through which raw material gas is supplied, raw material gas cannot be sufficiently and efficiently sucked into the throat. This could make additional measures necessary to more efficiently suck raw material gas, such as increasing the supply pressure of raw material gas.

[0010] An object of the present invention is to reduce noise produced while the device is operating without affecting the ability of the venturi mixer to produce a gas-air mixture.

MEANS FOR ACHIEVING THE OBJECT

[0011] In order to achieve this object, this invention provide a gas-air mixture production device comprising a raw material gas supply means, an air supply means, a venturi mixer for mixing raw material gas supplied from the raw material gas supply means with combustion air supplied from the air supply means, and a noise suppressor provided at an outlet of the venturi mixer for a gas-air mixture and configured to reduce noise produced when raw material gas and combustion air are mixed together.

[0012] Noise generated when raw material gas and combustion air are mixed together is mostly transmitted through the gas-air mixture outlet of the venturi mixer and through the pipe for the gas-air mixture to outside the venturi mixer. Thus, by providing a noise suppressor at the gas-air mixture outlet, it is possible to reduce noise. Further, since the noise suppressor is provided outside the throat, where gas and air have already been mixed together, it is not necessary to provide a peel member, as used in Patent document 2, for guiding raw material gas (or combustion air as in Patent document 2) into the throat. Since there is no peel member, the flow sectional area at the restricted portion of the throat is not partially reduced by the peel member. Thus, noise is less likely to be generated by a change in flow speed in the restricted portion (noise due to the above cause (1)).

[0013] A negative pressure is reliably generated when raw material gas flows because there is no peel member, which can prevent generation of such a negative pressure. Thus, combustion air can be reliably introduced into the throat under this negative pressure.

[0014] With the venturi mixer of the present invention, when raw material gas is blown, combustion air is sucked into the throat. At this time, the gas and air flow substantially parallel to each other (see arrows A and G in Fig. 1), as opposed to the flow directions of gas and air in Patent document 2, which are substantially perpendicular to each other. Thus even without the peel member as used in Patent document 2, noise is less likely to be generated when raw material gas and combustion air are mixed together (noise due to the above cause (2)).

[0015] Preferably, the noise suppressor is a hollow member including a noise suppressing material provided on the inner wall of the noise suppressor, and configured such that the gas-air mixture flows through the hollow space of the noise suppressor.

[0016] By using a hollow member as the noise suppressor, it is possible to quickly reduce noise without affecting the flow of the gas-air mixture. The noise suppressing material may be a foamed member made e.g. of foamed urethane.

[0017] In any of the above-described arrangements, a parallel portion having a flow sectional area which is constant in the flow direction of the gas-air mixture may be provided between the venturi mixer and the noise suppressor.

[0018] The gas-air mixture tends to generates noise when its flow speed changes. Thus, if a noise suppressor is provided immediately downstream of the area where the flow sectional area changes (throat), the noise suppressor may be unable to sufficiently reduce noise. By providing the parallel portion in the flow passage of the gas-air mixture and providing the noise suppressor downstream of the parallel portion, where the flow speed becomes constant, it is possible to further efficiently reduce noise.

ADVANTAGES OF THE INVENTION

[0019] According to the present invention, raw material gas is blown through the nozzle toward the throat and mixed with combustion air to produce a gas-air mixture. A noise suppressor is provided at the outlet of the throat to reduce noise generated while gas and air are mixed together. The noise suppressor does not affect the flows of raw material gas and combustion air and can efficiently reduce noise, thus making it possible to use the gas-air mixture production device during the nighttime.

BRIEF DESCRIPTION OF THE DRAWING(S)

[0020]

Fig. 1 is a sectional view of a gas-air mixture production device according to the present invention.

BEST MODE FOR EMBODYING THE INVENTION

[0021] Fig. 1 shows a gas-air mixture production device with a noise suppressor according to the present invention. This device is used to produce a mixed gas M which conforms in calorie to commonly used urban gas (such as 12A or 13A) by mixing a raw material gas G with combustion air A.

[0022] This device includes a venturi mixer 1 for mixing a raw material gas G with combustion air A, a noise suppressor 2 for reducing noise produced from the venturi mixer 1, and an air valve 3 for roughly adjusting the supply amount of the combustion air A corresponding to the supply pressure of the raw material gas G.

[0023] The venturi mixer 1 includes a nozzle 4 through which the raw material gas G is blown, and a throat 5 coaxial with and slightly spaced apart from the nozzle 4. The throat 5 has a restricted portion 6 near its inlet and has a conical shape as a whole such that its inner diameter gradually increases toward its outlet. A parallel portion 7 is connected to the outlet of the throat 5 which is constant in cross-sectional area in the flow direction.

[0024] Raw material gas G is supplied into the nozzle 4 through a raw material gas supply pipe 8. An air supply pipe 9 for combustion air A is connected to the inlet of the throat 5. Combustion air A is supplied through the air supply pipe 9 and mixed with the raw material gas G to produce mixed gas M.

[0025] The noise suppressor 2 includes a pipe 10 made of vinyl chloride, a tubular noise suppressing member 11 made of foamed polyethylene and mounted in the pipe 10, and a cap 12 provided at the free end of the pipe 10 to protect the noise suppressing member 11. The cap 12 has a hole through which the mixed gas M can be discharged. The noise suppressor 2 has its inlet connected to the parallel portion 7 and its outlet connected to a cushion tank (not shown) in which the mixed gas M is temporarily stored. The pipe 10 and/or the noise suppressing member 11 may be made of a material other than the above-mentioned material, provided the noise suppressor can perform its expected function.

[0026] The noise suppressing member 11 may have a different shape, provided the noise suppressor performs its expected function. As shown in Fig. 1, the suppressing member 11 preferably has an inner diameter slightly smaller than the inner diameter of the parallel portion 7. By setting the inner diameter of the noise suppressing member 11 smaller than the inner diameter of the parallel portion, noise produced from the venturi mixer 1 cannot easily pass through the noise suppressor 2, so that the noise suppressing member 11 can more effectively suppress noise.

[0027] The air valve 3 includes a diaphragm 12, and a valve body 13 which moves together with the diaphragm 12 while being kept coaxial with the diaphragm 12. The diaphragm 12 is biased from a spring chamber 14 by pressurized air fed into the spring chamber 14 and a spring 16 in the spring chamber through a pressure receiving plate 15, and is also biased in the opposite direction from a diaphragm chamber 17 by raw material gas G introduced through a raw material gas supply pipe 8. When the pressure of raw material gas G increases, the diaphragm 12 is displaced leftwardly and the valve body 13 is moved in the valve-opening direction. When the pressure of raw material gas G decreases, the diaphragm 12 is displaced rightwardly, thus moving the valve body 13 in the valve-closing direction. By the movement of the valve body 13, it is possible to roughly adjust the amount of combustion air A supplied into the venturi mixer 1 corresponding to the amount of raw material gas G supplied. This makes it possible to easily and accurately adjust the gas-air mixing ratio while the gas and air are mixed together.

[0028] When raw material gas G is blown through the nozzle 4 toward the throat 5 (as shown by the arrow G in Fig. 1), a negative pressure is generated at and around the inlet of the throat 5, which causes the combustion air A supplied through the air supply pipe 9 to be sucked into the throat 5 (as shown by the arrow A in Fig. 1). Raw material gas G and combustion air A are thus mixed together as a gas-air mixture M.

[0029] The noise suppressor 2 reduces noise produced when gas and air are mixed together. In the embodiment, the noise suppressor 2 is connected to the throat 6 not directly but through the parallel portion 7. The flow sectional area of the parallel portion 7 is constant in the flow direction of the gas-air mixture M. Thus, the gas-air mixture M flows through the parallel portion at a constant speed. By supplying the gas-air mixture M into the noise suppressor 2 after stabilizing its flow by allowing the mixture M to flow at a constant speed in the parallel portion 7, it is possible to further efficiently reduce noise.

[0030] The length of the noise suppressor 2 can be suitably adjusted such that it can most effectively suppress noise. The parallel portion 7, of which the inner diameter is constant, may be omitted, and the noise suppressor may be directly connected to the outlet of the throat 5.

[0031] The noise level of this device was measure with or without the noise suppressor 2 attached. Without the noise suppressor 2, the noise level was about 62 dB. This noise level could be problematic if this device is used during a quiet night time. When the noise suppressor 2 was mounted, the noise level decreased by as much as about 10 dB. At this noise level, there will be practically no noise problem even during a night time.

[0032] Since the noise suppressor 2 is provided in the flow passage downstream of the portion of the device where the gas-air mixture M is produced from raw material gas G and combustion air A, the noise suppressor 2 scarcely influences the flows of raw material gas G, combustion air A and gas-air mixture M. Thus gas-air mixture M of which the calorie has been adjusted to a predetermined value can be smoothly supplied to users.

DESCRIPTION OF THE NUMERALS

[0033]

1. Venturi mixer
2. Noise suppressor
3. Air valve
4. Nozzle
5. Throat
6. Restricted portion
7. Parallel portion
8. Raw material gas supply pipe (Raw material gas supply means)
9. Air supply pipe (Air supply means)
10. Pipe
11. Noise suppressing member
12. Cap

A. Combustion air

G. Raw material gas

M. Gas-air mixture

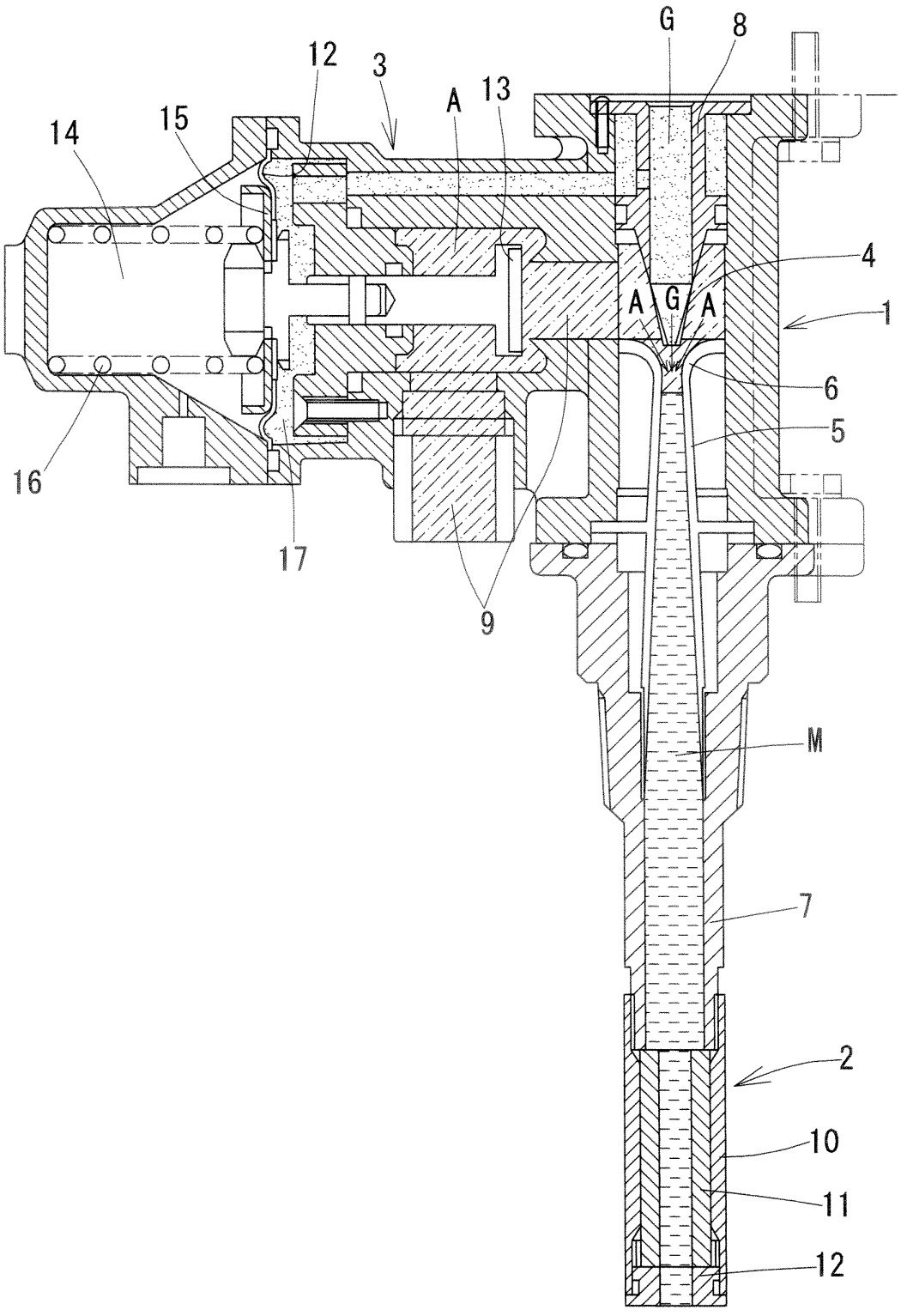
Claims

1. A gas-air mixture production device comprising a raw material gas supply means (8), an air supply means (9), a venturi mixer (1) for mixing raw material gas (G) supplied from the raw material gas supply means (8) with combustion air (A) supplied from the air supply means (9), and a noise suppressor (2) provided at an outlet of the venturi mixer (1) for a gas-air mixture (M) and configured to reduce noise produced when raw material gas and combustion air are mixed together.

2. The gas-air mixture production device of claim 1, wherein the noise suppressor (2) is a hollow member including a noise suppressing material (11) provided on the inner wall of the noise suppressor, and configured such that the gas-air mixture (M) flows through the hollow space of the noise suppressor.

3. The gas-air mixture production device of claim 1 or 2, further comprising a parallel portion (7) provided between the venturi mixer (1) and the noise suppressor (2) and having a flow sectional area which is constant in the flow direction of the gas-air mixture (M).

Fig.1



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/051287

A. CLASSIFICATION OF SUBJECT MATTER
B01F5/04(2006.01)i, *F23K5/00*(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)
B01F1/00-5/26, F23K5/00-5/22

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2011
Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2010-2133 A (Buyo Gas Kabushiki Kaisha), 07 January 2010 (07.01.2010), paragraph [0037]; fig. 5 (Family: none)	1-3
Y	JP 2008-149294 A (Matsushita Electric Works, Ltd.), 03 July 2008 (03.07.2008), paragraphs [0009], [0031] to [0042]; fig. 6, 7 (Family: none)	1-3
Y	JP 2009-687 A (Regal Joint Co., Ltd.), 08 January 2009 (08.01.2009), paragraph [0015]; fig. 1 (Family: none)	3

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

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
09 March, 2011 (09.03.11)	22 March, 2011 (22.03.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4604113 B **[0007]**
- JP 8296812 A **[0007]**