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(54) **METHOD AND CONTROLLER FOR OPERATING A GAS BURNER APPLIANCE**

VERFAHREN UND STEUERGERÄT ZUM BETRIEB EINES GASBRENNERGERÄTS

PROCÉDÉ ET APPAREIL DE COMMANDE POUR FAIRE FONCTIONNER UN APPAREIL À BRÛLEUR À GAZ

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EP 4 092 325 B1

Description

[0001] The invention relates to a method for operating a gas burner appliance. Further on, the invention relates to a gas burner appliance comprising a controller for operating the gas burner appliance.

[0002] EP 2 667 097 A1 discloses a method for operating a gas burner appliance. During burner-on-phases of the gas burner appliance, after combustion has been started in connection with a burner start, a gas/air mixture having a defined mixing ratio of gas and air is provided to a combustion chamber for combusting the gas/air mixture. The mixing ratio of gas and air of the gas/air mixture corresponds to the so-called λ-value of the gas/air mixture. The gas/air mixture is provided by a mixing device mixing an air flow provided by an air duct with a gas flow provided by a gas duct. The mixing device may be provided by a Venturi nozzle. The air flow flowing through the air duct is provided by fan in such a way that the nominal fan speed of the fan depends on a nominal burner-load of the gas burner appliance, wherein a fan speed range of the fan defines a so-called modulation range of the gas burner appliance. According to EP 2 667 097 A1, the defined mixing ratio of gas and air and thereby the λ-value of the gas/air mixture is kept constant over the entire modulation range of the gas burner appliance by a pneumatic gas flow regulator. The pneumatic gas flow regulator is provided by a gas armature. In addition to the pneumatic gas flow regulator the gas armature comprises a safety gas valve and a throttle used for calibration. The pneumatic gas flow regulator uses a pressure difference between the gas pressure of the gas flow in the gas duct and a reference pressure, wherein either the air pressure of the air flow in the air duct or the ambient pressure is used as reference pressure, and wherein the pressure difference between the gas pressure of the gas flow in the gas duct and the reference pressure is determined and controlled pneumatically. EP 2 667 097 A1 discloses a method for operating a gas burner appliance in which the defined mixing ratio of the gas/air mixture is kept constant over the entire modulation range of the gas burner. This is done by the pneumatic gas flow regulator establishing a pneumatic control to keep the mixing ratio of gas and air within the gas/air mixture constant.

[0003] It is also possible to control the mixing ratio of gas and air within the gas/air mixture by an electric gas flow modulator.

[0004] DE 198 24 521 A1 discloses a method to control the mixing ratio of gas and air of the gas/air mixture and thereby the λ-value of the gas/air mixture on basis of a signal provided by an electrical or electronic pressure sensor or flow meter. An actual value corresponding to a pressure ratio between a gas pressure in a gas duct and an air pressure in an air duct or corresponding to a pressure ratio between the gas pressure in the gas duct and the air pressure at the reference point is provided by the electrical or electronic sensor, wherein this actual value is compared with a nominal value. A control variable for the electric gas flow modulator is generated on basis of the control deviation between the actual value and nominal value, wherein the electric gas flow modulator is adjusted on basis of this control variable to control the defined mixing ratio of gas and air in the gas/air mixture thereby keeping the λ-value of the gas/air mixture constant.

[0005] As mentioned above, the amount of the air flow and thereby the amount of the flow of the gas/air mixture having the defined mixing ratio of gas and air provided to the combustion chamber depends on the nominal burner load. The nominal burner-load corresponds to a desired heat demand. The nominal burner-load defines the nominal fan speed at which the fan is operated. The fan speed range of the fan of the gas burner appliance defines the modulation range of the gas burner appliance. A maximum fan speed of the fan defines the maximum burner-load of the gas burner appliance. If a desired heat demand requires maximum burner load, then the fan is operated at maximum fan speed. If a desired heat demand requires burner-load being 50% of the maximum burner load, then the fan is operated at 50% of the maximum fan speed. If a desired heat demand requires burner-load being 20% of the maximum burner load, then the fan is operated at 20% of the maximum fan speed. As mentioned above, at any burner load of the gas burner appliance and at any fan speed of the fan the mixing ratio of gas and air of the is kept constant either by using an electric gas flow modulator or by using a pneumatic gas flow regulator.

[0006] EP 2 966 354 B1 discloses another method for operating a gas burner appliance.

[0007] During burner-on phases the fan is operated with constant fan speed. When further, while the fan is operated with constant fan speed, a defined change of the control variable for a gas valve is detected which is required to keep the actual value of the signal provided by an electrical or electronic sensor at the nominal value for the same, it is detected that a siphon assigned to combustion chamber of the gas burner is blown empty.

[0008] For a safe and proper operation of a gas burner appliance it is necessary that the air flow resistance of the gas burner appliance is known and preferably within a defined range. The air flow resistance of the gas burner appliance depends e. g. on the air flow resistance of the air duct and on the air flow resistance of an exhaust pipe of the combustion chamber.

[0009] EP 2 655 971 B1 discloses a method for operating a gas burner appliance, namely for stabilizing the operation behavior of the gas burner appliance for making allowance of disturbances in the air path, the exhaust gas path and the like. The method makes use of a flame ionization signal to increase a lower permissible fan speed that is assigned to a lower modulation limit to compensate disturbances in the air path, the exhaust gas path and the like.

[0010] JP 2017 116382 A, US 2004/062290 A1, US 2015/045971 A1, EP 2 466 202 B1 and US 5,520,533 A

disclose other prior art.

[0011] It is desired to have better knowledge about the air flow resistance of the gas burner appliance. Against this background, a novel method for operating a gas burner appliance is provided.

[0012] The method according to the present invention, defined in claim 1, is used to determine the air flow resistance of the gas burner appliance by executing the following steps before combustion becomes started in connection with a burner start:

[0013] Measuring a first absolute air pressure by the absolute pressure sensor when the gas safety valve unit is closed and when the fan is stopped. Measuring a second absolute air pressure by the absolute pressure sensor when the gas safety valve unit is closed and when the fan is running. Determining a pressure difference between the first absolute air pressure and the second absolute air pressure. Determining on basis of the pressure difference the air flow resistance of the gas burner appliance.

[0014] The air flow resistance of the gas burner appliance is determined from the pressure difference or from an air mass flow on basis of a characteristic map or characteristic curve. When the air flow resistance of the gas burner appliance is determined the air mass flow, the method comprises the following additional step: Measuring an ambient air temperature. Determining from the first absolute air pressure and the ambient air temperature an air density. Determining from the air density and the pressure difference the air mass flow. Determining on basis of the air mass flow the air flow resistance of the gas burner appliance.

[0015] The method according to the present invention allows an easy and accurate determination of the air flow resistance of the gas burner appliance. With the knowledge about the air flow resistance of the gas burner appliance, it is possible to provide a safe and improved operation the gas burner appliance after combustion has been started.

[0016] Preferably, the method comprises the following additional step: Comparing the air flow resistance or the pressure difference or the air mass flow with at least one respective threshold. Adapting operation of the gas burner appliance for the combustion of the gas/air mixture on basis of said comparison. This allows an improved combustion of the gas/air mixture.

[0017] The air flow resistance may be compared with a respective first threshold and a respective second threshold, wherein if the air flow resistance is below the first threshold, a regular air flow resistance of the gas burner appliance is determined and the fan is operated at a regular nominal fan speed, and if the air flow resistance is above the first threshold and below the second threshold, a permissible increased air flow resistance of the gas burner appliance is determined and the fan is operated at an increased nominal fan speed, and if the air flow resistance is above the second threshold, an impermissible increased air flow resistance of the gas burner appliance is determined and a warning message is generated and/or the operation of the gas burner appliance is stopped, thereby preventing the combustion of the gas/air mixture.

[0018] Alternatively, the air mass flow or the pressure difference may be compared with a respective first threshold and a respective second threshold, wherein if the air mass flow or the pressure difference is above the first threshold, a regular air flow resistance of the gas burner appliance is determined and the fan is operated at a regular nominal fan speed, and if the air mass flow or the pressure difference is below the first threshold and above the second threshold, a permissible increased air flow resistance of the gas burner appliance is determined and the fan is operated at an increased nominal fan speed, and if the mass flow is or the pressure difference below the second threshold, an impermissible increased air flow resistance of the gas burner appliance is determined and a warning message is generated and/or the operation of the gas burner appliance is stopped, thereby preventing the combustion of the gas/air mixture.

[0019] The controller for operating a gas burner appliance according to the present invention is defined in claim 10.

[0020] Preferred developments of the invention are provided by the dependent claims and the description which follows.

[0021] Exemplary embodiments are explained in more detail on the basis of the drawing, in which:

Figure 1 shows a first gas burner appliance to be controlled by the method and controller of the present invention;

Figure 2 shows a second gas burner appliance to be controlled by the method and controller of the present invention;

Figure 3 shows a third gas burner appliance to be controlled by the method and controller of the present invention.

[0022] The present invention relates to a method and a controller for operating a gas burner appliance. Figure 1 shows a schematic view of a first exemplary gas burner appliance 10. The gas burner appliance 10 comprises a combustion chamber 11 in which combustion of a gas/air mixture M having a defined mixing ratio of gas G and air A takes place during burner-on phases of the gas burner appliance 10, namely after starting the gas burner appliance and igniting the gas/air mixture M. The combustion of the gas/air mixture results into flames 12 and into exhaust gas E. The flames 12 are monitored by a combustion quality sensor, preferably by a flame ionization sensor 13 providing as output signal an electrical flame ionization current. The flame ionization sensor 13 provides its output signal to a controller 26. The exhaust gas E emanates from the combustion chamber 11 through an exhaust pipe 29.

[0023] The gas/air mixture M is provided to the com-

bustion chamber 11 of the gas burner appliance 10 by mixing a flow of the air A with a flow of the gas G. A fan 14 sucks in air A flowing through an air duct 15 and gas G flowing through a gas duct 16. A gas flow modulator 18 for adjusting the gas flow through the gas duct 16 and preferably two gas safety valves 19 are assigned to the gas duct 16. The gas flow modulator 18 and the gas safety valves 19 are part of a gas armature 17 further comprising a sieve 20 and at least one sensor 21. In Figure 1 the sensor 21 is an absolute pressure sensor that measures at least the absolute air pressure.

[0024] The absolute pressure sensor 21 may in addition measure the air temperature. It is possible that the gas armature 17 may comprise separate sensors to measure the absolute air pressure and the air temperature. The at least one sensor 21 provides its output signal to the controller 26.

[0025] The gas safety valves 19 are operated by at least one electric coil 22 being part of the gas armature 17. In burner-on phases the at least one electric coil 22 is energized by the controller 26 to open the gas safety valves 19. In burner-off phases the gas safety valves 19 are closed. In Figure 1, each gas safety valve 19 is operated by one separate electric coil 22. It is possible to operate the gas safety valves 19 by a common electric coil 22.

[0026] The gas flow modulator 18 is operated by a motor 23 also having an electric coil 24. In Figure 1, the gas flow modulator 18 is an electric gas flow modulator 18 operated by the controller 26.

[0027] The gas/air mixture M having the defined mixing ratio of gas G and air A is provided to the combustion chamber 11 of the gas burner appliance 10. The gas/air mixture M is provided by mixing the air flow A provided by an air duct 15 with a gas flow G provided by a gas duct 16. The air flow and the gas flow become preferably mixed by a mixing device 25. The mixing device 25 may be a venturi nozzle.

[0028] The absolute pressure sensor 21, namely the measuring point of the same, is positioned between the gas safety valve unit 19 and the mixing device 25. In Figure 1, the absolute pressure sensor 21 is positioned between the gas safety valve unit 19 and the gas flow modulator 18. Alternatively, the absolute pressure sensor 21, namely the measuring point of the same, may be positioned between the gas flow modulator 18 and the mixing device 25.

[0029] The quantity of the air flow A and thereby the quantity of the gas/air mixture flow M is adjusted by the fan 14, namely by the speed of the fan 14. The fan speed can be adjusted on basis of a nominal burner-load. A nominal fan speed of the fan 14 depends on the nominal burner load.

[0030] The fan 14 is operated by the controller 26. The fan speed range of the fan 14 defines a modulation range of the gas burner appliance 10. A modulation of "1" means that the fan 14 is operated at maximum fan speed (100% of maximum fan speed) and thereby at a full-load of the gas burner appliance 10. A modulation of "2" means that the fan 14 is operated at 50% of the maximum fan speed and a modulation of "5" means that the fan 14 is operated at 20% of the maximum fan speed. By changing the fan speed of the fan 14, the burner-load of the gas burner appliance 10 can be adjusted.

[0031] Over the entire modulation range of the gas burner appliance 10 the defined mixing ratio of gas G and air A within the gas/air mixture M and thereby the λ-value of the gas/air mixture M is kept constant. Said defined mixing ratio of gas G and air A or said λ-value of the gas/air mixture M is controlled over the modulation range of the gas burner appliance using the electric gas flow modulator 18 of a gas armature 17 in order to keep the defined mixing ratio of gas and air and thereby the λ-value constant over the modulation range of the gas burner appliance 10. In Figure 1, the control variable for the electric gas flow modulator 18 in order to keep the λ-value constant is generated by the controller 26 on basis of the flame ionization current provided by the flame ionization sensor 13.

[0032] Figures 2 and 3 show schematic views of other exemplary gas burner appliances 10' and 10". In Figures 1, 2 and 3 identical reference numbers are used for identical parts. In order to avoid unnecessary repetitions, below only the differences of the gas burner appliances 10, 10' and 10, 10" will be described.

[0033] In Figure 2, the constant mixing ratio of gas G and air A within the gas/air mixture M is controlled by the electric gas flow modulator 18 on basis of a signal provided by an electric or electronic pressure sensor or flow meter 27 and not on basis of the flame ionization current provided by the flame ionization sensor 13. In this case the electric or electronic sensor 27 may provide to the controller 26 an actual value corresponding to a pressure ratio between a gas pressure in a gas duct 16 and an air pressure in an air duct 15 or corresponding to a pressure ratio between the gas pressure in the gas duct 16 and the air pressure at the reference point, wherein the controller 26 may compare said actual value with a nominal value. In this case, the controller 26 may generate the control variable for the electric gas flow modulator 18 on basis of the control deviation between the actual value and the nominal value, wherein the gas flow modulator 18 may be operated on basis of this control variable to keep over the entire modulation range of the gas burner appliance 10 the defined mixing ratio of gas and air and thereby the λ-value constant.

[0034] In Figure 2, the absolute pressure sensor 21 is positioned between the gas safety valve unit 19 and the gas flow modulator 18. Alternatively, the absolute pressure sensor 21, namely the measuring point of the same, may be positioned between the gas flow modulator 18 and the mixing device 25.

[0035] In Figure 3, the gas armature 17 comprises a pneumatic gas flow regulator 28. A pneumatic controller 28a of the pneumatic gas flow regulator 28 controls the opening/closing position of the gas regulation valve 28b.

The position of the pneumatic gas regulation valve 28b is adjusted by the pneumatic controller 28a on basis of a pressure difference between the gas pressure of the gas flow in the gas duct 16 and a reference pressure. The pneumatic gas regulation valve 28a is controlled by the pneumatic controller 28b in such a way that at the outlet pressure of the gas regulation valve 28b is equal to the reference pressure. In Figure 3, 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. In Figure 3, the pressure difference between the gas pressure and the reference pressure is determined pneumatically a by pneumatic sensor of the pneumatic controller 28a. The mixing ratio of the defined gas/air mixture is controlled by the pneumatic controller 28a in such a way that over the entire modulation range of the gas burner appliance 10 the defined mixing ratio of the gas/air mixture M and thereby the λ-value constant is kept constant.

[0036] In Figure 3, the absolute pressure sensor 21 is positioned between the pneumatic gas flow regulator 28 and the mixing device 25. If the gas regulation valve 28b of the pneumatic gas flow regulator 28 is in the closed position not gas tight, the absolute pressure sensor 21 may alternatively be positioned between the gas safety valve unit 19 and the pneumatic gas flow regulator 28.

[0037] The present invention relates to a method for operating such a gas burner appliance 10, 10', 10", wherein the gas burner appliance 10, 10', 10" is at least operated to determine the air flow resistance of the gas burner appliance 10, 10', 10".

[0038] It may also be possible to adapt operation of the gas burner appliance 10, 10', 10" for the combustion of the gas/air mixture on basis of said comparison.

[0039] To determine the air flow resistance of the gas burner appliance 10, 10', 10" the following steps are executed before combustion becomes started in connection with a burner start:

Measuring a first absolute air pressure by the absolute pressure sensor 21 when the gas safety valve unit 19 is closed and when the fan 14 is stopped.

Measuring a second absolute air pressure by the absolute pressure sensor 21 when the gas safety valve unit 19 is closed and when the fan 14 is running.

Determining a pressure difference between the first absolute air pressure and the second absolute air pressure.

Determining on basis of the pressure difference the air flow resistance of the gas burner appliance 10, 10', 10", on basis of a characteristic map or characteristic curve.

[0040] The above steps allow an easy, accurate and reliable determination of the air flow resistance of the gas burner appliance 10, 10', 10".

[0041] In order to further improve accuracy of the determination of the air flow resistance of the gas burner appliance 10, 10', 10", the method may comprise the following additional steps:

Measuring an ambient temperature.

Determining from the first absolute air pressure and the ambient temperature an air density.

Determining from the air density and the pressure difference an air mass flow, on basis of a characteristic map or characteristic curve.

[0042] Preferably, the air flow resistance or the pressure difference or the air mass flow is compared with at least one respective threshold. On basis of this comparison the operation of the gas burner appliance 10, 10', 10" for the combustion of the gas/air mixture may be adapted. With the knowledge about the air flow resistance of the gas burner appliance 10, 10', 10", it is possible to provide a safe and improved operation the gas burner appliance 10, 10', 10".

[0043] Preferably, the air flow resistance is compared with a respective first threshold and a respective second threshold. If the air flow resistance is below the first threshold, a regular air flow resistance of the gas burner appliance 10, 10', 10" is determined and the fan 14 is operated during active combustion at a regular nominal fan speed depending from the nominal burner load or heat demand. If the air flow resistance is above the first threshold and below the second threshold, a permissible increased air flow resistance of the gas burner appliance 10, 10', 10" is detected and the fan 14 is operated during active combustion at an increased nominal fan speed being larger than the regular nominal fan speed. If the air flow resistance is above the second threshold, an impermissible increased air flow resistance of the gas burner appliance 10, 10', 10" is detected and a warning message is generated and/or the operation of the gas burner appliance 10, 10', 10" is stopped thereby preventing active combustion.

[0044] Alternatively, the air mass flow or the pressure difference is compared with a respective first threshold and a respective second threshold. If the air mass flow or the pressure difference is above the first threshold, a regular air flow resistance of the gas burner appliance 10, 10', 10" is determined and the fan 14 is operated during active combustion at a regular nominal fan speed depending from the nominal burner load or heat demand. If the air mass flow or the pressure difference is below the first threshold and above the second threshold, a permissible increased air flow resistance of the gas burner appliance 10, 10', 10" is detected and the fan 14 is operated during active combustion at an increased nominal fan speed being larger than the regular nominal fan speed. If the mass flow or the pressure difference is below

the second threshold, an impermissible increased air flow resistance of the gas burner appliance 10, 10', 10" is detected and a warning message is generated and/or the operation of the gas burner appliance 10, 10', 10" is stopped thereby preventing active combustion.

[0045] The increased nominal fan speed of the fan 14 may be determined on basis of a difference between the air flow resistance or the pressure difference or the air mass flow and the first threshold. This is done on basis of a characteristic map or characteristic curve.

[0046] This provides a safe and improved operation the gas burner appliance 10, 10', 10" especially after combustion has been started. Further on, if the air flow resistance or the pressure difference or the mass flow is too high, the combustion is prevented and the operation of the gas burner appliance 10, 10', 10" is stopped thereby increasing the operational safety.

[0047] A reference value for the air flow resistance of the gas burner appliance 10, 10', 10" may be determined by determining the air flow resistance of the gas burner appliance 10, 10', 10" immediately after installation of the gas burner appliance 10, 10', 10" in the field or during an initial operation of the gas burner appliance 10, 10', 10". An air flow resistance determined before combustion becomes started in connection with a burner start bay be compared with the reference value. If a difference between the air flow resistance and the reference value is below a respective first threshold, a regular air flow resistance of the gas burner appliance 10 may be determined and the fan 14 may be operated at a regular nominal fan speed during active combustion. If the difference between the air flow resistance and the reference value is above the first threshold and below a respective second threshold, a permissible increased air flow resistance of the gas burner appliance 10, 10', 10" may be determined and the fan 14 may be operated at an increased nominal fan speed during active combustion. If the difference between the air flow resistance and the reference value is above the second threshold, an impermissible increased air flow resistance of the gas burner appliance 10, 10', 10" may be determined and a warning message may be generated and/or stopping operation of the gas burner appliance 10, 10', 10" and/or the operation of the gas burner appliance 10, 10', 10" is stopped thereby preventing active combustion.

[0048] The increased nominal fan speed of the fan 14 may be determined on basis of a deviation between the difference between the air flow resistance and the reference value and the first threshold. This isdone on basis of a characteristic map or characteristic curve.

[0049] Further, the air flow resistance determined before combustion becomes started in connection with a burner start may be compared with a factory provided reference value. If a difference between the air flow resistance and the factory provided reference value is below a respective first threshold, a regular air flow resistance of the gas burner appliance 10 may be determined and the fan 14 may be operated at a regular nominal fan speed during active combustion. If the difference between the air flow resistance and the factory provided reference value is above the first threshold and below a respective second threshold, a permissible increased air flow resistance of the gas burner appliance 10, 10', 10" may be determined and the fan 14 may be operated at an increased nominal fan speed during active combustion. If the difference between the air flow resistance and the factory provided reference value is above the second threshold, an impermissible increased air flow resistance of the gas burner appliance 10, 10', 10" may be determined and a warning message may be generated and/or stopping operation of the gas burner appliance 10, 10', 10" and/or the operation of the gas burner appliance 10, 10', 10" is stopped thereby preventing active combustion.

[0050] As mentioned above, if a permissible increased air flow resistance of the gas burner appliance 10, 10', 10" is determined, the fan 14 may be operated at an increased nominal fan speed during active combustion. This allows to compensate power variations of the gas burner appliance 10, 10', 10" caused by an increased air flow resistance. Preferably the increased nominal fan speed is bound by a maximum fan speed, preferably to prevent a blown free siphon. Such a siphon is not shown in Figures 1 to 3. Such a siphon may be assigned to the combustion chamber 11 or exhaust pipe 29.

List of reference signs

[0051]

10	gas burner appliance
10'	gas burner appliance
10"	gas burner appliance
11	combustion chamber
12	flame
13	flame ionization sensor
14	fan
15	air duct
16	gas duct
17	gas armature
18	gas flow modulator
19	safety gas valve
20	sieve
21	air pressure and air temperature sensor
22	coil
23	motor
24	coil
25	mixer
26	controller
27	electric or electronic sensor
28	gas flow regulator
28a	pneumatic controller
28b	gas regulation valve
29	exhaust pipe

Claims

1. Method for operating a gas burner appliance (10, 10', 10"), the gas burner appliance (10, 10', 10") comprising:

a combustion chamber (11) in which a defined gas/air mixture is combusted after combustion has been started in connection with a burner start,
a mixing device (25) to provide said gas/air mixture by mixing an air flow provided by an air duct (15) with a gas flow provided by a gas duct (16),
a fan (14) to provide the air flow or the flow of the gas/air mixture, wherein a fan speed of the fan (14) depends on a burner-load of the gas burner appliance (10, 10', 10"),
a gas safety valve unit (19) assigned to the gas duct (16) to open or close the gas duct (16),
a gas flow modulator (18) or a gas flow regulator (28) assigned to the gas duct (16) to keep a mixing ratio of gas and air of the defined gas/air mixture constant over the modulation range of the gas burner appliance,
an absolute pressure sensor (21) positioned between the gas safety valve unit (19) and the mixing device (25),
wherein the gas burner appliance is operated to determine the air flow resistance of the gas burner appliance by executing the following steps before combustion becomes started in connection with a burner start:

measuring a first absolute pressure by the absolute pressure sensor (21) when the gas safety valve unit (19) is closed and when the fan (14) is stopped,
measuring a second absolute pressure by the absolute pressure sensor (21) when the gas safety valve unit (19) is closed and when the fan (14) is running,
determining a pressure difference between the first absolute pressure and the second absolute pressure,
determining on basis of the pressure difference the air flow resistance of the gas burner appliance (10, 10', 10") in such a way that

the air flow resistance of the gas burner appliance (10, 10', 10") is determined from the pressure difference on basis of a characteristic map or characteristic curve, or
the air flow resistance of the gas burner appliance (10, 10', 10") is determined from an air mass flow on basis of a characteristic map or characteristic curve, wherein the air mass flow is determined by measuring an ambient temperature, by determining from the first absolute pressure and the ambient temperature an air density and by determining from the air density and the pressure difference the air mass flow.

2. Method of claim 1, comprising:

comparing the air flow resistance or the pressure difference or the air mass flow with at least one respective threshold,
adapting operation of the gas burner appliance (10, 10', 10") for the combustion of the gas/air mixture on basis of said comparison.

3. Method of claim 2, comprising:
comparing the air flow resistance with a respective first threshold and a respective second threshold, wherein

if the air flow resistance is below the first threshold, determining a regular air flow resistance of the gas burner appliance (10, 10', 10") and operating the fan (14) at a regular nominal fan speed,
if the air flow resistance is above the first threshold and below the second threshold, determining a permissible increased air flow resistance of the gas burner appliance (10, 10', 10") and operating the fan (14) at an increased nominal fan speed,
if the air flow resistance is above the second threshold, determining an impermissible increased air flow resistance of the gas burner appliance (10, 10', 10") and generating a warning message and/or stopping operation of the gas burner appliance (10, 10', 10").

4. Method of claim 2, comprising:
comparing the air mass flow or the pressure difference with a respective first threshold and a respective second threshold, wherein

if the air mass flow or the pressure difference is above the first threshold, determining a regular air flow resistance of the gas burner appliance (10, 10', 10") and operating the fan (14) at a regular nominal fan speed,
if the air mass flow or the pressure difference is below the first threshold and above the second threshold, determining a permissible increased air flow resistance of the gas burner appliance (10, 10', 10") and operating the fan (14) at an increased nominal fan speed,
if the mass flow or the pressure difference is below the second threshold, determining an impermissible increased air flow resistance of the

gas burner appliance (10, 10', 10") and generating a warning message and/or stopping operation of the gas burner appliance (10, 10', 10").

5. Method of claim 2, comprising:

determining a reference value for the air flow resistance of the gas burner appliance (10, 10', 10") by determining the air flow resistance of the gas burner appliance (10, 10', 10") immediately after installation of the gas burner appliance (10, 10', 10") in the field or during an initial operation of the gas burner appliance (10, 10', 10"),
comparing an air flow resistance determined before combustion becomes started in connection with a burner start with the reference value, wherein

if a difference between the air flow resistance and the reference value is below a respective first threshold, determining a regular air flow resistance of the gas burner appliance (10) and operating the fan (14) at a regular nominal fan speed,
if the difference between the air flow resistance and the reference value is above the first threshold and below a respective second threshold, determining a permissible increased air flow resistance of the gas burner appliance (10, 10', 10") and operating the fan (14) at an increased nominal fan speed,
if the difference between the air flow resistance and the reference value is above the second threshold, determining an impermissible increased air flow resistance of the gas burner appliance (10, 10', 10") and generating warning message and/or stopping operation of the gas burner appliance (10, 10', 10").

6. Method of claim 2, comprising:
comparing the air flow resistance determined before combustion becomes started in connection with a burner start with a factory provided reference value, wherein

if a difference between the air flow resistance and the factory provided reference value is below a respective first threshold, determining a regular air flow resistance of the gas burner appliance (10) and operating the fan (14) at a regular nominal fan speed,
if the difference between the air flow resistance and the factory provided reference value is above the first threshold and below a respective second threshold, determining a permissible increased air flow resistance of the gas burner appliance (10, 10', 10") and operating the fan (14) at an increased nominal fan speed,
if the difference between the air flow resistance and the factory provided reference value is above the second threshold, determining an impermissible increased air flow resistance of the gas burner appliance (10, 10', 10") and generating warning message and/or stopping operation of the gas burner appliance (10, 10', 10").

7. Method of claim 3 or 4 or 5 or 6, comprising:
bounding the increased nominal fan speed by a maximum fan speed preferably to prevent a blown free siphon.

8. Method of one of claims 1 to 7, wherein
after combustion has been started, said defined mixing ratio of gas and air is controlled over the modulation range of the gas burner appliance using a pneumatic gas flow regulator (28).

9. Method of one of claims 1 to 7, wherein
after combustion has been started, said defined mixing ratio of gas and air is controlled over the modulation range of the gas burner appliance using an electric gas flow modulator (18).

10. Gas burner appliance (10, 10', 10") comprising:

a controller (26) for operating the gas burner appliance (10, 10', 10"),
a combustion chamber (11) in which a defined gas/air mixture is combusted after combustion has been started in connection with a burner start,
a mixing device (25) to provide said gas/air mixture by mixing an air flow provided by an air duct (15) with a gas flow provided by a gas duct (16),
a fan (14) to provide the air flow or the flow of the gas/air mixture, wherein a fan speed of the fan (14) depends on a burner-load of the gas burner appliance (10, 10', 10"),
a gas safety valve unit (19) assigned to the gas duct (16) to open or close the gas duct (16),
a gas flow modulator (18) or a gas flow regulator (28) assigned to the gas duct (16) to keep a mixing ratio of gas and air of the defined gas/air mixture constant over the modulation range of the gas burner appliance, and
an absolute pressure sensor (21) positioned between the gas safety valve unit (19) and the mixing device (25), the controller (26) further being configured to determine the air flow resistance of the gas burner appliance (10, 10', 10") by executing the following steps before combustion becomes started in connection with a burner start:

receive a first absolute pressure from the

absolute pressure sensor (21) measured when the gas safety valve unit (19) is closed and when the fan (14) is stopped,
receive a second absolute pressure from the absolute pressure sensor (21) measured when the gas safety valve unit (19) is closed and when the fan (14) is running,
determine a pressure difference between the first absolute pressure and the second absolute pressure,
determine on basis of the pressure difference the air flow resistance of the gas burner appliance (10, 10', 10") in such a way that

the air flow resistance of the gas burner appliance (10, 10', 10") is determined from the pressure difference on basis of a characteristic map or characteristic curve, or
the air flow resistance of the gas burner appliance (10, 10', 10") is determined from an air mass flow on basis of a characteristic map or characteristic curve, wherein the air mass flow is determined by measuring an ambient temperature, by determining from the first absolute pressure and the ambient temperature an air density and by determining from the air density and the pressure difference the air mass flow.

Patentansprüche

1. Verfahren zum Betrieb eines Gasbrennergeräts (10, 10', 10"), wobei das Gasbrennergerät (10, 10', 10") Folgendes aufweist:

eine Brennkammer (11), in der ein definiertes Gas/Luft-Gemisch verbrannt wird, nachdem die Verbrennung in Verbindung mit einem Brennerstart gestartet wurde,
eine Mischvorrichtung (25) zum Bereitstellen des Gas/Luft-Gemischs durch Mischen eines Luftstroms, der durch einen Luftkanal (15) bereitgestellt wird, mit einem Gasstrom, der durch einen Gaskanal (16) bereitgestellt wird,
einen Lüfter (14) zum Bereitstellen des Luftstroms oder des Stroms des Gas/Luft-Gemischs, wobei eine Lüfterdrehzahl des Lüfters (14) von einer Brennerlast des Gasbrennergeräts (10, 10', 10") abhängt,
eine Gassicherheitsventileinheit (19), die dem Gaskanal (16) zugeordnet ist, zum Öffnen oder Schließen des Gaskanals (16),
einen Gasstrommodulator (18) oder einen Gasstromregler (28), der dem Gaskanal (16) zugeordnet ist, zum Konstanthalten eines Mischungsverhältnisses von Gas und Luft des definierten Gas/Luft-Gemischs über den Modulationsbereich des Gasbrennergeräts,
einen Absolutdrucksensor (21), der zwischen der Gassicherheitsventileinheit (19) und der Mischvorrichtung (25) angeordnet ist,
wobei das Gasbrennergerät dazu betrieben wird, den Luftstromwiderstand des Gasbrennergeräts zu bestimmen, indem die folgenden Schritte ausgeführt werden, bevor die Verbrennung in Verbindung mit einem Brennerstart gestartet wird:

Messen eines ersten Absolutdrucks durch den Absolutdrucksensor (21), wenn die Gassicherheitsventileinheit (19) geschlossen ist und wenn der Lüfter (14) stillsteht,
Messen eines zweiten Absolutdrucks durch den Absolutdrucksensor (21), wenn die Gassicherheitsventileinheit (19) geschlossen ist und wenn der Lüfter (14) läuft,
Bestimmen eines Druckunterschieds zwischen dem ersten Absolutdruck und dem zweiten Absolutdruck,
Bestimmen des Luftstromwiderstands des Gasbrennergeräts (10, 10', 10") auf der Grundlage des Druckunterschieds, derart, dass

der Luftstromwiderstand des Gasbrennergeräts (10, 10', 10") auf der Grundlage eines Kennfelds oder einer Kennlinie aus dem Druckunterschied bestimmt wird, oder
der Luftstromwiderstand des Gasbrennergeräts (10, 10', 10") auf der Grundlage eines Kennfelds oder einer Kennlinie aus einem Luftmassenstrom bestimmt wird, wobei der Luftmassenstrom durch Messen einer Umgebungstemperatur, durch Bestimmen einer Luftdichte aus dem ersten Absolutdruck und der Umgebungstemperatur und durch Bestimmen des Luftmassenstroms aus der Luftdichte und dem Druckunterschied bestimmt wird.

2. Verfahren nach Anspruch 1, Folgendes aufweisend:

Vergleichen des Luftstromwiderstands oder des Druckunterschieds oder des Luftmassenstroms mit zumindest einem jeweiligen Schwellenwert,
Anpassen des Betriebs des Gasbrennergeräts (10, 10', 10") für die Verbrennung des Gas/Luft-Gemischs auf der Grundlage des Vergleichs.

3. Verfahren nach Anspruch 2, Folgendes aufweisend:
Vergleichen des Luftstromwiderstands mit einem

diesbezüglichen ersten Schwellenwert und einem diesbezüglichen zweiten Schwellenwert, wobei

wenn der Luftstromwiderstand unter dem ersten Schwellenwert liegt, Bestimmen eines normalen Luftstromwiderstands des Gasbrennergeräts (10, 10', 10") und Betreiben des Lüfters (14) mit einer normalen Lüfternenndrehzahl,
wenn der Luftstromwiderstand über dem ersten Schwellenwert und unter dem zweiten Schwellenwert liegt, Bestimmen eines zulässigen erhöhten Luftstromwiderstands des Gasbrennergeräts (10, 10', 10") und Betreiben des Lüfters (14) mit einer erhöhten Lüfternenndrehzahl,
wenn der Luftstromwiderstand über dem zweiten Schwellenwert liegt, Bestimmen eines unzulässigen erhöhten Luftstromwiderstands des Gasbrennergeräts (10, 10', 10") und Erzeugen einer Warnmeldung und/oder Stoppen des Betriebs des Gasbrennergeräts (10, 10', 10").

4. Verfahren nach Anspruch 2, Folgendes aufweisend: Vergleichen des Luftmassenstroms oder des Druckunterschieds mit einem jeweiligen ersten Schwellenwert und einem jeweiligen zweiten Schwellenwert, wobei

wenn der Luftmassenstrom oder der Druckunterschied über dem ersten Schwellenwert liegt, Bestimmen eines normalen Luftstromwiderstands des Gasbrennergeräts (10, 10', 10") und Betreiben des Lüfters (14) mit einer normalen Lüfternenndrehzahl,
wenn der Luftmassenstrom oder der Druckunterschied unter dem ersten Schwellenwert und über dem zweiten Schwellenwert liegt, Bestimmen eines zulässigen erhöhten Luftstromwiderstands des Gasbrennergeräts (10, 10', 10") und Betreiben des Lüfters (14) mit einer erhöhten Lüfternenndrehzahl,
wenn der Luftmassenstrom oder der Druckunterschied unter dem zweiten Schwellenwert liegt, Bestimmen eines unzulässigen erhöhten Luftstromwiderstands des Gasbrennergeräts (10, 10', 10") und Erzeugen einer Warnmeldung und/oder Stoppen des Betriebs des Gasbrennergeräts (10, 10', 10").

5. Verfahren nach Anspruch 2, Folgendes aufweisend:

Bestimmen eines Referenzwerts für den Luftstromwiderstand des Gasbrennergeräts (10, 10', 10") durch Bestimmen des Luftstromwiderstands des Gasbrennergeräts (10, 10', 10") unmittelbar nach der Installation des Gasbrennergeräts (10, 10', 10") am Einsatzort oder während eines Erstbetriebs des Gasbrennergeräts (10, 10', 10"),

Vergleichen eines Luftstromwiderstands, der bestimmt wird, bevor die Verbrennung in Verbindung mit einem Brennerstart gestartet wird, mit dem Referenzwert, wobei

wenn ein Unterschied zwischen dem Luftstromwiderstand und dem Referenzwert unter einem diesbezüglichen ersten Schwellenwert liegt, Bestimmen eines normalen Luftstromwiderstands des Gasbrennergeräts (10) und Betreiben des Lüfters (14) mit einer normalen Lüfternenndrehzahl,
wenn der Unterschied zwischen dem Luftstromwiderstand und dem Referenzwert über dem ersten Schwellenwert und unter einem diesbezüglichen zweiten Schwellenwert liegt, Bestimmen eines zulässigen erhöhten Luftstromwiderstands des Gasbrennergeräts (10, 10', 10") und Betreiben des Lüfters (14) mit einer erhöhten Lüfternenndrehzahl,
wenn der Unterschied zwischen dem Luftstromwiderstand und dem Referenzwert über dem zweiten Schwellenwert liegt, Bestimmen eines unzulässigen erhöhten Luftstromwiderstands des Gasbrennergeräts (10, 10', 10") und Erzeugen einer Warnmeldung und/oder Stoppen des Betriebs des Gasbrennergeräts (10, 10', 10").

6. Verfahren nach Anspruch 2, Folgendes aufweisend: Vergleichen des Luftstromwiderstands, der bestimmt wird, bevor die Verbrennung in Verbindung mit einem Brennerstart gestartet wird, mit einem werkseitig bereitgestellten Referenzwert, wobei

wenn ein Unterschied zwischen dem Luftstromwiderstand und dem werkseitig bereitgestellten Referenzwert unter einem diesbezüglichen ersten Schwellenwert liegt, Bestimmen eines normalen Luftstromwiderstands des Gasbrennergeräts (10) und Betreiben des Lüfters (14) mit einer normalen Lüfternenndrehzahl,
wenn der Unterschied zwischen dem Luftstromwiderstand und dem werkseitig bereitgestellten Referenzwert über dem ersten Schwellenwert und unter einem diesbezüglichen zweiten Schwellenwert liegt, Bestimmen eines zulässigen erhöhten Luftstromwiderstands des Gasbrennergeräts (10, 10', 10") und Betreiben des Lüfters (14) mit einer erhöhten Lüfternenndrehzahl,
wenn der Unterschied zwischen dem Luftstromwiderstand und dem werkseitig bereitgestellten Referenzwert über dem zweiten Schwellenwert liegt, Bestimmen eines unzulässigen erhöhten Luftstromwiderstands des Gasbrennergeräts

(10, 10', 10") und Erzeugen einer Warnmeldung und/oder Stoppen des Betriebs des Gasbrennergeräts (10, 10', 10").

7. Verfahren nach Anspruch 3 oder 4 oder 5 oder 6, Folgendes aufweisend:
Begrenzen der erhöhten Lüfternenndrehzahl durch eine maximale Lüfterdrehzahl, vorzugsweise um einen freigeblasenen Siphon zu vermeiden.

8. Verfahren nach einem der Ansprüche 1 bis 7, wobei:
nachdem die Verbrennung gestartet wurde, das definierte Mischungsverhältnis von Gas und Luft mittels eines pneumatischen Gasstromreglers (28) über den Modulationsbereich des Gasbrennergeräts geregelt wird.

9. Verfahren nach einem der Ansprüche 1 bis 7, wobei:
nachdem die Verbrennung gestartet wurde, das definierte Mischungsverhältnis von Gas und Luft mittels eines elektrischen Gasstrommodulators (18) über den Modulationsbereich des Gasbrennergeräts geregelt wird.

10. Gasbrennergerät (10, 10', 10"), Folgendes aufweisend:

ein Steuergerät (26) zum Betrieb des Gasbrennergeräts (10, 10', 10"),
eine Brennkammer (11), in der ein definiertes Gas/Luft-Gemisch verbrannt wird, nachdem die Verbrennung in Verbindung mit einem Brennerstart gestartet wurde,
eine Mischvorrichtung (25) zum Bereitstellen des Gas/Luft-Gemischs durch Mischen eines Luftstroms, der durch einen Luftkanal (15) bereitgestellt wird, mit einem Gasstrom, der durch einen Gaskanal (16) bereitgestellt wird,
einen Lüfter (14) zum Bereitstellen des Luftstroms oder des Stroms des Gas/Luft-Gemischs, wobei eine Lüfterdrehzahl des Lüfters (14) von einer Brennerlast des Gasbrennergeräts (10, 10', 10") abhängt,
eine Gassicherheitsventileinheit (19), die dem Gaskanal (16) zugeordnet ist, zum Öffnen oder Schließen des Gaskanals (16),
einen Gasstrommodulator (18) oder einen Gasstromregler (28), der dem Gaskanal (16) zugeordnet ist, zum Konstanthalten eines Mischungsverhältnisses von Gas und Luft des definierten Gas/Luft-Gemischs über den Modulationsbereich des Gasbrennergeräts und
einen Absolutdrucksensor (21), der zwischen der Gassicherheitsventileinheit (19) und der Mischvorrichtung (25) angeordnet ist,
wobei das Steuergerät (26) ferner dazu ausgestaltet ist, den Luftstromwiderstand des Gasbrennergeräts (10, 10', 10") zu bestimmen, indem die folgenden Schritte ausgeführt werden, bevor die Verbrennung in Verbindung mit einem Brennerstart gestartet wird:

Empfangen eines ersten Absolutdrucks von dem Absolutdrucksensor (21), der gemessen wird, wenn die Gassicherheitsventileinheit (19) geschlossen ist und wenn der Lüfter (14) stillsteht,
Empfangen eines zweiten Absolutdrucks von dem Absolutdrucksensor (21), der gemessen wird, wenn die Gassicherheitsventileinheit (19) geschlossen ist und wenn der Lüfter (14) läuft,
Bestimmen eines Druckunterschieds zwischen dem ersten Absolutdruck und dem zweiten Absolutdruck,
Bestimmen des Luftstromwiderstands des Gasbrennergeräts (10, 10', 10") auf der Grundlage des Druckunterschieds, derart dass

der Luftstromwiderstand des Gasbrennergeräts (10, 10', 10") auf der Grundlage eines Kennfelds oder einer Kennlinie aus dem Druckunterschied bestimmt wird oder
der Luftstromwiderstand des Gasbrennergeräts (10, 10', 10") auf der Grundlage eines Kennfelds oder einer Kennlinie aus einem Luftmassenstrom bestimmt wird, wobei der Luftmassenstrom durch Messen einer Umgebungstemperatur, durch Bestimmen einer Luftdichte aus dem ersten Absolutdruck und der Umgebungstemperatur und durch Bestimmen des Luftmassenstroms aus der Luftdichte und dem Druckunterschied bestimmt wird.

Revendications

1. Procédé pour faire fonctionner un appareil à brûleur à gaz (10, 10', 10"), l'appareil à brûleur à gaz (10, 10', 10") comprenant :

une chambre de combustion (11) dans laquelle un mélange gaz/air défini est brûlé après que la combustion a été démarrée en liaison avec un démarrage de brûleur,
un dispositif de mélange (25) pour fournir ledit mélange gaz/air par mélange d'un écoulement d'air fourni par un conduit d'air (15) avec un écoulement de gaz fourni par un conduit de gaz (16),
un ventilateur (14) pour fournir l'écoulement d'air ou l'écoulement du mélange gaz/air, dans

lequel une vitesse de ventilateur du ventilateur (14) dépend d'une charge de brûleur de l'appareil à brûleur à gaz (10, 10', 10"),
une unité de soupape de sécurité de gaz (19) assignée au conduit de gaz (16) pour ouvrir ou fermer le conduit de gaz (16),
un modulateur d'écoulement de gaz (18) ou un régulateur d'écoulement de gaz (28) assigné au conduit de gaz (16) pour maintenir constant un ratio de mélange de gaz et d'air du mélange gaz/air défini sur la plage de modulation de l'appareil à brûleur à gaz,
un capteur de pression absolue (21) positionné entre l'unité de soupape de sécurité de gaz (19) et le dispositif de mélange (25),
l'appareil à brûleur à gaz étant mis en fonctionnement pour déterminer la résistance à l'écoulement d'air de l'appareil à brûleur à gaz en exécutant les étapes suivantes avant que la combustion ne démarre en liaison avec un démarrage de brûleur :

mesure d'une première pression absolue par le capteur de pression absolue (21) lorsque l'unité de soupape de sécurité de gaz (19) est fermée et lorsque le ventilateur (14) est arrêté,
mesure d'une deuxième pression absolue par le capteur de pression absolue (21) lorsque l'unité de soupape de sécurité de gaz (19) est fermée et lorsque le ventilateur (14) est en marche,
déterminer une différence de pression entre la première pression absolue et la deuxième pression absolue,
déterminer, sur la base de la différence de pression,

la résistance à l'écoulement d'air de l'appareil à brûleur à gaz (10, 10', 10") de telle sorte que la résistance à l'écoulement d'air de l'appareil à brûleur à gaz (10, 10', 10") soit déterminée à partir de la différence de pression sur la base d'une carte caractéristique ou d'une courbe caractéristique, ou
la résistance à l'écoulement d'air de l'appareil à brûleur à gaz (10, 10', 10") est déterminée à partir d'un débit massique d'air sur la base d'une carte caractéristique ou d'une courbe caractéristique, le débit massique d'air étant déterminé par la mesure d'une température ambiante, en déterminant à partir de la première pression absolue et de la température ambiante une densité d'air et en déterminant à partir de la densité d'air et de la différence de pression le débit massique d'air.

2. Procédé selon la revendication 1, comprenant :

la comparaison de la résistance à l'écoulement d'air ou de la différence de pression ou du débit massique d'air avec au moins un seuil respectif, l'adaptation du fonctionnement de l'appareil à brûleur à gaz (10, 10', 10") pour la combustion du mélange gaz/air sur la base de ladite comparaison.

3. Procédé selon la revendication 2, comprenant :
la comparaison de la résistance à l'écoulement d'air avec un premier seuil respectif et un deuxième seuil respectif, dans laquelle

si la résistance à l'écoulement d'air est inférieure au premier seuil, déterminer une résistance à l'écoulement d'air régulière de l'appareil à brûleur à gaz (10, 10', 10") et faire fonctionner le ventilateur (14) à une vitesse de ventilateur nominale régulière,
si la résistance à l'écoulement d'air est supérieure au premier seuil et inférieure au deuxième seuil, déterminer une résistance à l'écoulement d'air accrue acceptable de l'appareil à brûleur à gaz (10, 10', 10") et faire fonctionner le ventilateur (14) à une vitesse de ventilateur nominale accrue,
si la résistance à l'écoulement d'air est supérieure au deuxième seuil, déterminer une résistance à l'écoulement d'air accrue inacceptable de l'appareil à brûleur à gaz (10, 10', 10") et générer un message d'avertissement et/ou arrêter le fonctionnement de l'appareil à brûleur à gaz (10, 10', 10").

4. Procédé selon la revendication 2, comprenant :
la comparaison du débit massique d'air ou de la différence de pression avec un premier seuil respectif et un deuxième seuil respectif, dans laquelle

si le débit massique d'air ou la différence de pression est supérieur(e) au premier seuil, déterminer une résistance à l'écoulement d'air régulière de l'appareil à brûleur à gaz (10, 10', 10") et faire fonctionner le ventilateur (14) à une vitesse de ventilateur nominale régulière,
si le débit massique d'air ou la différence de pression est inférieur(e) au premier seuil et supérieur(e) au deuxième seuil, déterminer une résistance à l'écoulement d'air accrue acceptable de l'appareil à brûleur à gaz (10, 10', 10") et faire fonctionner le ventilateur (14) à une vitesse de ventilateur nominale accrue,
si le débit massique ou la différence de pression est inférieur(e) au deuxième seuil, déterminer

une résistance à l'écoulement d'air accrue inacceptable de l'appareil à brûleur à gaz (10, 10', 10") et générer un message d'avertissement et/ou arrêter le fonctionnement de l'appareil à brûleur à gaz (10, 10', 10").

5. Procédé selon la revendication 2, comprenant :

la détermination d'une valeur de référence pour la résistance à l'écoulement d'air de l'appareil à brûleur à gaz (10, 10', 10") en déterminant la résistance à l'écoulement d'air de l'appareil à brûleur à gaz (10, 10', 10") immédiatement après l'installation de l'appareil à brûleur à gaz (10, 10', 10") dans le champ ou pendant un fonctionnement initial de l'appareil à brûleur à gaz (10, 10', 10"),
la comparaison d'une résistance à l'écoulement d'air déterminée avant que la combustion ne démarre en liaison avec un démarrage de brûleur avec la valeur de référence, dans laquelle

si une différence entre la résistance à l'écoulement d'air et la valeur de référence est inférieure à un premier seuil respectif, déterminer une résistance à l'écoulement d'air régulière de l'appareil à brûleur à gaz (10) et faire fonctionner le ventilateur (14) à une vitesse de ventilateur nominale régulière,
si la différence entre la résistance à l'écoulement d'air et la valeur de référence est supérieure au premier seuil et inférieure à un deuxième seuil respectif, déterminer une résistance à l'écoulement d'air accrue acceptable de l'appareil à brûleur à gaz (10, 10', 10") et faire fonctionner le ventilateur (14) à une vitesse de ventilateur nominale accrue,
si la différence entre la résistance à l'écoulement d'air et la valeur de référence est supérieure au deuxième seuil, déterminer une résistance à l'écoulement d'air accrue inacceptable de l'appareil à brûleur à gaz (10, 10', 10") et générer un message d'avertissement et/ou arrêter le fonctionnement de l'appareil à brûleur à gaz (10, 10', 10").

6. Procédé selon la revendication 2, comprenant :
la comparaison de la résistance à l'écoulement d'air déterminée avant que la combustion ne démarre en liaison avec un démarrage de brûleur avec une valeur de référence fournie en usine, dans laquelle

si une différence entre la résistance à l'écoulement d'air et la valeur de référence fournie en usine est inférieure à un premier seuil respectif, déterminer une résistance à l'écoulement d'air régulière de l'appareil à brûleur à gaz (10) et faire fonctionner le ventilateur (14) à une vitesse de ventilateur nominale régulière,
si la différence entre la résistance à l'écoulement d'air et la valeur de référence fournie en usine est supérieure au premier seuil et inférieure à un deuxième seuil respectif, déterminer une résistance à l'écoulement d'air accrue acceptable de l'appareil à brûleur à gaz (10, 10', 10") et faire fonctionner le ventilateur (14) à une vitesse de ventilateur nominale accrue,
si la différence entre la résistance à l'écoulement d'air et la valeur de référence fournie en usine est supérieure au deuxième seuil, déterminer une résistance à l'écoulement d'air accrue inacceptable de l'appareil à brûleur à gaz (10, 10', 10") et générer un message d'avertissement et/ou arrêter le fonctionnement de l'appareil à brûleur à gaz (10, 10', 10").

7. Procédé selon la revendication 3 ou la revendication 4 ou la revendication 5 ou la revendication 6, comprenant :
la limitation de la vitesse de ventilateur nominale accrue par une vitesse de ventilateur maximale préférablement pour empêcher un siphon soufflé à l'air libre.

8. Procédé selon l'une des revendications 1 à 7, dans lequel
après que la combustion a été démarrée, ledit ratio de mélange défini de gaz et d'air est commandé sur la plage de modulation de l'appareil à brûleur à gaz à l'aide d'un régulateur d'écoulement de gaz pneumatique (28).

9. Procédé selon l'une des revendications 1 à 7, dans lequel
après que la combustion a été démarrée, ledit ratio de mélange défini de gaz et d'air est commandé sur la plage de modulation de l'appareil à brûleur à gaz à l'aide d'un modulateur d'écoulement de gaz électrique (18).

10. Appareil à brûleur à gaz (10, 10', 10") comprenant :

un dispositif de commande (26) pour faire fonctionner l'appareil à brûleur à gaz (10, 10', 10"),
une chambre de combustion (11) dans laquelle un mélange gaz/air défini est brûlé après que la combustion a été démarrée en liaison avec un démarrage de brûleur,
un dispositif de mélange (25) pour fournir ledit mélange gaz/air par mélange d'un flux d'air fourni par un conduit d'air (15) avec un flux de gaz fourni par un conduit de gaz (16),
un ventilateur (14) pour fournir l'écoulement d'air ou l'écoulement du mélange gaz/air, dans

lequel une vitesse de ventilateur du ventilateur (14) dépend d'une charge de brûleur de l'appareil à brûleur à gaz (10, 10', 10"),
une unité de soupape de sécurité de gaz (19) assignée au conduit de gaz (16) pour ouvrir ou fermer le conduit de gaz (16),
un modulateur d'écoulement de gaz (18) ou un régulateur d'écoulement de gaz (28) assigné au conduit de gaz (16) pour maintenir constant un ratio de mélange de gaz et d'air du mélange gaz/air défini sur la plage de modulation de l'appareil à brûleur à gaz, et
un capteur de pression absolue (21) positionné entre l'unité de soupape de sécurité de gaz (19) et le dispositif de mélange (25),
le dispositif de commande (26) étant en outre configuré pour déterminer la résistance à l'écoulement d'air de l'appareil à brûleur à gaz (10, 10', 10") en exécutant les étapes suivantes avant que la combustion ne démarre en liaison avec un démarrage de brûleur :

recevoir une première pression absolue en provenance du capteur de pression absolue (21) mesurée lorsque l'unité de soupape de sécurité de gaz (19) est fermée et lorsque le ventilateur (14) est arrêté,
recevoir une deuxième pression absolue en provenance du capteur de pression absolue (21) mesurée lorsque l'unité de soupape de sécurité de gaz (19) est fermée et lorsque le ventilateur (14) est en marche,
déterminer une différence de pression entre la première pression absolue et la deuxième pression absolue,
déterminer, sur la base de la différence de pression,

la résistance à l'écoulement d'air de l'appareil à brûleur à gaz (10, 10', 10") de telle sorte que la résistance à l'écoulement d'air de l'appareil à brûleur à gaz (10, 10', 10") soit déterminée à partir de la différence de pression sur la base d'une carte caractéristique ou d'une courbe caractéristique, ou
la résistance à l'écoulement d'air de l'appareil à brûleur à gaz (10, 10', 10") est déterminée à partir d'un débit massique d'air sur la base d'une carte caractéristique ou d'une courbe caractéristique, le débit massique d'air étant déterminé par la mesure d'une température ambiante, en déterminant à partir de la première pression absolue et de la température ambiante une densité d'air et en déterminant à partir de la densité d'air et de la différence de pression le débit massique d'air.

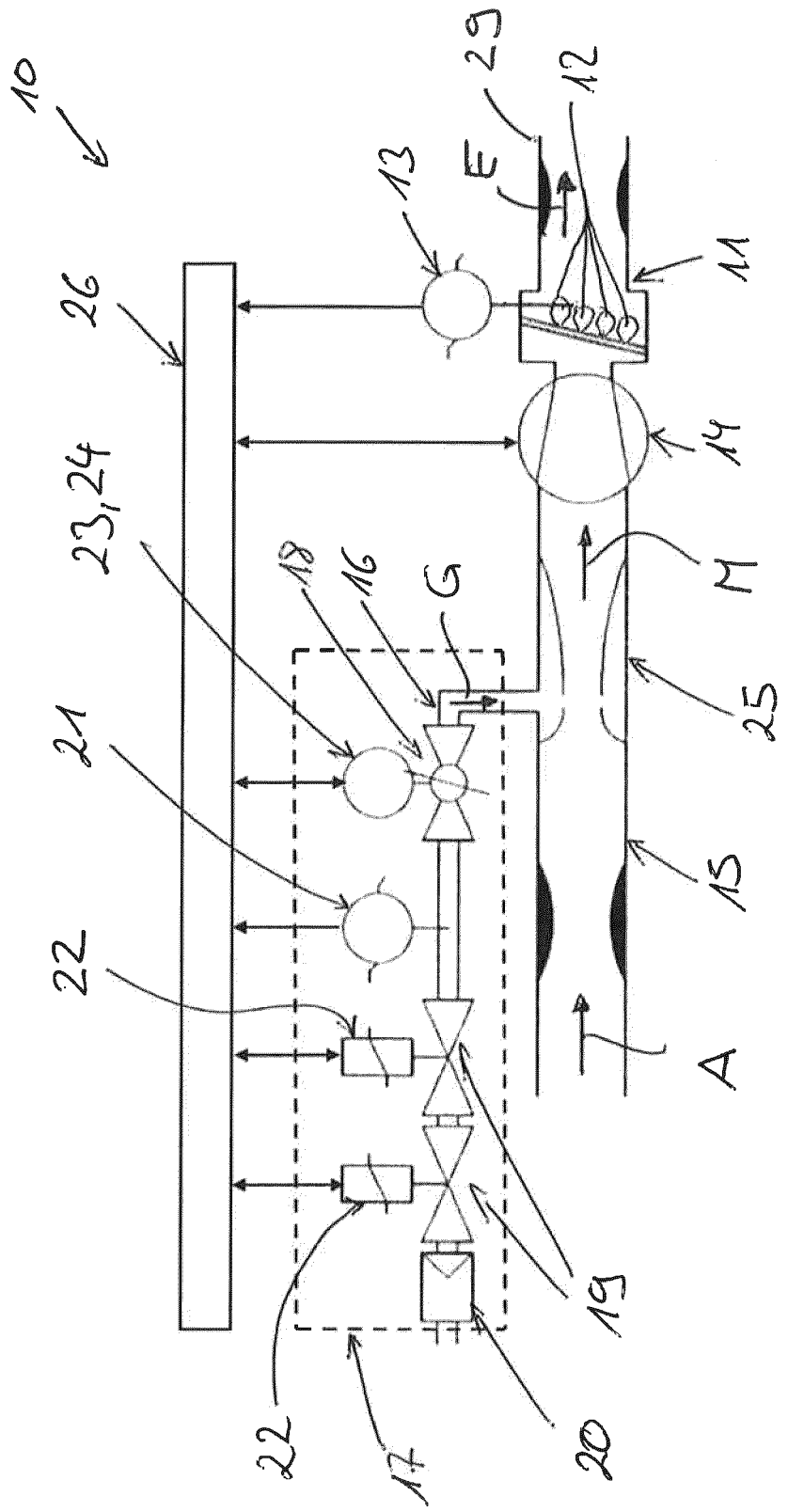

Fig.1

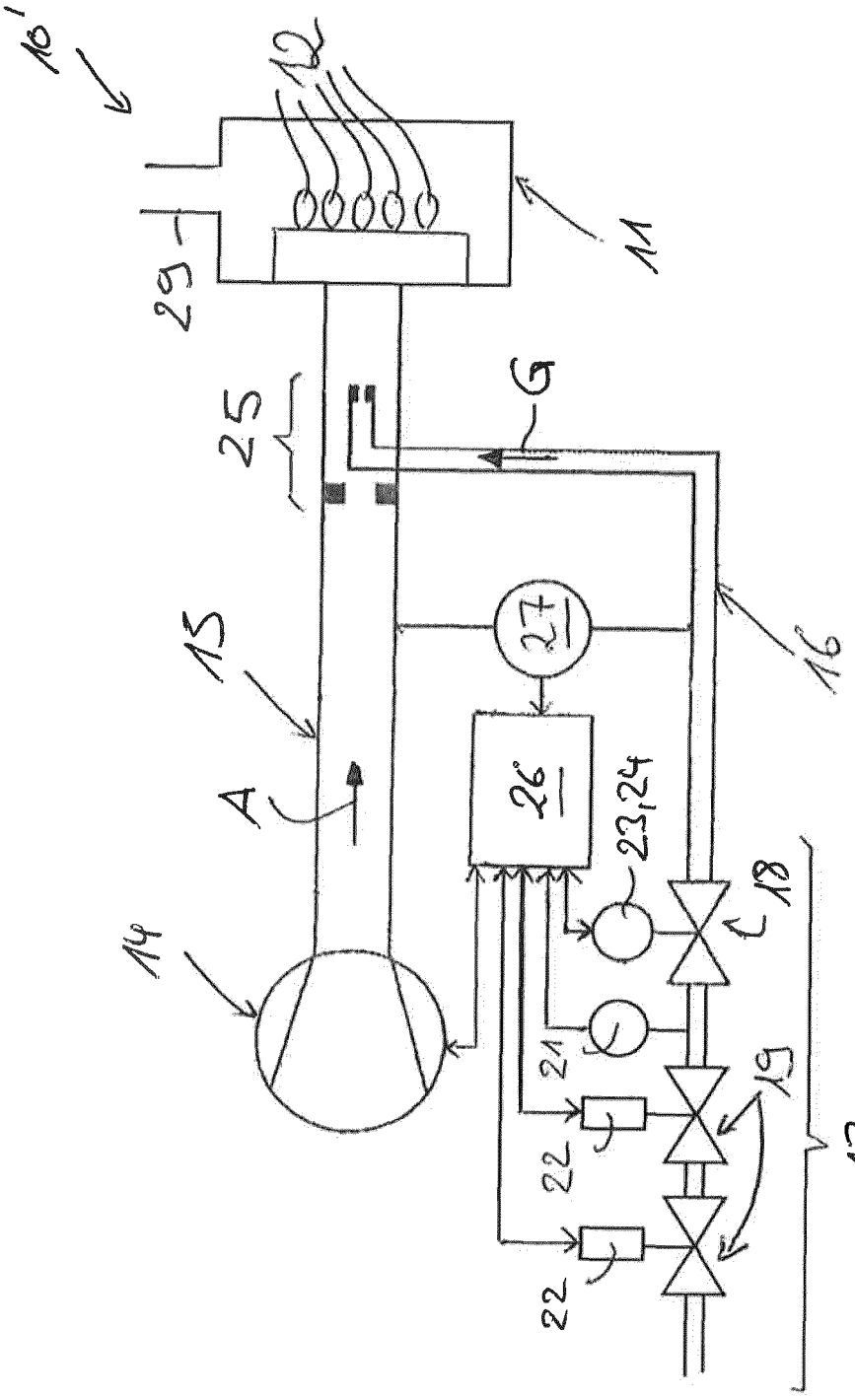

Fig. 2

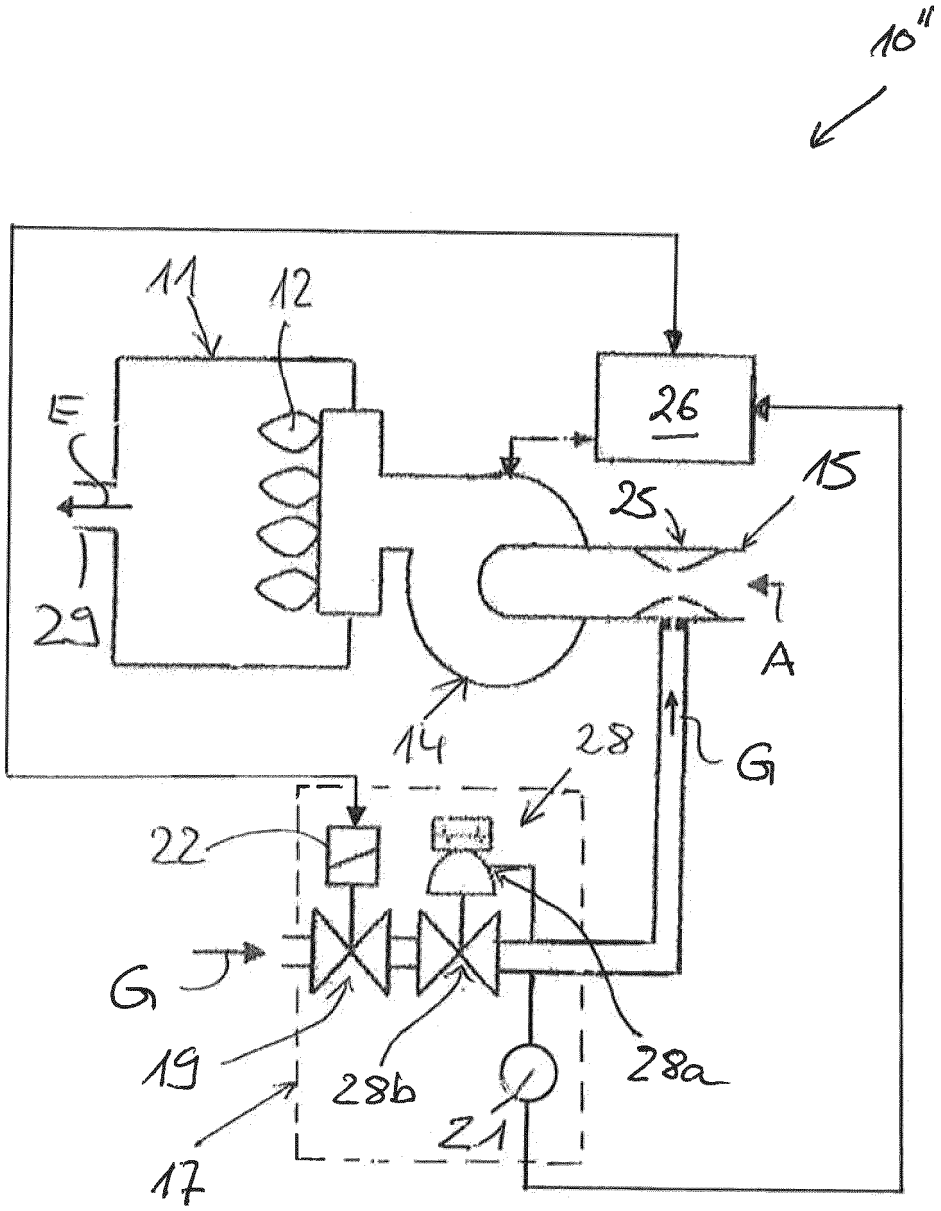

Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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