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(54) Method for operating a gas burner

Verfahren zum Betrieb eines Gasbrenners

Procédé de fonctionnement d'un brûleur à gaz

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EP 2 667 097 B1

Description

[0001] The present patent application relates to a method for operating a gas burner.

[0002] EP 0 833 106 B1 discloses a method for operating a gas burner. According to this prior art document, during burner-on phases of the gas burner a defined gas/air mixture having a defined mixing ratio of gas and air is provided to a burner chamber of the gas burner. The defined gas/air mixture is provided by mixing an air flow provided by an air duct with a gas flow provided by a gas duct. The quantity of the air flow is adjusted by a fan. The defined mixing ratio of the gas/air mixture is controlled by a controller.

[0003] It is further known from EP 0 833 106 B1 that the defined gas/air mixture has to be calibrated to the quality of the gas in order to ensure an optimum and complete combustion of the gas. The quality of the gas is defined by the so-called "Wobbe-Index". EP 0 833 106 B1 discloses a method to calibrate the defined gas/air mixture to different gas qualities depending on a signal provided by an ionization sensor.

[0004] EP 0 962 703 B1 discloses that the calibration of the defined gas/air mixture to different gas qualities on basis of a signal provided by an ionization sensor shall only be performed in a range close to full-load operation of the gas burner, whereby the range close to full full-load operation lies between 60% and 100% of full full-load operation of the gas burner.

[0005] EP 1 309 821 B1 discloses that the calibration of the defined gas/air mixture to different gas qualities on basis of a signal provided by an ionization sensor shall be only performed at selected times, namely immediately after installation of the sensor and/or immediately after restart of the gas burner and/or immediately after a reset. DE 10 2008 031 979 A1 discloses a calibration of the defined gas/air mixture to different gas qualities on basis of a signal provided by an ionization sensor, whereby for the calibration during burner-on phases in a first step the gas/air mixture is made leaner by increasing the air amount of the gas/air mixture relative to the gas amount of the same until the gradient of the signal provided by the ionization sensor becomes grater than a threshold, and that afterwards the gas/air mixture is made richer by increasing the gas amount of the gas/air mixture relative to the air amount of the same.

[0006] Other prior art is disclosed by DE 196 18 573 C1 and by WO 2004/015333

[0007] Document EP 0806610 A2 discloses a method of operating a gas burner according to the preamble of claim 1.

[0008] Against this background, a novel method for operating a gas burner is provided. The method for operating a gas burner according to the present application is defined in the claim 1.

The method according to the present application is directed to the calibration of the defined gas/air mixture to different gas qualities. The present application teaches to distinguish between a flattening detection and a maximum detection of the signal provided by the ionization sensor. Such a differentiation between the flattening detection and the maximum detection provides an improved calibration of the defined gas/air mixture to different gas qualities. The calibration is simple and reliable.

[0009] For calibration of the gas/air mixture, the throttle position of a throttle assigned to the gas duct or to the mixing device is preferably continuously changed in order to continuously increase the gas flow while keeping the fan speed and the air flow constant thereby continuously increasing the gas amount of the gas/air mixture relative to the air amount of the same. The signal provided by the ionization sensor is continuously monitored and analyzed while the gas amount of the gas/air mixture becomes continuously increased relative to the air amount of the same.

[0010] Only the calibration of the defined gas/air mixture depends on the signal provided by the ionization sensor. The control of the defined gas/air mixture as such over the modulation range of the gas burner is independent from the signal provided by the ionization sensor.

[0011] Preferred developments of the invention are provided by the dependent claims and the description which follows. Exemplary embodiments are explained in more detail on the basis of the drawing, in which:

Figure 1	shows a schematic view of a gas burner;
Figure 2	shows a diagram illustrating the present invention; and
Figure 3	shows an additional diagram further illustrating the present invention.

[0012] Figure 1 shows a schematic view of a gas burner 10. The gas burner comprises a burner chamber 11 in which combustion of a defined gas/air mixture having a defined mixing ratio of gas and air takes place during burner-on phases of the gas burner 10. The combustion of the gas/air mixture results into flames 12 monitored by an ionization sensor 13.

[0013] The defined gas/air mixture is provided to the burner chamber 11 of the gas burner 10 by mixing an air flow with a gas flow. A fan 14 sucks in air flowing through an air duct 15 and gas flowing though a gas duct 16. A gas regulating valve 18 for adjusting the gas flow through the gas duct 16 and a gas safety valve 19 are assigned to the gas duct 16.

[0014] The defined gas/air mixture having the defined mixing ratio of gas and air is provided to the burner chamber 11 of the gas burner 10. The defined gas/air mixture is provided by mixing the air flow provided by an air duct 15 with a gas flow provided by a gas duct 16. The air flow and the gas flow become preferably mixed by a mixing device 23. Such a mixing device can be designed as a so-called Venturi nozzle.

[0015] The quantity of the air flow and thereby the quantity of the gas/air mixture flow is adjusted by the fan 14, namely by the speed of the fan 14. The fan speed can be adjusted by an actuator 22 of the fan 14.

[0016] The fan speed of the fan 14 is controlled by a controller 20 generating a control variable for the actuator 22 of the fan 14.

[0017] The defined mixing ratio of the defined gas/air mixture is controlled by the gas regulating valve 18, namely by a pneumatic controller 24 of the same. The pneumatic controller 24 of the gas regulating valve 18 controls the opening/closing position of the gas valve 18. The position of the gas valve 18 is adjusted by the pneumatic controller 24 on basis of a pressure difference between the gas pressure of the gas flow in the gas pipe 16 and a reference pressure. The gas regulating valve 18 is controlled by the pneumatic controller 24 in such a way that at the outlet of the gas valve 18 the pressure is equal to the reference pressure.

[0018] In Figure 1, the ambient pressure serves as reference pressure. However, it is also possible to use the air pressure of the air flow in the air duct 15 as reference pressure. The pressure difference between the gas pressure and the reference pressure is determined pneumatically by pneumatic sensor of the pneumatic controller 24.

[0019] Alternatively, it is possible to determine the pressure difference between the gas pressure of the gas flow in the gas pipe and the reference pressure electronically by an electric sensor (not shown). In this case, the gas valve 18 would be controlled by an electronic controller, e.g. by the controller 20.

[0020] In any case, the mixing ratio of the defined gas/air mixture is controlled is such a way that over the entire modulation range of the gas burner the defined mixing ratio of the defined gas/air mixture is kept constant. A modulation of "1" means that the fan 14 is operated at maximum fan speed and thereby at full-load of the gas burner 10. A modulation of "5" means that the fan 14 is operated at 20% of the maximum fan speed and a modulation of "10" means that the fan 14 is operated at 10% of the maximum fan speed.

[0021] By changing the fan speed of the fan 14 the load of the gas burner 10 can be adjusted. Over the entire modulation range of the gas burner 10 the defined mixing ratio of the defined gas/air mixture is kept constant.

[0022] As described above, the mixing ratio of the defined gas/air mixture is controlled during burner-on phases so that over the entire modulation range of the gas burner 10 the defined mixing ratio of the gas/air mixture is kept constant. During burner-on phases the defined mixing ratio of gas and air of the defined gas/air mixture can be calibrated to different gas qualities. The calibration is performed by adjusting a position of a throttle 17. The throttle position can be adjusted by an actuator 21 assigned to the throttle 17. The controller 20 controls the actuator 21 and thereby the throttle position of the throttle 17.

[0023] The calibration can be performed at selected times, namely immediately after installation of the sensor and/or immediately after restart of the gas burner and/or immediately after a reset. Alternatively, the calibration can be performed in a modulating range of the gas burner 10 close to full-load operation of the same, e.g. between 50% (corresponds to a modulation of "2") and 100% (corresponds to a modulation of "1") of full full-load operation.

[0024] The calibration is based on a signal provided by the ionization sensor 13 positioned downstream of the mixing device 23 within the burner chamber 11. The present application is related to a unique calibration method for calibrating the gas/air mixture to different gas qualities.

[0025] For the calibration of the gas/air mixture the same is made richer by increasing the gas amount of the gas/air mixture relative to the air amount of the same until a flattening or a maximum of the signal provided by the ionization sensor 13 is detected. The arrow 25 is Figure 2 illustrates that the gas/air mixture is made richer. The further calibration of the gas/air mixture depends on if either a flattening or a maximum of the signal provided by the ionization sensor 13 is detected. This will be described in greater detail below referring to Figures 2, 3.

[0026] Figure 2 illustrates the dependence of the signal I provided by the ionization sensor 13 from the throttle position X_{17} of the throttle 17 assigned to the gas duct 16 used for the calibration. Figure 3 illustrates the dependence of a calibrated throttle position $X_{17\text{-CAL}}$ from a reference throttle position $X_{17\text{-REF}}$ determined during calibration.

[0027] It has to be noted that in the shown embodiment the throttle 17 which is used for the calibration is assigned to the gas duct 16. However, it should be understood that the throttle 17 which is used for the calibration can alternatively be assigned to the mixing device 23.

[0028] For the calibration of the gas/air mixture the throttle position X17 is changed through the actuator 21 and the controller 20 in order to increase the gas flow while keeping the fan speed and the air flow constant thereby increasing the gas amount of the gas/air mixture relative to the air amount of the same (see arrow 25 in Figure 2). The throttle position X_{17} is continuously changed in order to continuously increase the gas amount of the gas/air mixture relative to the air amount of the same until a flattening or a maximum of the signal I provided by the ionization sensor 13 is detected.

[0029] Figure 2 shows a reference throttle position $X_{17\text{-REF (MAX)}}$ for which a maximum of the signal I provided by the ionization sensor 13 is detected. Such a maximum can be detected when the signal I provided by the ionization sensor 13 drops by a certain amount while changing the throttle position X_{17} as illustrated by the arrow 26 in Figure 2.

[0030] For further clarification, Figure 2 shows in addition a reference throttle position $X_{17\text{-REF (FLAT)}}$ for which a flattening of the signal I provided by the ionization sensor 13 is detected. Such a flattening can be detected when the signal I provided by the ionization sensor 13 remains constant while changing the throttle position X_{17} as illustrated by the bracket 27 in Figure 2.

[0031] Both, the detection of the flattening and the detection of the maximum is performed by the controller 20 and depends on the actual signal I provided by the ionization sensor 13. For some calibrations a flattening of the signal provided by the ionization sensor 13 might be detected and for some other calibrations a maximum of the signal provided by the ionization sensor 13 might be detected.

[0032] When making the gas/air mixture richer, first a flattening of the signal I provided by the ionization sensor 13 might be detectable. The detection of the flattening is preferred. However, if a flattening can not be detected, a maximum of the signal I provided by the ionization sensor 13 can be detected so that the maximum detection serves as a backup or fallback when a flattening detection is not possible.

[0033] When a flattening of the signal I provided by the ionization sensor 13 can be detected, the calibration is based on the flattening detection.

[0034] Only in case a flattening detection is impossible, the calibration is based on the maximum detection.

[0035] The calibration of the gas/air mixture depends on a reference throttle position $X_{17\text{-REF}}$ for which a flattening or a maximum of the signal I provided by the ionization sensor 13 is detected. This reference throttle position $X_{17\text{-REF}}$ is determined by the controller 20.

[0036] The signal I provided by the ionization sensor 13 is continuously monitored and analyzed by the controller 20 while the gas amount of the gas/air mixture becomes continuously increased relative to the air amount of the same in order to determine a flattening or a maximum of the signal I provided by the ionization sensor 13 and in order to determine the respective reference throttle position $X_{17\text{-REF}}$.

[0037] The calibration further depends on an offset value ΔX_{17} added to the reference throttle position $X_{17\text{-REF}}$ for which the maximum or the flattening is detected, whereby the offset value ΔX_{17} depends on if either a flattening or a maximum of the signal I provided by the ionization sensor 13 is detected. This offset value ΔX_{17} is determined by the controller 20.

[0038] The offset value ΔX_{17} is determined on basis of a characteristic curve or on basis of a formula, whereby a first characteristic curve f_{FLAT} or a first formula is used when a flattening of the signal I provided by the ionization sensor 13 is detected, and whereby a second characteristic curve f_{MAX} or a second formula being different from the first characteristic curve f_{FLAT} or the first formula is used when a maximum of the signal I provided by the ionization sensor 13 is detected.

[0039] The first characteristic curve f_{FLAT} or the first formula being valid for a flattening detection differs in such a way from the second characteristic curve f_{MAX} or the second formula being valid for a maximum detection that these curves or formulas output a different offset value $\Delta X_{17\text{-MAX}}$ or $\Delta X_{17\text{-FLAT}}$ for the same or identical reference throttle position $X_{17\text{-REF}}$.

[0040] The reference throttle position $X_{17\text{-REF}}$ and the offset value ΔX_{17} added to the reference throttle position $X_{17\text{-REF}}$ are used to determine a calibrated throttle position $X_{17\text{-CAL}}$. At the calibrated throttle position $X_{17\text{-CAL}}$ the defined gas/air mixture is calibrated to the actual gas quality of the calibration. After calibration the throttle positionof is adjusted by the controller 20 to the calibrated throttle position $X_{17\text{-CAL}}$.

[0041] When a flattening of the of the signal I provided by the ionization sensor 13 is detected, the calibrated throttle position $X_{17\text{-CAL}}$ depends on the respective reference throttle position $X_{17\text{-REF (FLAT)}}$ and the respective offset value $\Delta X_{17\text{-FLAT}}$ determined on basis of the first characteristic curve f_{FLAT} or the first formula as follows:

$$X_{17\text{-CAL}} = X_{17\text{-REF (FLAT)}} + \Delta X_{17\text{-FLAT}}$$

[0042] When a flattening can not be detected but a maximum of the of the signal I provided by the ionization sensor 13 is detected, the calibrated throttle position $X_{17\text{-CAL}}$ depends on the respective reference throttle position $X_{17\text{-REF (MAX)}}$ and the respective offset value $\Delta X_{17\text{-MAX}}$ determined on basis of the second characteristic curve f_{MAX} or the second formula as follows:

$$X_{17\text{-CAL}} = X_{17\text{-REF (MAX)}} + \Delta X_{17\text{-MAX}}$$

[0043] The invention uses a reference throttle position for calibration, whereby the invention distinguishes between a reference throttle position for a detected flattening of the signal I provided by the ionization sensor 13 and a reference throttle position for a detected maximum of the signal I provided by the ionization sensor 13.

[0044] The controller 20 receives and analyses the signal provided by the ionization sensor 13. The controller 20 determines either a flattening or a maximum of the signal provided by the ionization sensor 13. The flattening detection is preferred. The maximum detection serves as a fallback or backup when a flattening can not be detected.

[0045] The controller 20 further determines the respective reference throttle position and respective offset value, whereby these values depend on if either a flattening or a maximum of the signal provided by the ionization sensor 13 is detected.

[0046] On basis of the respective reference throttle position and respective offset value the controller 20 determines calibrated throttle position for the calibration throttle 17.

List of reference signs

[0047]

10 gas burner
11 burner chamber
12 flame

13 ionization sensor
14 fan
15 air duct
16 gas duct
17 throttle
18 gas valve / regulating valve
19 gas valve / safety valve
20 controller
21 actuator
22 actuator
23 mixing device
24 pneumatic controller
25 arrow
26 arrow
27 bracket

Claims

1. Method for operating a gas burner (10), wherein during burner-on phases a defined gas/air mixture having a defined mixing ratio of gas and air is provided to a burner chamber (11) of the gas burner (10) for combusting the defined gas/air mixture within the burner chamber (11), wherein the defined gas/air mixture is provided by a mixing device (23) mixing an air flow provided by an air duct (15) with a gas flow provided by a gas duct (16), wherein the air flow provided by the air duct (15) depends on a fan speed of a fan (14) assigned to the air duct (15) or the burner chamber (11), wherein the gas flow provided the gas duct (16) depends on a position of at least one gas valve (18, 19) assigned to the gas duct (16), wherein during burner-on phases the defined mixing ratio of gas and air of the defined gas/air mixture can be calibrated to different gas qualities on basis of a signal provided by an ionization sensor (13) positioned downstream of the mixing device (23) within the burner chamber (11), wherein for the calibration of the gas/air mixture the gas/air mixture is made richer by increasing the gas amount of the gas/air mixture relative to the air amount of the same until a flattening or a maximum of the signal provided by the ionization sensor (13) is detected, wherein for calibration the gas/air mixture is made richer by changing a throttle position of a throttle (17) assigned to the gas duct (16) or to the mixing device (23) in order to increase the gas flow while keeping the fan speed and the air flow constant thereby increasing the gas amount of the gas/air mixture relative to the air amount of the same, and wherein the further calibration of the gas/air mixture depends on if either a flattening or a maximum of the signal provided by the ionization sensor (13) is detected,
characterized in that
the calibration of the gas/air mixture depends on a reference throttle position for which a flattening or a maximum of the signal provided by the ionization sensor (13) is detected;
the calibration further depends on an offset value added to the reference throttle position for which the flattening or the maximum is detected, whereby the offset value depends on if either a flattening or a maximum of the signal provided by the ionization sensor (13) is detected;
the offset value is determined on basis on a characteristic curve or on basis of a formula, whereby a first characteristic curve or a first formula is used when a flattening of the signal provided by the ionization sensor (13) is detected, and whereby a second characteristic curve or a second formula being different from the first characteristic curve or the first formula is used when a maximum of the signal provided by the ionization sensor (13) is detected.

2. Method as claimed in claim 1, **characterized in that** that for calibration of the gas/air mixture the throttle position is continuously changed in order to continuously increase the gas amount of the gas/air mixture relative to the air amount of the same until a flattening or a maximum of the signal provided by the ionization sensor (13) is detected.

3. Method as claimed in claim 1 or 2, **characterized in that** the first characteristic curve or the first formula being valid for a flattening detection differs in such a way from the second characteristic curve or the second formula valid for the maximum detection that the curves or formulas output a different offset value for an identical reference throttle position.

4. Method as claimed in one of claims 1 to 3, **characterized in that** the reference throttle position and the offset value added to the reference throttle position are used to determine a calibrated throttle position, whereby at the calibrated throttle position the defined gas/air mixture is calibrated to the actual gas quality of the calibration.

5. Method as claimed in one of claims 1 to 4, **characterized in that** only the calibration of the defined gas/air mixture depends on the signal provided by the ionization sensor (13), whereby the control of the defined gas/air mixture over the modulation range of the gas burner (11) is independent from the signal provided by the ionization sensor (13).

6. Method as claimed in claim 5, **characterized in that** the control of the defined gas/air mixture over the modulation range of the gas burner (11) depends on a pressure difference between the gas pressure of the gas flow in the gas pipe and a reference pressure, whereby either the air pressure of the air flow in the air duct or the ambient pressure is used as reference pressure.

7. Method as claimed in claim 6, **characterized in that** the pressure difference between the gas pressure of the gas flow in the gas pipe and the reference pressure is determined either pneumatically by pneumatic sensor or electronically by an electric sensor.

Patentansprüche

1. Verfahren zum Betrieb eines Gasbrenners (10), wobei in Phasen, in welchen der Brenner in Betrieb ist, ein definiertes Gas-Luft-Gemisch, das ein definiertes Mischungsverhältnis von Gas und Luft aufweist, einer Brennkammer (11) des Gasbrenners (10) bereitgestellt wird zur Verbrennung des definierten Gas-Luft-Gemischs in der Brennkammer (11), wobei das definierte Gas-Luft-Gemisch durch eine Mischvorrichtung (23) bereitgestellt wird, welche einen durch eine Luftleitung (15) bereitgestellten Luftstrom mit einem durch eine Gasleitung (16) bereitgestellten Gasstrom mischt, wobei der durch die Luftleitung (15) bereitgestellte Luftstrom von einer Gebläsegeschwindigkeit eines Gebläses (14) abhängt, das der Luftleitung (15) oder der Brennkammer (11) zugeordnet ist, wobei der durch die Gasleitung (16) bereitgestellte Gasstrom von einer Stellung mindestens eines Gasventils (18, 19) abhängt, das der Gasleitung (16) zugeordnet ist, wobei das definierte Mischungsverhältnis von Gas und Luft des definierten Gas-Luft-Gemischs in Phasen, in welchen der Brenner in Betrieb ist, auf der Grundlage eines durch einen Ionisationssensor (13) bereitgestellten Signals, welcher der Mischvorrichtung (23) nachgelagert innerhalb der Brennkammer (11) angeordnet ist, für verschiedene Gasqualitäten kalibriert werden kann, wobei für die Kalibrierung des Gas-Luft-Gemischs das Gas-Luft-Gemisch fetter gemacht wird, indem die Gasmenge des Gas-Luft-Gemischs im Verhältnis zur Luftmenge desselben erhöht wird, bis eine Abflachung oder ein Maximum des vom Ionisationssensor (13) bereitgestellten Signals erkannt wird, wobei das Gas-Luft-Gemisch für die Kalibrierung fetter gemacht wird, indem eine Drosselklappenstellung einer Drosselklappe (17), die der Gasleitung (16) oder der Mischvorrichtung (23) zugeordnet ist, verändert wird, um den Gasstrom zu erhöhen, während die Gebläsegeschwindigkeit und der Luftstrom konstant gehalten werden, wodurch die Gasmenge des Gas-Luft-Gemischs im Verhältnis zur Luftmenge desselben erhöht wird, und wobei die weitere Kalibrierung des Gas-Luft-Gemischs davon abhängt, ob entweder eine Abflachung oder ein Maximum des vom Ionisationssensor (13) bereitgestellten Signals erkannt wird,
dadurch gekennzeichnet, dass
die Kalibrierung des Gas-Luft-Gemischs von einer Referenzdrosselklappenstellung abhängt, für welche eine Abflachung oder ein Maximum des vom Ionisationssensor (13) bereitgestellten Signals erkannt wird;
die Kalibrierung ferner abhängt von einem Offsetwert, welcher der Referenzdrosselklappenstellung, für welche die Abflachung oder das Maximum erkannt wird, hinzufügt wird, wobei der Offsetwert davon abhängt, ob entweder eine Abflachung oder ein Maximum des vom Ionisationssensor (13) bereitgestellten Signals erkannt wird;
der Offsetwert ermittelt wird auf der Grundlage einer Kennlinie oder auf der Grundlage einer Formel, wobei eine erste Kennlinie oder eine erste Formel verwendet wird, wenn die Abflachung des vom Ionisationssensor (13) bereitgestellten Signals erkannt wird, und wobei eine zweite Kennlinie oder eine zweite Formel, die sich von der ersten Kennlinie oder der ersten Formel unterscheidet, verwendet wird, wenn ein Maximum des vom Ionisationssensor (13) bereitgestellten Signals erkannt wird.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** für die Kalibrierung des Gas-Luft-Gemischs die Drosselklappenstellung kontinuierlich verändert wird, um die Gasmenge des Gas-Luft-Gemischs im Verhältnis zur Luftmenge desselben kontinuierlich zu erhöhen, bis eine Abflachung oder ein Maximum des vom Ionisationssensor (13) bereitgestellten Signals erkannt wird.

3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** sich die erste Kennlinie oder die erste Formel, die für eine Abflachungserkennung gilt, derart von der zweiten Kennlinie oder der zweiten Formel, die für die Erkennung des Maximums gilt, unterscheidet, dass die Linien oder Formeln einen unterschiedlichen Offsetwert für eine identische Referenzdrosselklappenstellung ausgeben.

4. Verfahren nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Referenzdrosselklappenstellung und der zur Referenzdrosselklappenstellung hinzugefügte Offsetwert dazu verwendet werden, eine kalibrierte Drosselklappenstellung zu ermitteln, wobei das definierte Gas-Luft-Gemisch bei der kalibrierten Drosselklappenstellung auf die tatsächliche Gasqualität der Kalibrierung kalibriert ist.

5. Verfahren nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** nur die Kalibrierung des definierten Gas-Luft-Gemischs vom Signal, das vom Ionisationssensor (13) bereitgestellt wird, abhängt, wobei die Regelung des definierten Gas-Luft-Gemischs über den Einstellungsbereich des Gasbrenners (11) nicht vom Signal, das der Ionisationssensor (13) bereitstellt, abhängt.

6. Verfahren nach Anspruch 5, **dadurch gekennzeichnet, dass** die Regelung des definierten Gas-Luft-Gemischs über den Einstellungsbereich des Gasbrenners (11) von einem Druckunterschied zwischen dem Gasdruck des Gasstroms in der Gasleitung und einem Referenzdruck abhängt, wobei entweder der Luftdruck des Luftstroms in der Luftleitung oder der Umgebungsdruck als Referenzdruck verwendet wird.

7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** der Druckunterschied zwischen dem Gasdruck des Gasstroms in der Gasleitung und dem Referenzdruck entweder pneumatisch durch einen pneumatischen Sensor oder elektronisch durch einen elektrischen Sensor ermittelt wird.

Revendications

1. Procédé pour faire fonctionner un brûleur à gaz (10), dans lequel pendant des phases de mise en fonctionnement de brûleur, un mélange air/gaz défini ayant un rapport de mélange défini de gaz et d'air est fourni à une chambre de combustion (11) du brûleur à gaz (10) pour brûler le mélange air/gaz défini dans la chambre de combustion (11), dans lequel le mélange air/gaz défini est fourni par un dispositif de mélange (23) mélangeant un flux d'air fourni par une conduite d'air (15) avec un écoulement gazeux fourni par une conduite de gaz (16), dans lequel le flux d'air fourni par la conduite d'air (15) dépend d'une vitesse de ventilateur d'un ventilateur (14) attribué à la conduite d'air (15) ou à la chambre de combustion (11), dans lequel l'écoulement gazeux fourni par la conduite de gaz (16) dépend d'une position d'au moins une soupape à gaz (18, 19) attribuée à la conduite de gaz (16), dans lequel, pendant des phases de mise en fonctionnement du brûleur, le rapport de mélange défini de gaz et d'air du mélange air/gaz défini peut être étalonné à différentes qualités de gaz sur la base d'un signal fourni par un capteur d'ionisation (13) positionné en aval du dispositif de mélange (23) dans la chambre de combustion (11), dans lequel, pour l'étalonnage du mélange air/gaz, le mélange air/gaz est rendu plus riche en augmentant la quantité de gaz du mélange air/gaz par rapport à la quantité d'air de ce dernier jusqu'à ce qu'un aplatissement ou un maximum du signal fourni par le capteur d'ionisation (13) soit détecté, dans lequel, pour l'étalonnage, le mélange air/gaz est rendu plus riche en changeant une position de papillon des gaz d'un papillon des gaz (17) attribué à la conduite de gaz (16) ou au dispositif de mélange (23), afin d'augmenter l'écoulement gazeux tout en gardant la vitesse de ventilateur et le flux d'air constants, ce qui permet d'augmenter la quantité de gaz du mélange air/gaz par rapport à la quantité d'air de ce dernier, et dans lequel l'étalonnage supplémentaire du mélange air/gaz dépend si soit un aplatissement, soit un maximum du signal fourni par le capteur d'ionisation (13) est détecté,
caractérisé en ce que
l'étalonnage du mélange air/gaz dépend d'une position de papillon des gaz de référence pour laquelle un aplatissement ou un maximum du signal fourni par le capteur d'ionisation (13) est détecté ;
l'étalonnage dépend en outre d'une valeur de décalage ajoutée à la position de papillon des gaz de référence pour laquelle l'aplatissement ou le maximum est détecté, de telle sorte que la valeur de décalage dépende de la détection soit d'un aplatissement, soit d'un maximum du signal fourni par le capteur d'ionisation (13);
la valeur de décalage est déterminée sur la base d'une courbe caractéristique ou sur la base d'une formule de telle sorte qu'une première courbe caractéristique ou une première formule soit utilisée lorsqu'un aplatissement du signal fourni par le capteur d'ionisation (13) est détecté et de telle sorte qu'une seconde courbe caractéristique ou une seconde formule qui sont différentes de la première courbe caractéristique ou de la première formule, soit utilisée lorsqu'un maximum du signal fourni par le capteur d'ionisation (13) est détecté.

2. Procédé selon la revendication 1, **caractérisé en ce que** pour l'étalonnage du mélange air/gaz, la position du papillon des gaz est changée de façon continue afin d'augmenter de façon continue la quantité de gaz du mélange air/gaz par rapport à la quantité d'air de ce dernier jusqu'à ce qu'un aplatissement ou un maximum du signal fourni par le capteur d'ionisation (13) soit détecté.

3. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** la première courbe caractéristique ou la première formule qui sont valables pour une détection d'aplatissement diffèrent de la seconde courbe caractéristique ou de la seconde formule valables pour la détection de maximum de telle manière que les courbes ou les formules produisent une valeur de décalage différente pour une position de papillon des gaz de référence identique.

4. Procédé selon l'une des revendication 1 à 3, **caractérisé en ce que** la position de papillon des gaz de référence et la valeur de décalage ajoutée à la position de papillon des gaz de référence sont utilisées pour déterminer une position de papillon des gaz étalonnée de telle sorte qu'à la position de papillon des gaz étalonnée, le mélange air/gaz défini soit étalonné à la qualité de gaz actuelle de l'étalonnage.

5. Procédé selon l'une des revendications 1 à 4,

caractérisé en ce que seul l'étalonnage du mélange air/gaz défini dépend du signal fourni par le capteur d'ionisation (13) de telle sorte que la régulation du mélange air/gaz défini sur la plage de modulation du brûleur à gaz (11) soit indépendante du signal fourni par le capteur d'ionisation (13).

6. Procédé selon la revendication 5, **caractérisé en ce que** la régulation du mélange air/gaz défini sur la plage de modulation du brûleur à gaz (11) dépend d'une différence de pression entre la pression gazeuse de l'écoulement gazeux dans le tuyau de gaz et une pression de référence de telle sorte que soit la pression d'air du flux d'air dans la conduite d'air, soit la pression ambiante soit utilisée comme pression de référence.

7. Procédé selon la revendication 6, **caractérisé en ce que** la différence de pression entre la pression gazeuse de l'écoulement gazeux dans le tuyau de gaz et la pression de référence est déterminée soit de manière pneumatique par un capteur pneumatique, soit de manière électronique par un capteur électrique.

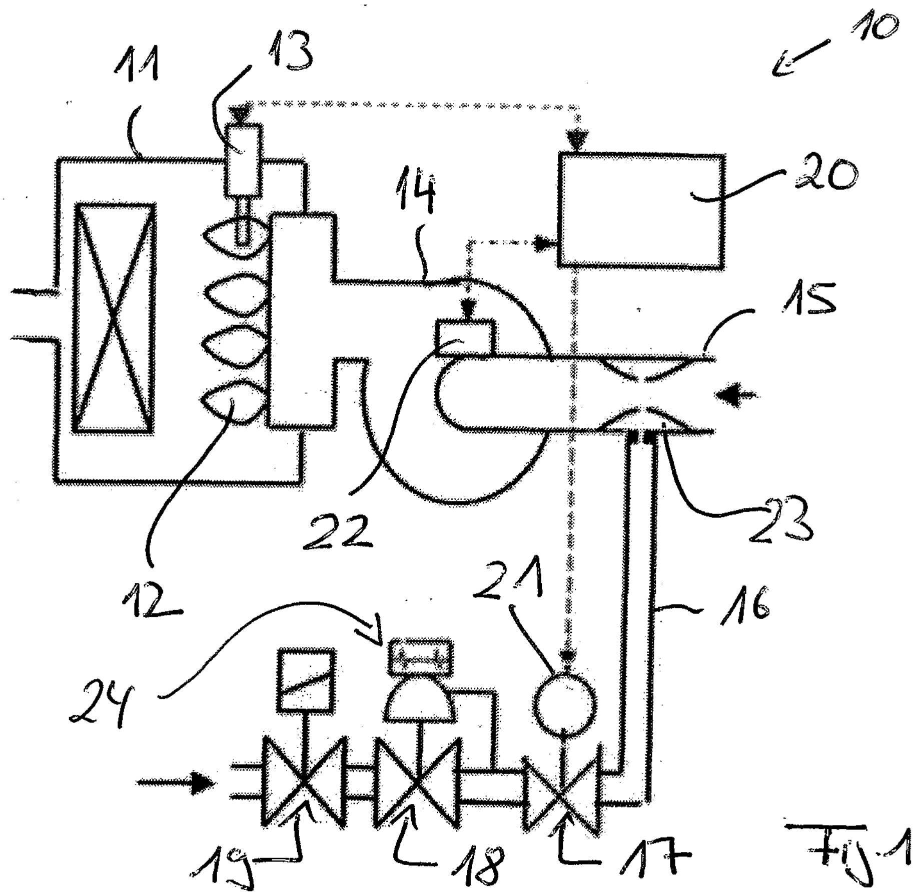

Fig 1

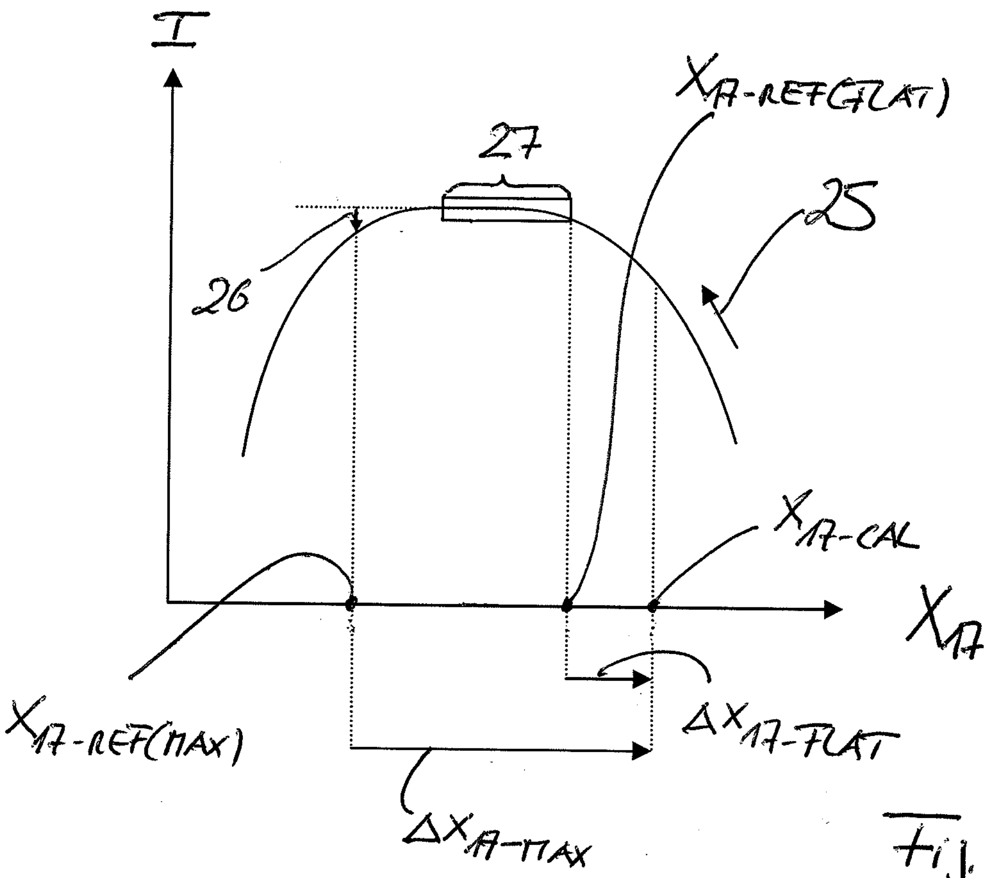
I
X17-REF(FLAT)
27
25
26
X17-CAL
X17
X17-REF(MAX)
ΔX17-FLAT
ΔX17-MAX

Fig. 2

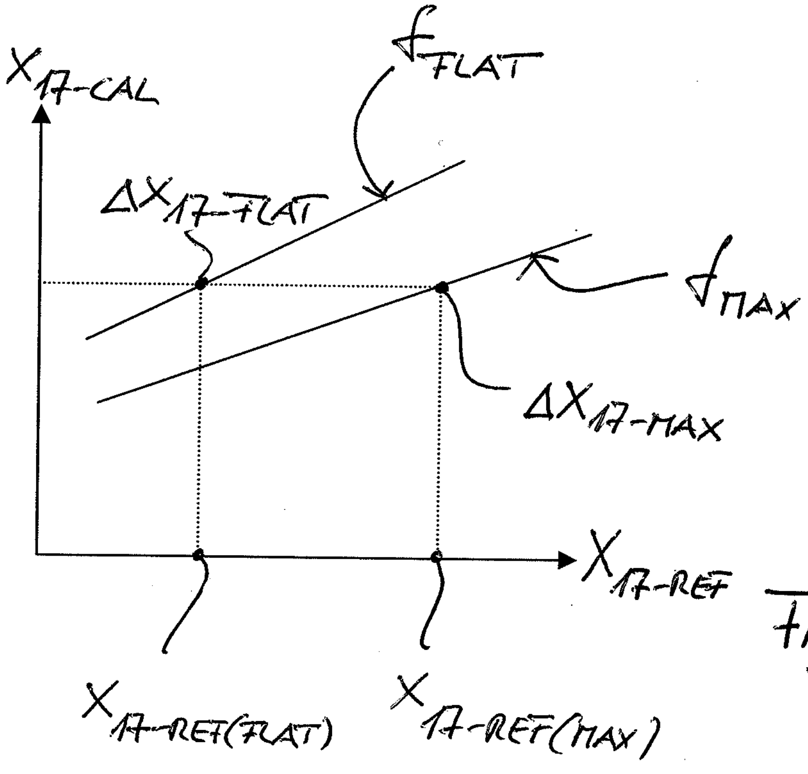
X17-CAL
fFLAT
ΔX17-FLAT
fMAX
ΔX17-MAX
X17-REF
X17-REF(FLAT)
X17-REF(MAX)

Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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