



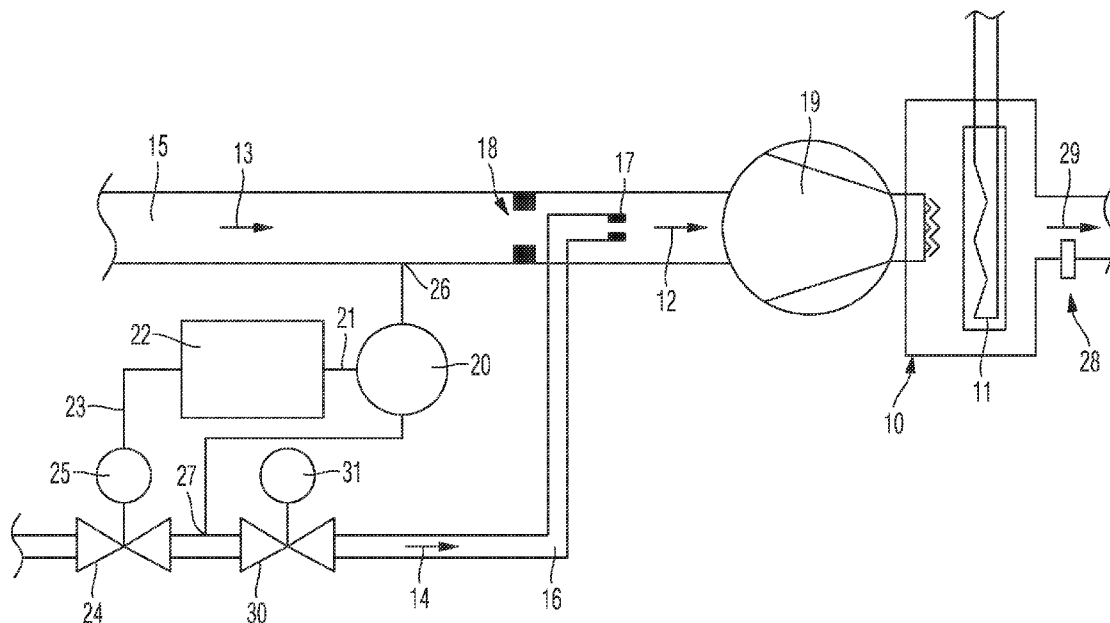
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(19) **United States**(12) **Patent Application Publication**
Munsterhuis et al.(10) **Pub. No.: US 2012/0058439 A1**(43) **Pub. Date: Mar. 8, 2012**(54) **DEVICE FOR THE CALIBRATION OF A GAS
BURNER REGULATING SYSTEM**(52) **U.S. Cl. 431/12; 431/76**(75) **Inventors:** **Wim Munsterhuis**, Dalen (NL);
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(CH)(21) **Appl. No.: 13/227,405**(22) **Filed: Sep. 7, 2011**(30) **Foreign Application Priority Data**

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Publication Classification(51) **Int. Cl.**
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F23N 5/00 (2006.01)(57) **ABSTRACT**

Method for the calibration of a gas burner regulating system using a sensor (28) which is associated with the exhaust gas (29) discharged from the gas burner (10) and measures the concentration of at least one combustible or oxidizable constituent in the exhaust gas, wherein for calibration, starting from a relatively lean gas-combustion-air mixture (12) which is fed to the gas burner (10) for combustion, the gas-combustion-air mixture (12) may be enriched, specifically until the measurement signal which is provided by the sensor (28) first increases and then reduces to approximately zero, wherein the gas-combustion-air mixture (12), in which the measurement signal which is provided by the sensor (28) amounts to approximately zero, is defined as a gas-combustion-air mixture (12) with a stoichiometric combustion air ratio of $\lambda=1$, and wherein starting from this gas-combustion-air mixture (12) the gas-combustion-air mixture may be enleaned to a desired combustion air ratio of $\lambda>1$.



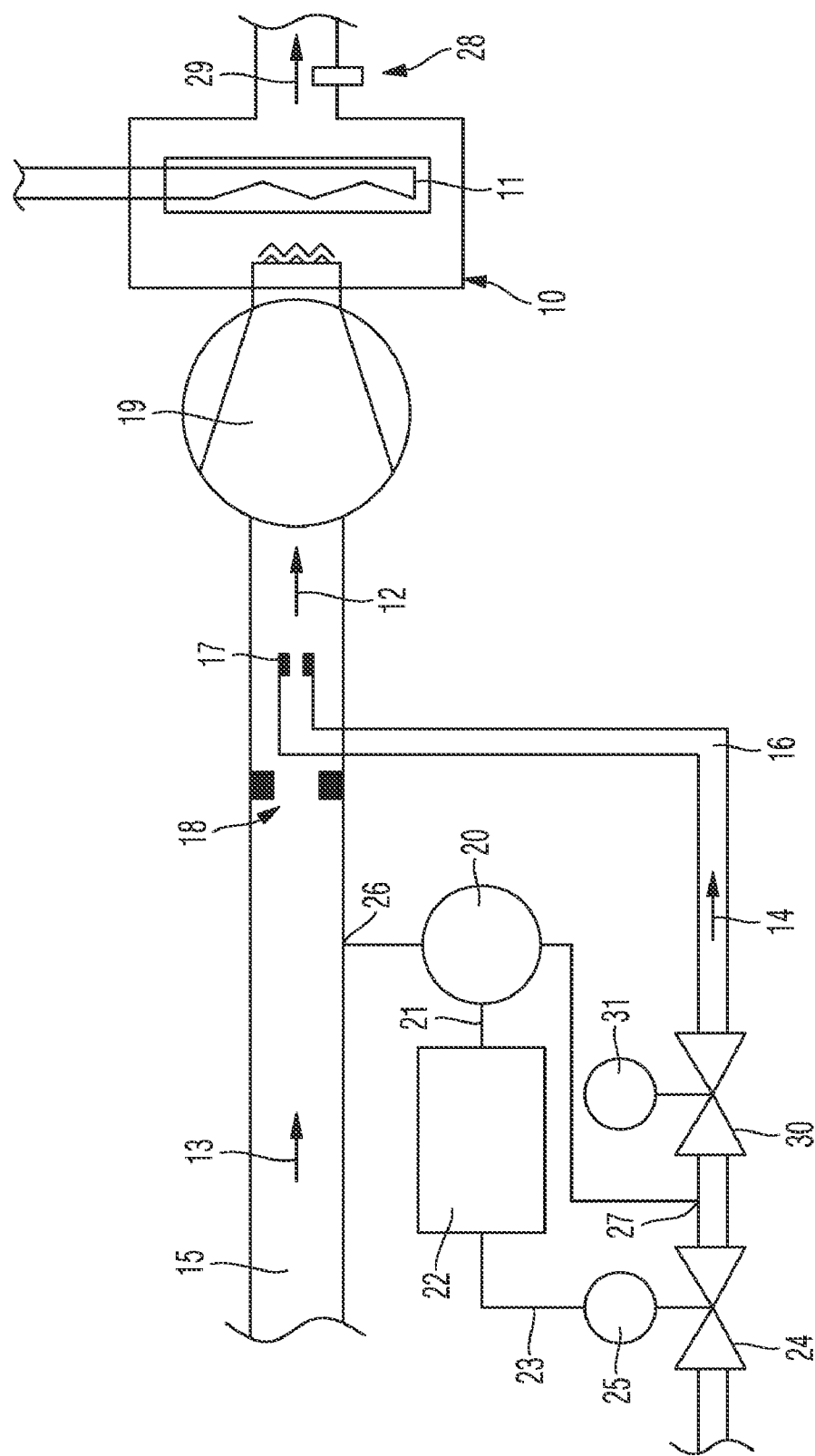


Fig. 1

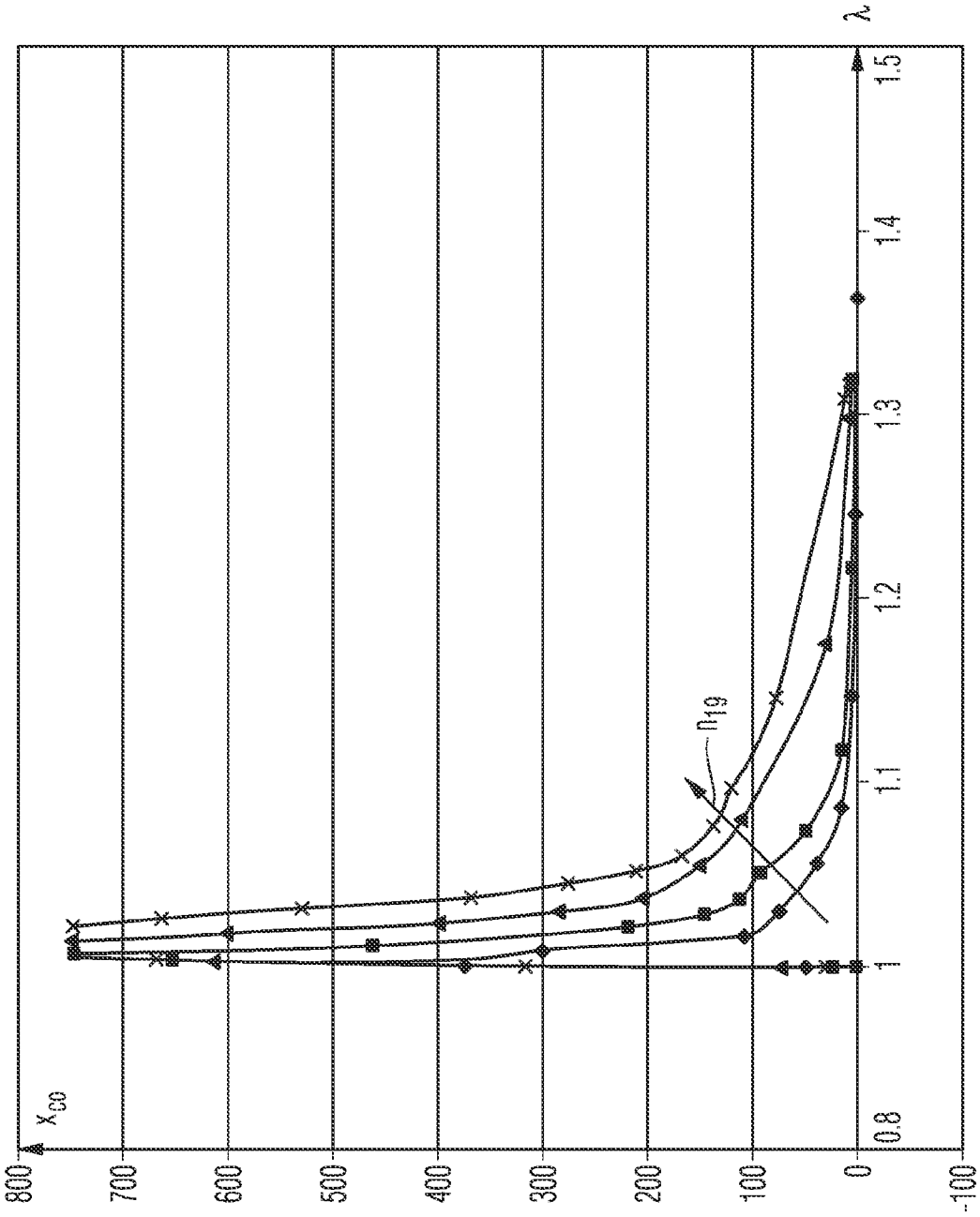


Fig. 2

DEVICE FOR THE CALIBRATION OF A GAS BURNER REGULATING SYSTEM

TECHNICAL FIELD

[0001] This disclosure relates to methods for calibrating a gas burner regulating system, and methods for gas burner regulation.

BACKGROUND

[0002] A method for gas burner regulation, in which a gas-combustion-air mixture is fed to a gas burner for combustion, is known from DE 198 24 521 A1. The gas-combustion-air mixture is provided as a result of intermixing a gas flow and an air flow or combustion air flow, wherein the quantity of the gas-combustion-air mixture which is fed to the gas burner, and therefore a so-called burner load, is adjusted by means of a blower, specifically by means of a rotational speed of the blower. According to this prior art, the blower is associated with the air flow. By means of a gas valve which is associated with the gas flow, the gas flow is adjusted in dependence upon the combustion air flow in such a way that a prespecified, defined composition of the gas-combustion-air mixture is maintained, specifically in the sense of a 1:1-gas/air compound regulation or even for forming a 1:N-gas/air compound regulation. For this, according to this prior art, a sensor is connected between the gas flow and the combustion air flow, the measurement signal of which is fed to a regulating device which, in dependence upon the measurement signal of the sensor, operates the gas valve in such a way that the defined composition of the gas-combustion-air mixture is maintained.

[0003] In order to ensure a good combustion quality in the gas burner, even in the case of fluctuating gas qualities, the composition of the gas-combustion-air mixture which is to be fed to the gas burner for combustion has to be adapted to the gas quality.

[0004] Therefore, in the case of a gas with a high calorific value the quantity of gas in comparison to the quantity of air in the gas-combustion-air mixture can be reduced. On the other hand, if it is a gas with a low calorific value then the quantity of gas in the gas-combustion-air mixture has to be increased. Adapting the composition of the gas-combustion-air mixture especially to the gas quality is carried out via a calibration of the gas burner regulating system.

[0005] A method for regulating a gas burner, in which the calibration of the composition of the gas-combustion-air mixture is carried out by means of a carbon monoxide sensor which is associated with an exhaust gas flow discharged from the burner, is known from EP 1 331 444 A2. The carbon monoxide sensor detects the carbon monoxide concentration in the exhaust gas. According to this prior art, for calibration of the gas-combustion-air mixture, specifically of the composition of the gas-combustion-air mixture, it is conducted so that starting from any, relatively lean composition the gas-combustion-air mixture is enriched, specifically until the carbon monoxide concentration, which is detected by the carbon monoxide sensor, in the exhaust gas reaches or exceeds a prespecified limit value. Upon reaching or exceeding this limit value, the gas-combustion-air mixture, according to this prior art, is not further enriched, rather this composition of the gas-combustion-air mixture is associated with a so-called combustion air ratio λ of 1.08. Starting from the gas-combustion-air mixture which is calibrated to the combustion air ratio

of $\lambda=1.08$, the composition of this can subsequently be enleaned for providing a larger combustion air ratio.

[0006] This calibration method which is known from EP 1 131 444 A2 has the disadvantage that this is dependent upon the burner load. In this respect, a separate calibration has to be undertaken for each burner load when applying the method which is known from this prior art. This is disadvantageous.

SUMMARY

[0007] There is a need for a method for the calibration of a burner regulating system which is independent of a so-called burner load.

[0008] This disclosure relates to methods for calibrating a gas burner regulating system, and also methods for gas burner regulation. In one example, and for the calibration of a gas burner regulating system, starting from a relatively lean gas-combustion-air mixture which is fed to the gas burner for combustion, the gas-combustion-air mixture is enriched, specifically until the measurement signal which is provided by a sensor first increases and then reduces to approximately zero, wherein the gas-combustion-air mixture, in which the measurement signal which is provided by the sensor amounts to approximately zero, is defined as a gas-combustion-air mixture with a stoichiometric combustion air ratio of $\lambda=1$, wherein starting from this gas-combustion-air mixture, this can be enleaned to a desired combustion air ratio of $\lambda>1$.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Example developments may be gathered from the dependent claims and from the subsequent description. Exemplary embodiments of the disclosure, without being limited thereto, are explained in more detail with reference to the drawing. In the drawing:

[0010] FIG. 1 shows a schematized view of a gas burner regulating system for illustrating a method according to the disclosure; and

[0011] FIG. 2 shows a diagram for further illustration of a method according to the disclosure.

DESCRIPTION

[0012] This disclosure relates to methods for calibrating a gas burner regulating system, and also to methods for gas burner regulation.

[0013] FIG. 1 shows in a greatly schematized manner an exemplary construction of a gas burner regulating system, wherein a gas-combustion-air mixture 12 for combustion is fed to a gas burner 10, in the combustion chamber of which a heat exchanger 11 is positioned in the depicted exemplary embodiment. The gas-combustion-air mixture 12 which is to be fed to the gas burner 10 for combustion is provided as a result of intermixing an air flow or combustion air flow 13 and a gas flow 14, wherein the combustion air flow 13 is fed via a combustion air line 15 and the gas flow 14 is fed via a gas line 16, and wherein the gas line 16, specifically a gas nozzle 17 of the gas line, opens into the combustion air line downstream to a restriction point 18 of said combustion air line 15.

[0014] The amount of gas-combustion-air mixture 12 which is to be fed to the gas burner 10 for combustion is adjusted by means of a blower 19, specifically by means of a rotational speed of the blower 19, wherein the blower 19, according to FIG. 1, is associated with the gas-combustion-air mixture flow 12.

[0015] In order to make available to the gas burner **10** a gas-combustion-air mixture **12** with a defined composition in the sense of a 1:N-gas/air compound regulation independently of the quantity of combustion air **13** which is drawn in by means of the blower **13**, in the exemplary embodiment of FIG. **1**, a sensor **20** is connected between the combustion air line **15** and the gas line **16**, the measured variable **21** of which sensor is fed to a control unit **22** which, depending upon the measured variable **21** of the sensor **20**, outputs a manipulated variable **23** for operating a gas valve **24**, specifically an actuating motor **25** of the gas valve **24** in order to therefore adjust the gas flow **14** and to maintain the defined gas-combustion air ratio in the sense of a 1:N-gas/air compound regulation in the gas-combustion-air mixture **12**.

[0016] In the depicted exemplary embodiment of FIG. **1**, the sensor **20** is a sensor which provides an electric or electronic measurement signal **21** for the control unit **22**, wherein the sensor **20** acts on the combustion air line **15** by a first measuring point **26** and acts on the gas line **16** by a second measuring point **27**.

[0017] Reference may also be made at this point to the fact that the 1:N-gas/air compound regulation can also be provided in a pneumatic way.

[0018] In order to ensure a good combustion quality in the gas burner **10**, especially in the case of fluctuating gas qualities, calibration of the gas burner regulating system is necessary, wherein in the exemplary embodiment of FIG. **1**, a sensor **28**, which is associated with an exhaust gas flow **29** discharged from the gas burner **10**, is used for calibration of the gas burner regulating system. It is to be subsequently assumed from this that this sensor **28** is designed as a carbon monoxide sensor which with oxygen present in the exhaust gas measures the concentration of combustible or oxidizable carbon monoxide in the exhaust gas **29** of the gas burner **10**. Instead of a carbon monoxide sensor, however, use can also be made of any other sensor, by means of which with oxygen present in the exhaust gas at least one combustible or oxidizable constituent can be detected in the combustible or oxidizable exhaust gas **29** of the gas burner **10**. Such sensors are also referred to as CO_e sensors.

[0019] For such a sensor **28**, which is designed as a carbon monoxide sensor, FIG. **2** shows a concentration X_{CO} of carbon monoxide CO, which is formed in the exhaust gas, against the so-called air coefficient or the so-called combustion air ratio λ for different burner loads, wherein it can be gathered from FIG. **2** that the carbon monoxide concentration X_{CO}, which is formed in the exhaust gas, with a defined air coefficient λ is dependent upon the burner load which in the exemplary embodiment of FIG. **1** is determined by the rotational speed n₁₉ of the blower **19** and therefore by the quantity of gas-combustion-air mixture flow **12** which is fed to the gas burner **10**.

[0020] For calibration of the gas burner regulating system, and starting from a relatively lean gas-combustion-air mixture **12** with any composition, which is currently fed to the gas burner **10** for combustion, the gas-combustion-air mixture **12** is enriched, reducing the combustion air ratio λ or the air coefficient, specifically until the measurement signal which is provided by the sensor **28** first increases and then reduces to approximately zero. The gas-combustion-air mixture **12**, in which the measurement signal which is provided by the sensor **28**, that is to say the carbon monoxide concentration X_{CO} which is measured by the sensor, amounts to approximately zero, is defined as a gas-combustion-air mixture **12** with a

stoichiometric combustion air ratio of $\lambda=1$. Starting from this gas-combustion-air mixture **12** with the stoichiometric combustion air ratio of $\lambda=1$, the gas-combustion-air mixture **12** is subsequently enleaned to a desired combustion air ratio of $\lambda>1$, for example to a gas-combustion-air mixture with a combustion air ratio of $\lambda>1.3$.

[0021] During the above calibration, a gas flow rate adjusting device, which may be associated with the gas flow **14**, is adjusted for the enriching and subsequent enleaning of the gas-combustion-air mixture **12** in order to thereby adjust the gas quantity of the gas-combustion-air mixture. The gas nozzle **17** can be this gas flow rate adjusting device. Alternatively, a separate gas flow rate adjusting device **30** which is integrated into the gas line **16**, or a gas flow rate adjusting device which is integrated into the gas valve **24**, can be used for the calibration.

[0022] The gas flow rate adjusting device which is used for the calibration—in the exemplary embodiment of FIG. **1**—must be positioned downstream of the measuring point **27** at which the sensor **20** acts on the gas line **16**. If a gas flow rate adjusting device which is integrated into the gas valve **24** were to be consequently used for the calibration, then the measuring point **27** of FIG. **1** would have to be relocated.

[0023] FIG. **1** shows a servo motor **31**, for which the opening position of the gas flow rate adjusting device **30** can be adapted for the calibration.

[0024] Starting from that opening position of the gas flow rate adjusting device **30** in which the gas-combustion-air mixture **12** is defined with the stoichiometric combustion air ratio of $\lambda=1$ by way of the calibration, the gas flow rate adjusting device **30** is closed further by a defined degree for providing a combustion air ratio of $\lambda>1$, wherein this defined degree is dependent upon characteristics of the gas flow rate adjusting device **30** and is determined in dependence upon characteristics of the gas flow rate adjusting device **30**.

[0025] For the calibration, use is made of a non-calibrated sensor, specifically a non-calibrated carbon monoxide sensor **28** in the depicted exemplary embodiment, which with oxygen present in the exhaust gas **29** detects the concentration of carbon monoxide in the exhaust gas **29**.

[0026] The calibration of the gas burner regulating system may be carried out automatically after there being an event which triggers the calibration.

[0027] An event which triggers the calibration can be a signal which occurs at regular time intervals in order to carry out calibration of the gas burner regulating system at defined time intervals.

[0028] A further event can be a manually triggered signal in order to carry out, when triggered, calibration of the gas burner regulating system by means of a monitor.

[0029] Furthermore, calibration can be triggered in dependence upon the measurement signal which is provided by the sensor **28**, specifically when the carbon monoxide concentration X_{CO}, which is measured by the sensor **28**, exceeds a limit value.

[0030] The signal of the sensor **28** may be used exclusively for calibration and not for the 1:N-gas/air compound regulation. The sensor **20** may serve for the 1:N-gas/air compound regulation, wherein the air flow **13** which is provided by means of the blower **19** serves with respect to control engineering as an input reference variable for the gas flow **14** in order to provide the defined 1:N-gas/air compound regulation.

[0031] When calibrating by using the sensor 28, the composition of the gas-air mixture 12 can be adjusted in order to compensate for different gas qualities. For this, a gas flow rate adjusting device 30 may be adjusted in dependence upon the measurement signal of the sensor 28, the opening position of which device remains unaltered during the subsequent 1:N-gas/air compound regulation. During the subsequent 1:N-gas/air compound regulation, the gas valve 24 may be operated for matching the gas flow 14 to the air flow 13.

[0032] The calibration of a gas burner regulating system may be independent of the so-called burner load.

List of Designations

[0033]	10 Gas burner
[0034]	11 Heat exchanger
[0035]	12 Gas-combustion-air mixture
[0036]	13 Combustion air flow
[0037]	14 Gas flow
[0038]	15 Combustion air line
[0039]	16 Gas line
[0040]	17 Gas nozzle
[0041]	18 Restriction point
[0042]	19 Blower
[0043]	20 Sensor
[0044]	21 Measured variable
[0045]	22 Control unit
[0046]	23 Manipulated variable
[0047]	24 Gas valve
[0048]	25 Servo motor
[0049]	26 Measuring point
[0050]	27 Measuring point
[0051]	28 Sensor
[0052]	29 Exhaust gas flow
[0053]	30 Gas flow rate adjusting device
[0054]	31 Servo motor

1. A method for calibrating a gas burner regulating system using a sensor which is associated with an exhaust gas discharged from a gas burner and measures a measurement signal that is related to a concentration of at least one combustible or oxidizable constituent in the exhaust gas, the method comprising:

starting from a relatively lean gas-combustion-air mixture which is fed to the gas burner for combustion, the gas-combustion-air mixture is enriched until the measurement signal which is provided by the sensor first increases and then reduces to approximately zero, wherein the gas-combustion-air mixture, in which the measurement signal which is provided by the sensor amounts to approximately zero, is defined as a gas-combustion-air mixture with a stoichiometric combustion air ratio of $\lambda=1$, and in that starting from this gas-combustion-air mixture the gas-combustion-air mixture is enleaned to a desired combustion air ratio of $\lambda>1$.

2. A method according to claim 1, wherein the sensor is a carbon monoxide sensor that measures the concentration of carbon monoxide in the exhaust gas.

3. A method according to claim 1, wherein during the calibration of the gas burner regulating system, a gas flow rate adjusting device is adjusted for the enriching and subsequent enleaning of the gas-combustion-air mixture in order to thereby adjust a quantity of gas which is to be intermixed with a combustion air flow and to thereby adjust the composition of the combustion-air mixture which is to be fed to the gas burner for combustion.

4. A method according to claim 3, wherein starting from an open position of the gas flow rate adjusting device in which the gas-combustion-air mixture is defined with the stoichiometric combustion air ratio of $\lambda=1$, the gas flow rate adjusting device, for providing a combustion air ratio of $\lambda>1$, is closed further by a defined degree which is determined in dependence upon characteristics of the gas flow rate adjusting device.

5. A method according to claim 1, wherein the calibration of the gas burner regulating system is carried out automatically after there being an event which triggers the calibration.

6. A method for gas burner regulation, wherein a gas-combustion-air mixture, which is provided as a result of intermixing a gas flow and an air flow, is fed to a gas burner for combustion, wherein the quantity of gas-combustion-air mixture which is fed to the gas burner, and therefore a burner load, is adjusted by means of a blower which is associated with the air flow or with the gas-combustion-air mixture flow, wherein the gas flow, by means of a gas valve which is associated with the gas flow, is adjusted in dependence upon the air flow in such a way that a prespecified, defined composition of the gas-combustion-air mixture is maintained independently of the air flow, and wherein for calibration of the gas burner regulating system, specifically for calibration of the composition of the gas-combustion-air mixture, use is made of a sensor which is associated with an exhaust gas discharged from the gas burner and measures a concentration of at least one combustible or oxidizable constituent in the exhaust gas, wherein the calibration of the gas burner regulating system includes:

starting from a relatively lean gas-combustion-air mixture which is fed to the gas burner for combustion, the gas-combustion-air mixture is enriched until the measurement signal which is provided by the sensor first increases and then reduces to approximately zero, wherein the gas-combustion-air mixture, in which the measurement signal which is provided by the sensor amounts to approximately zero, is defined as a gas-combustion-air mixture with a stoichiometric combustion air ratio of $\lambda=1$, and in that starting from this gas-combustion-air mixture the gas-combustion-air mixture is enleaned to a desired combustion air ratio of $\lambda>1$.

7. The method of claim 3, wherein the gas flow rate adjusting device includes a gas nozzle that is associated with the gas flow.

8. A method according to claim 2, wherein during the calibration of the gas burner regulating system, a gas flow rate adjusting device is adjusted for the enriching and subsequent enleaning of the gas-combustion-air mixture in order to thereby adjust a quantity of gas which is to be intermixed with a combustion air flow and to thereby adjust the composition of the combustion-air mixture which is to be fed to the gas burner for combustion.

9. A method according to claim 2, wherein the calibration of the gas burner regulating system is carried out automatically after there being an event which triggers the calibration.

10. A method according to claim 3, wherein the calibration of the gas burner regulating system is carried out automatically after there being an event which triggers the calibration.

11. A method according to claim 4, wherein the calibration of the gas burner regulating system is carried out automatically after there being an event which triggers the calibration.

12. A gas burner regulating system for regulating a gas-combustion-air mixture that is provided to a gas burner, comprising:

a control unit configured to control a gas flow rate adjusting device, the control unit enriching the gas-combustion-air mixture that is provided to a gas burner by moving the gas flow rate adjusting device to a more open position, and enleaning the gas-combustion-air mixture that is provided to a gas burner by moving the gas flow rate adjusting device to a more closed position;

a sensor associated with an exhaust gas discharged from the gas burner, the sensor configured to provide a measurement signal that is related to a concentration of at least one combustible or oxidizable constituent in the exhaust gas;

during a calibration process, and starting from a relatively lean gas-combustion-air mixture which is fed to the gas burner for combustion, the control unit moves the gas flow rate adjusting device to a more open position to enrich the gas-combustion-air mixture until the measurement signal of the sensor first increases and then reduces to approximately zero, wherein the gas-combustion-air mixture which corresponds to the measurement signal being approximately zero is defined as a gas-combustion-air mixture with a stoichiometric combustion air ratio of $\lambda=1$; and

the control unit then moves the gas flow rate adjusting device to a more closed position to enlean the gas-combustion-air mixture to a desired combustion air ratio of $\lambda>1$.

13. The gas burner regulating system of claim **12**, wherein the sensor is a carbon monoxide sensor.

14. The gas burner regulating system of claim **12**, wherein the control unit repeats the calibration process automatically after there is a triggering event detected.

15. The gas burner regulating system of claim **12**, wherein the triggering event is reception of a signal that occurs at regular time intervals.

16. The gas burner regulating system of claim **12**, wherein the triggering event is manually initiated.

17. The gas burner regulating system of claim **12**, wherein the triggering event is detection of the measurement signal exceeding a threshold value.

18. The gas burner regulating system of claim **12** further comprising a multiple speed blower for providing combustion air to form the gas-combustion-air mixture, the speed of the blower is adjustable to support different burner loads.

19. The gas burner regulating system of claim **12**, wherein the gas flow rate adjusting device include a gas nozzle.

20. The gas burner regulating system of claim **12**, wherein the gas flow rate adjusting device include a gas valve.

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