

(19)



(11)

EP 2 971 964 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

29.11.2017 Bulletin 2017/48

(51) Int Cl.:

F23N 5/12 (2006.01)

F23N 5/24 (2006.01)

(86) International application number:

PCT/IB2013/051918

(21) Application number: **13731491.0**

(22) Date of filing: **11.03.2013**

(87) International publication number:

WO 2014/140687 (18.09.2014 Gazette 2014/38)

(54) **BURNER COMBUSTION CONTROL METHOD AND DEVICE**

VERBRENNUNGSREGELUNGSVERFAHREN UND VORRICHTUNG FÜR EINEN BRENNER

PROCÉDÉ ET DISPOSITIF DE COMMANDE DE COMBUSTION DE BRÛLEUR

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(43) Date of publication of application:

20.01.2016 Bulletin 2016/03

(73) Proprietor: **Idea S.p.A.**

37049 Villa Bartolomea (Verona) (IT)

(72) Inventors:

- **GIORDANO, Bruno**
37049 Verona (IT)

• **BICEGO, Lorenzo**

30175 Venezia (IT)

• **GIACON, Franco**

35138 Padova (IT)

• **TREVISANATO, Nicola**

30174 Venezia (IT)

(74) Representative: **Lissandrini, Marco**

Bugnion S.p.A.

Via Pancaldo 68

37138 Verona (IT)

(56) References cited:

DE-A1- 19 744 008

DE-A1- 19 820 192

DE-A1-102006 006 964

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 2 971 964 B1

Description

Technical field

[0001] The present invention relates to a method and a device for controlling the combustion of a burner for use in applications in which there is combustion. Such a method and device are known from document DE102006006964 which discloses in combination all the features of the preamble of claim 1 and of claim 15. In particular, the present invention is employed in atmospheric or premix burners. Preferably, the fuel is in a gas or liquid form and is fed to the burner through a supply pipe.

Background art

[0002] In a non-limiting example application, a possible use of the burner according to this invention is in the field of heating boilers.

[0003] In the prior art a known device for controlling the combustion of a burner comprises:

- an on-off and regulating device (preferably a valve) which regulates the fuel feed flow;
- supply means designed to feed a comburent to the burner;
- means for detecting the presence of a flame produced by the burner;
- a control unit connected to the on-off and regulating device and to the comburent feed means and designed to control these devices;

Preferably, the comburent feed means comprise a fan which feeds air. In other words, the comburent preferably comprises air, but could comprise any other type of comburent.

[0004] In particular, it should be noted that the purpose of the control unit is principally that of ensuring non-toxic combustion, that is, combustion which does not produce exhaust gases, such as carbon monoxide, which are harmful to human health. The control system uses an ionization current curve where the curve is defined as a function of the excess air index. It should be noted that the excess air index is widely defined as the ratio between the quantity of comburent air and the quantity of fuel and is indicated with the symbol λ (lambda). The ionization curve is created based on laboratory tests on the burner in a step preceding the installation of the burner at the premises of the final user.

[0005] Thus, once the ionization current curve is known, the ionization current value can be measured (using the measurement instrumentation) during the operation of the burner and then compared with a preset threshold value (on the control unit) in such a way as to control the combustion.

[0006] However, the ionization current curve is substantially bell-shaped and there are therefore two differ-

ent values for one ionization current value. In particular, one of the values is for an excess air index greater than 1 (combustion without harmful gases) while the other is the value for an excess air index less than 1 (combustion with generation of harmful gases). During combustion, it is therefore necessary to control that part of the curve which is the one which ensures an excess air index greater than 1.

[0007] Various methods exist for this type of control. Many of these are based on the SCOT method as described in prior patents/patent applications US5924859 and WO2011/117896. In practice, this control method consists of periodically running a test routine during boiler operation to check if the excess air index value is greater than or less than 1. More specifically, the check routine involves increasing or decreasing the flow of comburent air or fuel and then measuring the corresponding variation of the flame ionization current to check if this increases or decreases; this makes it possible to obtain the curve slope and as a result the operating condition of the burner. For example, this routine involves regulating the ventilation means in such a way as to reduce the air flow and, as a result, the excess air index. If the reduction corresponds to a reduction of the ionization current value, this means that the burner is generating harmful gases. If, on the other hand, the reduction of the air flow corresponds to an increase of the ionization current value, this means that the burner is operating in the "good" zone (i. e. in the zone where harmful gases are not generated).

[0008] However, this known technology has certain drawbacks.

[0009] In practice, this control method requires a lengthy procedure for calibrating the flame ionization current detector in relation to the geometry of the burner in order to construct the flame ionization current curve which will then be used for the check routine.

[0010] Moreover, this method requires a very well-designed burner and a high-precision detector in order to operate correctly. Clearly, burner construction and detector precision are two factors influencing the overall costs of the control device.

[0011] Furthermore, the efficiency of this method is influenced by the ageing and/or deterioration of the detector and of the components, by the length of the discharge tubes, and by the presence of elements that obstruct the discharge tube which modify the actual trend of the ionization current curve with respect to the theoretical trend (normally calculated in a laboratory) and based on which the check is performed.

[0012] Thus, said solution is very sensitive and easily influenced by external factors.

Description of the invention

[0013] In view of this background, the purpose of the present invention is to provide a method and a device for controlling the combustion of a burner which overcome the aforementioned drawbacks.

[0014] The purpose of this invention is to provide a method and a device for controlling the combustion of a burner which are capable of adapting the combustion parameters of the burner as a function of the characteristic features of the system and of the components used.

[0015] An additional purpose of the present invention is to provide a method and a device for controlling the combustion of a burner which take into consideration any variations over time of variable combustion parameters.

[0016] A further purpose of this invention is to provide a method and a device for controlling the combustion of a burner which adapts itself to the variations over time of the combustion parameters.

[0017] The purposes indicated are substantially achieved by a method and a device for controlling the combustion of a burner as described in the claims herein.

Brief description of the drawings

[0018] Other features and advantages of the invention are more apparent in the detailed description below, with reference to a non-limiting and non-exclusive preferred embodiment of a method and a device for controlling the combustion of a burner as illustrated in the accompanying drawings, in which:

- Figure 1 is the theoretical curve showing the ionization current value as a function of the excess air index value;
- Figure 2 shows a device for controlling the combustion of a burner fitted in a boiler according to the present invention;
- Figure 3 is a block diagram of the method for controlling the burner according to the present invention.

Detailed description of the preferred embodiments of the invention

[0019] With reference to Figure 3, the method for controlling the combustion of a burner 1 comprises at least a step for igniting the burner 1.

[0020] The step for igniting the burner 1 in turn comprises a first sub-step of feeding a predetermined quantity of comburent to the burner 1. The predetermined quantity of comburent is fed to the burner 1 by means of comburent feed means 2.

[0021] As already mentioned, the comburent is preferably air and the comburent feed means 2 comprise a fan 14.

[0022] In particular, the step of feeding a predetermined quantity of comburent to the burner 1 comprises switching on the comburent feed means 2 and at least keeping these switched on for a predetermined period of initial time (also called pre-ventilating time) before feeding fuel to the burner 1 in such a way as to clean the air space surrounding the burner 1.

[0023] The predetermined initial time varies as a function of the characteristic features of the combustion

chamber in which the burner is inserted. In particular, the predetermined initial time is usually specified by the manufacturer of the equipment in which the burner is used.

[0024] The step of igniting the burner 1 in turn comprises a second sub-step in which the means for igniting the flame 4 during the next step are activated. These igniting means are designed to light the flame 4 on the burner 1.

[0025] Preferably, the method comprises monitoring and controlling of the energy of the igniting means in order to optimize the lighting. Preferably, the igniting means comprises a system (of known type and not part of this invention) for generating a spark.

[0026] In particular, in the specific and particular case of spark ignition, the energy of the igniting means is controlled by acting on the main characteristics of frequency, voltage and duration of the spark.

[0027] In addition, the ignition of the burner 1 comprises a third sub-step which comprises feeding a fuel to the burner 1 through a fuel supply pipe 3.

[0028] The step of feeding the fuel is implemented by increasing the flow of the fuel starting with a predetermined starting value. Preferably, the predetermined starting value of feeding the fuel is equal to zero.

[0029] In particular, the fuel flow is increased until the flame 4 is triggered in such a way as to ignite the burner 1. At this point, it is possible to switch off the flame 4 ignition means.

[0030] Moreover, the method comprises a step implemented once the fuel has been ignited of testing if fuel flow ignition value, which caused the ignition of the burner 1, falls within a range of reference values. The testing step in turn comprises two sub-steps:

- a first sub-step which comprises checking if the flow ignition value falls within a range of historical reference values;
- a second sub-step which comprises checking if the flow ignition value falls within a range of theoretical reference values.

[0031] In particular, the first sub-step comprises comparing the flow ignition value with the flow ignition values saved in a memory register 5 used for saving fuel parameters during the previous ignition steps. This first sub-step comprises the following operations:

- calculating the average of the flow ignition values saved in the memory register 5 used for saving fuel parameters during the previous ignition steps;
- determining an interval of historical reference values as a percentage of the average value added to and subtracted from the average value;
- comparing the flow ignition value with the predetermined interval of historical reference values in such a way as to check if flow ignition value falls within the interval of historical values.

[0032] In particular, the step of checking if the flow ignition value falls within the interval of historical values comprises the sub-step of generating a warning signal 6, 7 if the fuel flow ignition value is outside the interval of historical values.

[0033] It should be noted that the sub-step of comparing the flow ignition value with the interval of theoretical values is implemented following the sub-step of comparing the flow ignition value with the historical flow ignition values. In particular, the range of reference values comprises the interval of historical reference values and the interval of theoretical reference values.

[0034] In other words, the method comprises checking if the flow ignition value falls within a range of reference values provided by an algorithm for calculating fuel flow based on the history of the previous ignitions and on theoretical parameters.

[0035] Lastly, if the fuel flow ignition value falls within the range of reference values, the method comprises saving the fuel flow value in a memory register 5 used for saving fuel parameters and substantially keeping the fuel flow equal to the flow ignition value for at least a subsequent period of combustion time.

[0036] In other words, once the flame is lit, the method comprises saving the fuel flow ignition value (measured or calculated) which caused the ignition of the burner 1, in a memory register 5 used for saving fuel parameters. Moreover, the method also comprises saving, in the memory register 5 used for saving fuel parameters, the following values:

- the combustent flow value (indirectly measured or calculated);
- the ignition time;
- the number of attempts needed to perform the ignition.

[0037] Moreover, the method comprises checking, following the ignition of the fuel, if each of the abovementioned values falls within a respective range of reference values in the same way as the flow ignition value.

[0038] Once the request generated by the need to generate thermal energy is complete (after which the burner is ignited), the burner 1 is switched off in such a way as to complete an operating cycle of the burner. In effect, the operation of the burner 1 comprises a plurality of consecutive ignitions (each upstream of a respective cycle) of the burner 1 based on the need for heat requested by a user.

[0039] In detail, the sub-step of comparing the flow ignition value with the flow ignition values saved in the memory register 5 used for saving fuel parameters during the previous ignition steps, comprises:

- calculating the average of the flow ignition values saved in the memory register 5 used for saving fuel parameters during the previous ignition steps;
- determining an interval of historical reference values

as a percentage of the average value added to and subtracted from the average value (the range of reference values comprising the interval of historical reference values);

- comparing the flow ignition value with the predetermined interval of historical reference values in such a way as to check if the flow ignition value falls within the interval of historical values.

[0040] In other words, the predetermined percentage value is added to and subtracted from the average value calculated in such a way as to define an interval of historical values within which the fuel flow ignition value must fall.

[0041] In particular, if the fuel flow ignition value is outside (i.e. does not fall within) this interval of historical values, the method comprises generating a warning signal 6, 7.

[0042] Preferably, the step of determining the range of values comprises determining a first sub-interval of historical values and a second sub-interval of historical values which is greater than the first. For example, the first sub-interval of historical values is calculated based on a greater percentage (of the average of the flow ignition values saved in the memory register 5 used for saving fuel parameters of the fuel) than the percentage based on which the second sub-interval of historical values is calculated.

[0043] Thus, the sub-step of generating the warning signal comprises generating a first warning signal 6 if the fuel flow ignition value is outside the first range and of generating a second warning signal 7 if the fuel flow ignition value is outside the second range. In detail, the generation of the first warning signal 6 may comprise a step of resetting the burner 1 because the current flow ignition value is still not yet far enough away from the average of the fuel flow ignition values saved in the memory register 5 used for saving fuel parameters of the fuel.

[0044] Moreover, the step of increasing the fuel flow until the flame 4 is ignited comprises a first sub-step of detecting the presence of the flame 4 using detection means 8 located at the position of the flame 4. In addition, the step of increasing the fuel flow comprises a second sub-step of transmitting the information relating to the presence of flame 4 to a control unit 12 controlling the fuel flow to keep the flow ignition value fixed. It should be noted that the control unit is connected to on-off and regulating means 9 (preferably a regulator valve) controlling the quantity of fuel flowing in the related supply pipe 3 to reach the burner 1.

[0045] Moreover, the detection means 8 are designed to detect a combustion value representing combustion quality. Preferably, the combustion value is defined by the flame 4 ionization current. In other words, the detection means detect the flame ionization current value. In an alternative embodiment, the combustion value is defined by the flame ionization current and/or by other parameters representing combustion quality. For example,

the parameters representing combustion quality are: the temperature of the flame and/or the composition of its light emission spectrum and/or the composition of the ionized plasma and/or the residual combustion products.

[0046] Following the detection of the combustion value, the method comprises a step of comparing the combustion value detected with the historical flame 4 values saved in a memory register 10 used for saving flame values during the previous lighting steps, in such a way as to check if the combustion value falls within an interval of reference values the same way as for the fuel flow ignition value. The method comprises a subsequent step of saving the combustion value detected in a memory register 10 for saving flame values of the current if the combustion value falls within the interval of historical reference values.

[0047] In particular, the step of comparing the combustion value detected with the flame ionization values saved in the memory register 10 for saving flame values comprises the sub-steps of:

- calculating the average of the historical flame ionization current values saved in the memory register 10 for saving flame values following the previous lighting steps;
- determining the interval of historical flame values as a percentage of the average value added to and subtracted from the average value.

[0048] Moreover, the step of checking if the flame ionization current value falls within an interval of historical flame values comprises the sub-step of generating a warning signal if the flame ionization current value is outside the interval historical flame values.

[0049] In addition, following the step of checking if the flame ionization current value falls within an interval of historical flame values, the method comprises checking if the combustion value falls within an interval of theoretical flame values as a function of the characteristic features of the burner, of the fuel and of the comburent.

[0050] In particular, the method comprises a step of calculating a theoretical curve 11 representing the combustion value as a function of the excess air index value. The calculation step is performed in a laboratory before the installation of the burner 1 at the premises of the final user.

[0051] Lastly, the method comprises a step of detecting the theoretical flame value on the theoretical curve 11 corresponding to the fuel flow ignition value which caused the ignition of the burner 1.

[0052] In particular, the combustion value detected by the detection means 8 is compared with an interval of theoretical values as a function of the theoretical flame value on the theoretical curve 11 corresponding to the fuel flow ignition value. Furthermore, the interval of theoretical values is determined as a percentage of the theoretical flame value added to and subtracted from the theoretical flame value.

[0053] Moreover, the method comprises a step of generating a correction signal 13 if the combustion value departs from the interval of theoretical values. This correction signal 13 represents the difference between the theoretical value and the flame value detected for a pre-determined quantity of fuel.

[0054] It should be noted that the step of comparing the combustion value detected with a theoretical curve representing the theoretical combustion value is performed after a period of stabilization of the flame. In effect, to perform the comparison (between the ionization current value and the theoretical curve), the measured ionization current value, which is detected after the stabilization period, must be available.

[0055] Moreover, the method comprises a correction step (implemented after the step of comparing the ionization current value with the theoretical curve representing the ionization current value) which comprises modifying the fuel flow to the burner as a function of the contents of the correction signal 13 generated. It should be noted that the modification of the fuel flow to the burner as a function of the contents of the correction signal 13 generated is applied to the entire range of burner powers, where the expression "range of powers" means the plurality of fuel flow values corresponding to the different requests for heat by the user.

[0056] Figure 1 shows a graph of the trend of the theoretical curve 11 representing the ionization current value as a function of the excess air index value.

[0057] In practice, the implementation of the method according to this invention comprises directly or indirectly measuring a group of values (flame signal, fuel flow, comburent flow) defining a vector of values and comparing them with respective historical values saved in the historical memory registers to check the consistency of said values measured with the history of the ignitions, and with respective theoretical values. Following this comparison, the method comprises correcting the values measured where necessary.

[0058] A further part of this invention is a device for controlling the combustion of a burner 1 for implementing the method according to claim 1. This device comprises:

- on-off and regulating means 9 mounted along the supply pipe 3 for regulating the fuel flow. Preferably, on-off and regulating means 9 comprise a regulator valve;
- supply means 2 for feeding comburent towards the burner 1; Preferably, the comburent comprises air and the feed means 2 comprise a fan 14;
- flame 4 ignition means connected during use with the burner 1;
- detection means 8 for detecting the presence of a flame 4 connected to the burner 1 to detect the presence of flame 4;
- a control unit 12 connected to the on-off and regulating means 9, to the flame 4 ignition means, to the comburent feed means 2 and to the detection means

8.

[0059] Preferably, the detection means 8 for detecting the flame 4 comprise a probe with an electrode (of known type) for detecting the flame 4 ionization current.

[0060] In particular, the control unit 12 is designed to perform the steps of the control method as described herein. In detail, the control unit 12 is designed to:

- activate the comburent feed means 2 and thereby feed comburent to the burner;
- activate the flame 4 ignition means;
- regulate the opening of the on-off and regulating means 9 from an initial position towards an open position thereby increasing the fuel flow;
- detect the ignition of the flame 4 using of the detection means 8;
- check if the fuel flow ignition value, which caused the ignition of the burner 1, falls within a range of reference values;
- maintain the position reached by the on-off and regulating means 9 fixed for at least a period of combustion time so as to keep the fuel flow ignition value fed to the burner 1, which caused the ignition of the burner 1, fixed for this period;
- if the fuel flow ignition value falls within the range of reference values, save the fuel flow value in a memory register 10 used for saving flame values.

[0061] Figure 2 shows the device according to the present invention. It should be noted that the control unit 12 is designed to manage saving the excess air index and fuel flow ignition values in the respective memory registers 5, 10.

[0062] In particular, the control unit 12 comprises a first sub-unit 12a and a second sub-unit 12b. The first sub-unit 12a is designed to control the on-off and regulating means 9 (valve) and to control the comburent feed means 2 (fan 14).

[0063] The second sub-unit 12b is designed to receive the results of the comparisons between the fuel flow ignition value and the historical flow ignition values saved in the memory register 5. Moreover, the second sub-unit 12b is designed to compare the fuel flow ignition value with the respective predetermined theoretical values. Thus, the second sub-unit 12b is designed to transmit the correction signal to the first sub-unit 12a if the control of the fuel and/or comburent flow must be corrected.

[0064] This invention fulfils the purposes outlined above.

[0065] In particular, this invention ensures igniting the burner at an excess air index greater than 1 and thereby prevents operation in the zone for generating harmful gases. In effect, ignition occurs during the gradual increase of the fuel flow which allows decreasing the excess air index value by a theoretically infinite value towards the part of the curve with an excess air index greater than one and representing the ionization current.

[0066] In particular, this method takes advantage of the natural principle of lighting the flame when the ratio between air and fuel is optimal. Thus, the flame is always lit at the part of the ionization current curve for which the excess air index value is greater than 1. Figure 1 indicates, by way of example, a possible ignition point PA of the burner along the ionization current curve.

[0067] Moreover, ignition occurs with a variable quantity of fuel as a function of the actual conditions of the burner and of the variations over time of the combustion parameters. For example, the ageing of the burner will result in ignition with a greater or lesser fuel flow value with respect to the historic one. Thus, the control of the burner 1 is self-adaptive as a function of the changes influencing combustion.

[0068] However, the device checks, in any case, the fuel flow ignition values and the flame ionization current values detected with a range predetermined by the historical ignition values and with an operating margin calculated with reference to the predetermined theoretical laboratory values in such a way as to be able to modify, where necessary, the fuel flow as a function of a correction factor detected.

[0069] In other words, this invention enables identification and learning of the characteristic features of the burner and of the components used and adapts the combustion parameters accordingly.

[0070] Moreover, this invention provides a method and a device for controlling the combustion of a burner which automatically recognize the type of comburent in use and adapt the combustion parameters accordingly. In effect, once the fuel flow, comburent flow and flame values are measured, it is possible to deduce the type of fuel used by the burner.

[0071] Thus, this invention solves the technical problem initially mentioned.

[0072] It should also be noted that this invention is relatively easy to produce and that even the cost linked to implementation of the invention is not very high.

Claims

1. A method for controlling the combustion of a burner (1), comprising:

- at least one step of igniting the burner (1) where the step of igniting the burner (1) comprising the following sub-steps:
 - feeding a predetermined quantity of comburent to the burner (1);
 - activating flame igniting means (4) in order to light the flame (4) during the following step;
 - feeding a fuel to the burner (1) through a fuel supply pipe (3); the step of feeding the fuel being implemented by increasing the flow of the fuel starting with a predetermined starting value;
 - increasing the fuel flow until the flame (4) is

ignited so as to light the burner (1); said step of increasing the fuel flow comprising the following sub-steps:

- detecting the presence of the flame (4) using detection means (8) located at the position of the flame (4); said detection means (8) being designed to generate a combustion value representing the combustion quality detected;
- transmitting the information relating to the presence of flame (4) to a control unit (12) for controlling the fuel flow to substantially keep the fuel flow value equal to the fuel flow ignition value;

- testing if the fuel flow ignition value which ignites the burner (1), falls within a range of reference values;
- if the fuel flow ignition value falls within the range of reference values, saving the fuel flow value in a memory register (5) used for saving fuel parameters and substantially keeping the fuel flow equal to the flow ignition value for at least a period of combustion time subsequent to ignition;

characterized in that it comprises a step of checking if the combustion value falls within an interval of reference values; the method comprising a step of saving the combustion value detected in a memory register (10) for saving flame values of the flame if the combustion value falls within the interval of reference values.

2. The method according to claim 1, **characterized in that** the step of testing if the fuel flow ignition value falls within a range of reference values comprises a sub-step of comparing the fuel flow ignition value with the flow ignition values saved in the memory register (5) used for saving fuel parameters during the preceding ignition steps.

3. The method according to claim 2, **characterized in that** the sub-step of comparing the fuel flow ignition value with the flow ignition values saved in the memory register (5) used for saving fuel parameters during the previous ignition steps, comprises the following operations:

- calculating the average of the fuel flow ignition values saved in the memory register (5) used for saving fuel parameters during the previous ignition steps;
- determining an interval of historical reference values as a percentage of the average value added to and subtracted from the average value; the range of reference values comprising the in-

terval of the historical reference values;

- comparing the fuel flow ignition value with the predetermined interval of historical reference values in such a way as to test if the fuel flow ignition value falls within the interval of historical values.

4. The method according to claim 3, **characterized in that** the step of checking if the fuel flow ignition value falls within the interval of historical values comprises the sub-step of generating a warning signal (6), (7) if the fuel flow ignition value is outside the interval of historical values.

5. The method according to claim 4, **characterized in that** the step of determining the interval of historical reference values comprises determining a first sub-interval of historical reference values and a second sub-interval of historical reference values greater than the first sub-interval; the sub-step of generating the warning signal comprises generating a first warning signal (6) if the fuel flow ignition value is outside the first sub-interval, and of generating a second warning signal (7) if the fuel flow ignition value is outside the second sub-interval.

6. The method according to any one of the preceding claims, **characterized in that** the step of checking if the fuel flow ignition value falls within a range of reference values comprises a sub-step of comparing the fuel flow ignition value with an interval of theoretical values as a function of the predetermined theoretical flow ignition values as a function of the characteristic features of the burner, of the fuel and of the comburent; the range of reference values comprising the interval of theoretical reference values.

7. The method according to any one of the preceding claims, **characterized in that** the step of checking if the combustion value falls within an interval of reference values comprises a sub-step of comparing the combustion value with the historical flame values saved in the memory register (10) used for saving flame values during the previous ignition steps.

8. The method according to claim 7, **characterized in that** the sub-step of comparing the combustion value with the historical flame values saved in the memory register (10), comprises the following operations:

- calculating the average of the historical flame values saved in the memory register (10) for saving flame values of flame following the previous ignition steps;
- determining the interval of historical flame values as a percentage of the average value added to and subtracted from this average value.

9. The method according to any one of the preceding claims, **characterized in that** the step of checking if the combustion value falls within an interval of historical values comprises the sub-step of generating a warning signal if the combustion value (4) is outside this interval of values. 5
10. The method according to any one of the preceding claims, **characterized in that** the step of checking if the combustion value falls within an interval of reference values comprises a sub-step of checking if the combustion value falls within an interval of theoretical flame values as a function of the characteristic features of the burner, of the fuel and of the comburent. 10 15
11. The method according to any one of the preceding claims, **characterized in that** it comprises a step of calculating a theoretical curve (11) representing the combustion value as a function of the excess air index value. 20
12. The method according to claim 11, **characterized in that** it comprises a step of detecting the theoretical flame value on the theoretical curve (11) corresponding to the fuel flow ignition value which caused the ignition of the burner (1); the combustion value detected by the detection means (8) being compared with an interval of theoretical values as a function of the theoretical flame value on the theoretical curve (11) corresponding to the fuel flow ignition value. 25 30
13. The method according to claim 12, **characterized in that** the interval of theoretical values is determined as a percentage of the theoretical flame value added to and subtracted from the theoretical flame value. 35
14. The method according to claim 12 or claim 13, **characterized in that** it comprises: 40
- a step of generating a correction signal (13) if the combustion value departs from the interval of theoretical values; the correction signal (13) representing the difference between the theoretical value and the flame value detected for a predetermined quantity of fuel; 45
 - a correction step which comprises modifying the fuel flow to the burner as a function of the contents of the correction signal (13) generated. 50
15. A device for controlling the combustion of a burner (1), for implementing the method according to claim 1 above, comprising:
- on-off and regulating means (9) mounted along the supply pipe (3) for regulating the fuel flow towards the burner (1); 55
 - supply means (2) for feeding comburent to-

wards the burner (1);

- flame (4) ignition means connected during use with the burner (1);
- detection means (8) for detecting the presence of a flame (4) connected to the burner (1) and located at the position of the flame (4) to detect the presence of flame (4); said detection means (8) being designed to generate a combustion value representing the combustion quality detected;
- a control unit (12) connected to the on-off and regulating means (9), to the flame (4) ignition means, to the comburent feed means (2) and to the detection means (8);

said control unit (12) being designed to:

- activate the comburent feed means (2) and thereby feed comburent to the burner;
- activate the flame (4) ignition means;
- regulate the opening of the on-off and regulating means (9) from an initial position towards an open position thereby increasing the fuel flow;
- detect the ignition of the flame (4) using of the detection means (8);
- transmitting the information relating to the presence of flame (4) to a control unit (12) for controlling the fuel flow to substantially keep the fuel flow value equal to the fuel flow ignition value;
- check if the fuel flow ignition value, which caused the ignition of the burner (1), falls within a range of reference values;
- maintain the position reached by the on-off and regulating means (9) fixed for at least a period of combustion time so as to keep the fuel flow ignition value fed to the burner (1), which caused the ignition of the burner (1), fixed for this period;
- if the fuel flow ignition value falls within the range of reference values, save the fuel flow value in a memory register (10) used for saving flame values;

characterized in that the control unit is further designed to:

- check if the combustion value falls within an interval of reference values;
- save the combustion value detected in a memory register (10) for saving flame values of the flame if the combustion value falls within the interval of reference values.

Patentansprüche

1. Verbrennungsregelungsverfahren eines Brenners (1), umfassend:

- mindestens einen Schritt des Zündens des Brenners (1), wobei der Schritt des Zündens des Brenners (1) die folgenden Teilschritte umfasst:
- Zuführen einer vorbestimmten Menge an Brennstoff zum Brenner (1);
- Aktivieren vom Flammzündmittel (4), um die Flamme (4) während des folgenden Schritts zu entzünden;
- Zuführen eines Kraftstoffs zum Brenner (1) durch eine Kraftstoffversorgungsleitung (3); wobei der Schritt des Zuführens des Kraftstoffs durch Erhöhen des Kraftstoffdurchflusses, der mit einem vorbestimmten Startwert beginnt, durchgeführt wird;
- Erhöhen des Kraftstoffdurchflusses, bis die Flamme (4) gezündet wird, um den Brenner (1) zu entzünden;

wobei der Schritt des Erhöehens des Kraftstoffdurchflusses die folgenden Teilschritte umfasst:

- Erfassen des Vorhandenseins der Flamme (4) unter Verwendung von Erfassungsmitteln (8), die sich an der Position der Flamme (4) befinden; wobei die Erfassungsmittel (8) so ausgelegt sind, dass sie einen Verbrennungswert erzeugen, der die erfasste Verbrennungsqualität darstellt;
- Übertragen der Information in Bezug auf das Vorhandensein der Flamme (4) zu einer Regelungseinheit (12) zur Regelung des Kraftstoffdurchflusses, um den Kraftstoffdurchflusswert im wesentlichen dem Kraftstoffdurchflusszündwert gleich zu behalten;
- Prüfen, ob der Kraftstoffdurchflusszündwert, der den Brenner (1) zündet, innerhalb eines Bereichs von Referenzwerten fällt;
- Fällt der Kraftstoffdurchflusszündwert innerhalb des Bereichs von Referenzwerten, dann Speichern des Kraftstoffdurchflusswerts in einem Speicherregister (5), der zur Speicherung der Kraftstoffparameter verwendet wird, und im wesentlichen Behalten des Kraftstoffdurchflusses gleich dem Durchflusszündwert für mindestens einen Zeitraum von Verbrennungszeit nach der Zündung;

dadurch gekennzeichnet, dass es einen Schritt des Überprüfens umfasst, ob der Verbrennungswert innerhalb eines Intervalls von Referenzwerten fällt; wobei das Verfahren einen Schritt des Speicherns des erfassten Verbrennungswertes in einem Speicherregister (10) zur Speicherung der Flammwerte der Flamme umfasst, wenn der Verbrennungswert innerhalb eines Intervalls von Referenzwerten fällt.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** der Schritt des Prüfens, ob der Kraft-

stoffdurchflusszündwert innerhalb eines Bereichs von Referenzwerten fällt, einen Teilschritt des Vergleichens des Kraftstoffdurchflusszündwertes mit den Durchflusszündwerten umfasst, die im Speicherregister (5) gespeichert wurden, das zur Speicherung der Kraftstoffparameter während der vorhergehenden Zündschritte verwendet wurde.

3. Verfahren nach Anspruch 2, **dadurch gekennzeichnet, dass** der Teilschritt des Vergleichens des Kraftstoffdurchflusszündwertes mit den Durchflusszündwerten, die im Speicherregister (5) gespeichert wurden, das zur Speicherung der Kraftstoffparameter während der vorhergehenden Zündschritte verwendet wurde, die folgenden Operationen umfasst:

- Berechnen des Mittelwerts der Kraftstoffdurchflusszündwertes, die im Speicherregister (5) gespeichert wurden, das zur Speicherung der Kraftstoffparameter während der vorhergehenden Zündschritte verwendet wurde;
- Bestimmen eines Intervalls von historischen Referenzwerten als Prozentsatz des Mittelwertes, der dem Mittelwert addiert und von diesem subtrahiert wird;

wobei der Bereich der Referenzwerte das Intervall der historischen Referenzwerte umfasst;

- Vergleichen des Kraftstoffdurchflusszündwertes mit dem vorgegebenen Intervall historischer Referenzwerte, um zu prüfen, ob der Kraftstoffdurchflusszündwert innerhalb des Intervalls der historischen Werte fällt.

4. Verfahren nach Anspruch 3, **dadurch gekennzeichnet, dass** der Schritt des Überprüfens, ob der Kraftstoffdurchflusszündwert innerhalb des Intervalls von historischen Werten fällt, den Teilschritt des Erzeugens eines Warnsignals (6), (7) umfasst, wenn der Kraftstoffdurchflusszündwert ausserhalb des Intervalls der historischen Werte ist.

5. Verfahren nach Anspruch 4, **dadurch gekennzeichnet, dass** der Schritt des Bestimmens des Intervalls von historischen Referenzwerten das Bestimmen eines ersten Unterintervalls von historischen Referenzwerten und eines zweiten Unterintervalls von historischen Referenzwerten umfasst, das grösser als das erste Unterintervall ist; der Teilschritt des Erzeugens des Warnsignals umfasst das Erzeugen eines ersten Warnsignals (6), wenn der Kraftstoffdurchflusszündwert ausserhalb des ersten Unterintervalls ist, und das Erzeugen eines zweiten Warnsignals (7), wenn der Kraftstoffdurchflusszündwert ausserhalb des zweiten Unterintervalls ist

6. Verfahren nach einem der vorhergehenden Ansprü-

che, **dadurch gekennzeichnet, dass** der Schritt des Überprüfens, ob der Kraftstoffdurchflusszündwert innerhalb eines Bereichs von Referenzwerten fällt, einen Teilschritt des Vergleichens des Kraftstoffdurchflusszündwertes mit einem Intervall von theoretischen Werten in Abhängigkeit von der vorgegebenen theoretischen Durchflusszündwertes in Abhängigkeit von den charakteristischen Merkmalen des Brenners, des Kraftstoffs und des Brennstoffs umfasst; wobei der Bereich der Referenzwerte das Intervall der theoretischen Referenzwerte umfasst.

7. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Schritt des Überprüfens, ob der Verbrennungswert innerhalb eines Intervalls von Referenzwerten fällt, einen Teilschritt des Vergleichens des Verbrennungswertes mit den historischen Flammwerten umfasst, die im Speicherregister (10) gespeichert wurden, das zur Speicherung der Flammwerte während der vorhergehenden Zündschritte verwendet wurde.
8. Verfahren nach Anspruch 7, **dadurch gekennzeichnet, dass** der Teilschritt des Vergleichens des Verbrennungswertes mit den historischen Flammwerten, die im Speicherregister (10) gespeichert wurden, die folgenden Operationen umfasst:
 - Berechnen des Durchschnitts der historischen Flammwerte der Flamme, die im Speicherregister (10) zur Speicherung von Flammwerten der Flamme gespeichert wurden, nach den vorherigen Zündschritten;
 - Bestimmen des Intervalls der historischen Flammwerte als Prozentsatz des Mittelwertes, der diesem Mittelwert addiert und von diesem subtrahiert wird.
9. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Schritt des Überprüfens, ob der Verbrennungswert innerhalb eines Intervalls von historischen Werten fällt, den Teilschritt des Erzeugens eines Warnsignals umfasst, wenn der Verbrennungswert (4) ausserhalb dieses Intervalls von Werten ist.
10. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Schritt des Überprüfens, ob der Verbrennungswert innerhalb eines Intervalls von Referenzwerten fällt, einen Teilschritt des Überprüfens umfasst, ob der Verbrennungswert innerhalb eines Intervalls von theoretischen Flammwerten in Abhängigkeit von den charakteristischen Merkmalen des Brenners, des Kraftstoffs und des Brennstoffs fällt.
11. Verfahren nach einem der vorhergehenden Ansprüche,

che, **dadurch gekennzeichnet, dass** es einen Schritt des Berechnens einer theoretischen Kurve (11) umfasst, die den Verbrennungswert in Abhängigkeit vom überschüssigen Luftindexwert darstellt.

12. Verfahren nach Anspruch 11, **dadurch gekennzeichnet, dass** es einen Schritt des Erfassens des theoretischen Flammwerts auf der theoretischen Kurve (11) entsprechend des Kraftstoffdurchflusszündwertes umfasst, der die Zündung des Brenners (1) verursachte; wobei der von der Erfassungsmittel (8) erfasste Verbrennungswert mit einem Intervall theoretischer Werte in Abhängigkeit vom theoretischen Flammwert auf der dem Kraftstoffdurchflusszündwert entsprechenden theoretischen Kurve (11) verglichen wird.
13. Verfahren nach Anspruch 12, **dadurch gekennzeichnet, dass** das Intervall der theoretischen Werte als Prozentsatz des dem theoretischen Flammwert addierten und von diesem subtrahierten theoretischen Flammwerts bestimmt wird.
14. Verfahren nach Anspruch 12 oder 13, **dadurch gekennzeichnet, dass** es umfasst:
 - einen Schritt des Erzeugens eines Korrektursignals (13), wenn der Verbrennungswert vom Intervall der theoretischen Werte abweicht; wobei das Korrektursignal (13) die Differenz zwischen dem theoretischen Wert und dem Flammwert darstellt, der für eine vorbestimmte Kraftstoffmenge erfasst wurde;
 - einen Korrekturschritt, der das Modifizieren des Kraftstoffdurchflusses zum Brenner in Abhängigkeit vom Inhalt des erzeugten Korrektursignals (13) umfasst.
15. Vorrichtung zur Regulierung der Verbrennung eines Brenners (1) zur Implementierung des Verfahrens nach Anspruch 1 von oben, umfassend:
 - Ein/Aus- und Regelmittel (9), die entlang der Versorgungsleitung (3) zur Einstellung des Kraftstoffdurchflusses in Richtung des Brenners (1) montiert sind;
 - Versorgungsmittel (2) zum Zuführen des Brennstoffs in Richtung des Brenners (1);
 - Zündmittel der Flamme (4), die während des Gebrauchs mit dem Brenner (1) verbunden sind;
 - Erfassungsmittel (8) zum Erfassen des Vorhandenseins einer Flamme (4), die mit dem Brenner (1) verbunden sind, und die an der Position der Flamme (4) angeordnet sind; wobei die Erfassungsmittel (8) so ausgelegt sind, dass sie einen Verbrennungswert erzeugen, der die erfasste Verbrennungsqualität darstellt;
 - eine Regelungseinheit (12), die mit den

Ein/Aus- und Regelmitteln (9), mit den Zündmitteln der Flamme (4), mit den Brennstoffzuführungsmitteln (2) und mit den Erfassungsmitteln (8) verbunden ist;

wobei die Regelungseinheit (12) ausgelegt ist, um

- die Brennstoffzuführungsmittel (2) zu aktivieren und dabei dem Brenner Brennstoff zuzuführen;
- die Zündmittel der Flamme (4) zu aktivieren;
- das Öffnen der Ein-Aus- und Regelmittel (9) von einer Ausgangsposition zu einer offenen Position einzustellen, wodurch der Kraftstoffdurchfluss erhöht wird;
- die Zündung der Flamme (4) unter Verwendung von den Erfassungsmitteln (8) zu erfassen;
- die Information in Bezug auf das Vorhandensein der Flamme (4) zu einer Regelungseinheit (12) zur Regelung des Kraftstoffdurchflusses zu übertragen, um den Kraftstoffdurchflusswert im wesentlichen dem Kraftstoffdurchflusszündwert gleich zu behalten;
- zu überprüfen, ob der Kraftstoffdurchflusszündwert, der die Zündung des Brenners (1) verursachte, innerhalb eines Bereichs von Referenzwerten fällt;
- die Position beizubehalten, die durch die Ein-Aus- und Regelmittel (9) erreicht wurde, die mindestens für einen Zeitraum der Verbrennungszeit festgelegt wird, um den dem Brenner (1) zugeführten Kraftstoffdurchflusszündwert, der die Zündung des Brenners (1) verursachte, für diese Zeitdauer festzuhalten;
- Fällt der Kraftstoffdurchflusszündwert innerhalb des Bereichs der Referenzwerte, dann Speichern des Kraftstoffdurchflusszündwerts in einem Speicherregister (10), der zur Speicherung der Flammwerte verwendet wird;

dadurch gekennzeichnet, dass die Regelungseinheit ferner ausgelegt ist, um:

- zu überprüfen, ob der Verbrennungswert innerhalb eines Intervalls von Referenzwerten fällt;
- den erfassten Verbrennungswert in einem Speicherregister (10) zum Speichern der Flammwerte der Flamme zu speichern, wenn der Verbrennungswert innerhalb des Intervalls der Referenzwerte fällt.

Revendications

1. Procédé de commande de combustion d'un brûleur (1), comprenant :

- au moins une étape consistant à allumer le brûleur (1) où l'étape d'allumage du brûleur (1) comprend les sous-étapes suivantes :

- alimenter une quantité prédéterminée de comburant au brûleur (1) ;
- activer des moyens d'allumage de flamme (4) afin d'allumer la flamme (4) lors de l'étape suivante ;
- alimenter en un carburant le brûleur (1) par un tuyau d'alimentation en carburant (3) ; l'étape consistant à alimenter en carburant étant mise en oeuvre en augmentant le débit de carburant en commençant par une valeur de démarrage prédéterminée ;
- augmenter le débit de carburant jusqu'à ce que la flamme (4) s'enflamme de manière à allumer le brûleur (1) ; ladite étape consistant à augmenter le débit de carburant comprenant les sous-étapes suivantes :

- détecter la présence de la flamme (4) en utilisant des moyens de détection (8) situés en correspondance de la position de la flamme (4) ; lesdits moyens de détection (8) étant conçus pour générer une valeur de combustion représentant la qualité de combustion détectée ;
- transmettre les informations relatives à la présence de flamme (4) à une unité de commande (12) servant à commander le débit de carburant pour maintenir substantiellement la valeur du débit de carburant égale à la valeur d'allumage du débit de carburant ;
- tester si la valeur d'allumage du débit de carburant allumant le brûleur (1) est comprise dans une fourchette de valeurs de référence ;
- si la valeur d'allumage du débit de carburant est comprise dans une fourchette de valeurs de référence, enregistrer la valeur de débit de carburant dans un registre de mémoire (5) utilisé pour enregistrer des paramètres de carburant et pour maintenir substantiellement le débit de carburant égal à la valeur d'allumage du débit pendant au moins une période de temps de combustion suite à l'allumage ;

caractérisé en ce qu'il comprend une étape consistant à vérifier si la valeur de combustion est comprise dans un intervalle de valeurs de référence ; le procédé comprenant une étape consistant à enregistrer la valeur de combustion détectée dans un registre de mémoire (10) pour enregistrer les valeurs de flamme de la flamme si la valeur de combustion est comprise dans l'intervalle des valeurs de référence.

2. Procédé selon la revendication 1, **caractérisé en ce que** l'étape consistant à tester si la valeur d'allumage du débit de carburant est comprise dans une fourchette de valeurs de référence comprend une sous-étape consistant à comparer la valeur d'allumage du débit de carburant aux valeurs d'allumage de débit enregistrées dans le registre de mémoire (5) utilisé pour enregistrer des paramètres de carburant durant les étapes d'allumage précédentes.

3. Procédé selon la revendication 2, **caractérisé en ce que** la sous-étape consistant à comparer la valeur d'allumage du débit de carburant aux valeurs d'allumage de débit enregistrées dans le registre de mémoire (5) utilisé pour enregistrer des paramètres de carburant durant les étapes d'allumage précédentes, comprend les opérations suivantes :

- calculer la moyenne des valeurs d'allumage du débit de carburant enregistrées dans le registre de mémoire (5) utilisés pour enregistrer des paramètres de carburant durant les étapes d'allumage précédentes ;
- déterminer un intervalle de valeurs de référence historiques exprimé en pourcentage de la valeur moyenne ajoutée et soustraite à la valeur moyenne ; la fourchette de valeurs de référence comprenant l'intervalle des valeurs de référence historiques ;
- comparer la valeur d'allumage du débit de carburant à l'intervalle prédéterminé de valeurs de référence historiques de manière à tester si la valeur d'allumage du débit de carburant est comprise dans l'intervalle de valeurs historiques.

4. Procédé selon la revendication 3, **caractérisé en ce que** l'étape consistant à vérifier si la valeur d'allumage du débit de carburant est comprise dans l'intervalle des valeurs historiques comprend la sous-étape consistant à générer un signal d'avertissement (6), (7) si la valeur d'allumage du débit de carburant se trouve en dehors de l'intervalle des valeurs historiques.

5. Procédé selon la revendication 4, **caractérisé en ce que** l'étape consistant à déterminer l'intervalle des valeurs de référence historiques comprend la détermination d'un premier sous-intervalle de valeurs de référence historiques et un second sous-intervalle de valeurs de référence historiques supérieur au premier sous-intervalle ; la sous-étape consistant à générer le signal d'avertissement comprend la génération d'un premier signal d'avertissement (6) si la valeur d'allumage du débit de carburant se trouve en dehors du premier sous-intervalle, et la génération d'un second signal d'avertissement (7) si la valeur d'allumage du débit de carburant se trouve en

dehors du second sous-intervalle.

6. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'étape consistant à vérifier si la valeur d'allumage du débit de carburant est comprise dans la fourchette des valeurs de référence comprend une sous-étape consistant à comparer la valeur d'allumage du débit de carburant à un intervalle de valeurs théoriques en fonction de valeurs d'allumage de débit théoriques prédéterminées en fonction des caractéristiques techniques du brûleur, du carburant et du comburant ; la fourchette de valeurs de référence comprenant l'intervalle des valeurs de référence théoriques.

7. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'étape consistant à vérifier si la valeur de combustion est comprise dans un intervalle de valeurs de référence comprend une sous-étape consistant à comparer la valeur de combustion aux valeurs de flamme historiques enregistrées dans le registre de mémoire (10) utilisé pour enregistrer des valeurs de flamme durant les étapes d'allumage précédentes.

8. Procédé selon la revendication 7, **caractérisé en ce que** la sous-étape consistant à comparer la valeur de combustion aux valeurs de flamme historiques enregistrées dans le registre de mémoire (10) comprend les opérations suivantes :

- calculer la moyenne des valeurs de flamme historiques enregistrées dans le registre de mémoire (10) pour enregistrer des valeurs de flamme de flamme suivant les étapes d'allumage précédentes ;
- déterminer l'intervalle des valeurs de flamme historiques exprimé en pourcentage de la valeur moyenne ajoutée et soustraite à cette valeur moyenne.

9. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'étape consistant à vérifier si la valeur de combustion est comprise dans un intervalle de valeurs historiques comprend la sous-étape consistant à générer un signal d'avertissement si la valeur de combustion (4) se trouve en dehors de cet intervalle de valeurs.

10. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'étape consistant à vérifier si la valeur de combustion est comprise dans un intervalle de valeurs de référence comprend une sous-étape consistant à vérifier si la valeur de combustion est comprise dans un intervalle de valeurs de flamme théoriques en fonction des caractéristiques techniques du brûleur, du carburant et du comburant.

11. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'il** comprend une étape consistant à calculer une courbe théorique (11) représentant la valeur de combustion en fonction de la valeur de l'indice d'excès d'air. 5
12. Procédé selon la revendication 11, **caractérisé en ce qu'il** comprend une étape consistant à détecter la valeur de flamme théorique sur la courbe théorique (11) correspondant à la valeur d'allumage du débit de carburant provoquant l'allumage du brûleur (1); la valeur de combustion détectée par les moyens de détection (8) étant comparée à un intervalle de valeurs théoriques en fonction de la valeur de flamme théorique sur la courbe théorique (11) correspondant à la valeur d'allumage du débit de carburant. 10 15
13. Procédé selon la revendication 12, **caractérisé en ce que** l'intervalle des valeurs théoriques est déterminé en pourcentage de la valeur de flamme théorique ajoutée et soustraite à la valeur de flamme théorique. 20
14. Procédé selon les revendications 12 ou 13, **caractérisé en ce qu'il** comprend : 25
- une étape consistant à générer un signal de correction (13) si la valeur de combustion s'écarte de l'intervalle de valeurs théoriques ; le signal de correction (13) représentant la différence entre la valeur théorique et la valeur de flamme détectée pour une quantité prédéterminée de carburant ; 30
 - une étape de correction comprenant la modification du débit de carburant au brûleur en fonction du contenu du signal de correction (13) généré. 35
15. Dispositif de commande de la combustion d'un brûleur (1) servant à mettre en oeuvre le procédé selon la revendication 1 ci-dessus, comprenant : 40
- des moyens à action par tout ou rien et de réglage (9) montés le long du tuyau d'alimentation (3) servant à régler le débit de carburant vers le brûleur (1) ; 45
 - des moyens d'alimentation (2) servant à alimenter le comburant vers le brûleur (1) ;
 - des moyens d'allumage de flamme (4) reliés lors de l'utilisation avec le brûleur (1) ; 50
 - des moyens de détection (8) servant à détecter la présence d'une flamme (4) reliés au brûleur (1) et situés en correspondance de la position de la flamme (4) pour détecter la présence de flamme (4) ; lesdits moyens de détection (8) étant conçus pour générer une valeur de combustion représentant la qualité de combustion 55

détectée ;

- une unité de commande (12) reliée aux moyens à action par tout ou rien et de réglage (9), aux moyens d'allumage de flamme (4), aux moyens d'alimentation en comburant (2) et aux moyens de détection (8) ;

ladite unité de commande (12) étant conçue pour :

- activer les moyens d'alimentation en comburant (2) et par la même alimenter le comburant au brûleur ;
- activer les moyens d'allumage de flamme (4) ;
- régler l'ouverture des moyens à action par tout ou rien et de réglage (9) d'une position initiale vers une position d'ouverture en augmentant par la même le débit de carburant ;
- détecter l'allumage de la flamme (4) en utilisant les moyens de détection (8) ;
- transmettre les informations relatives à la présence de flamme (4) à une unité de commande (12) servant à commander le débit de carburant pour maintenir substantiellement la valeur du débit de carburant égale à la valeur d'allumage du débit de carburant ;
- vérifier si la valeur d'allumage du débit de carburant provoquant l'allumage du brûleur (1) est comprise dans une fourchette de valeurs de référence ;
- maintenir la position atteinte par les moyens à action par tout ou rien et de réglage (9) fixe pendant au moins une période de temps de combustion de manière à maintenir la valeur d'allumage du débit de carburant alimentée au brûleur (1), qui a provoqué l'allumage du brûleur (1), fixe pendant cette période ;
- si la valeur d'allumage du débit de carburant est comprise dans la fourchette des valeurs de référence, enregistrer la valeur du débit de carburant dans un registre de mémoire (10) utilisé pour enregistrer des valeurs de flamme ;

caractérisé en ce que l'unité de commande est conçue de plus pour :

- vérifier si la valeur de combustion est comprise dans un intervalle de valeurs de référence ;
- enregistrer la valeur de combustion détectée dans un registre de mémoire (10) pour enregistrer des valeurs de flamme de la flamme si la valeur de combustion est comprise dans l'intervalle de valeurs de référence.

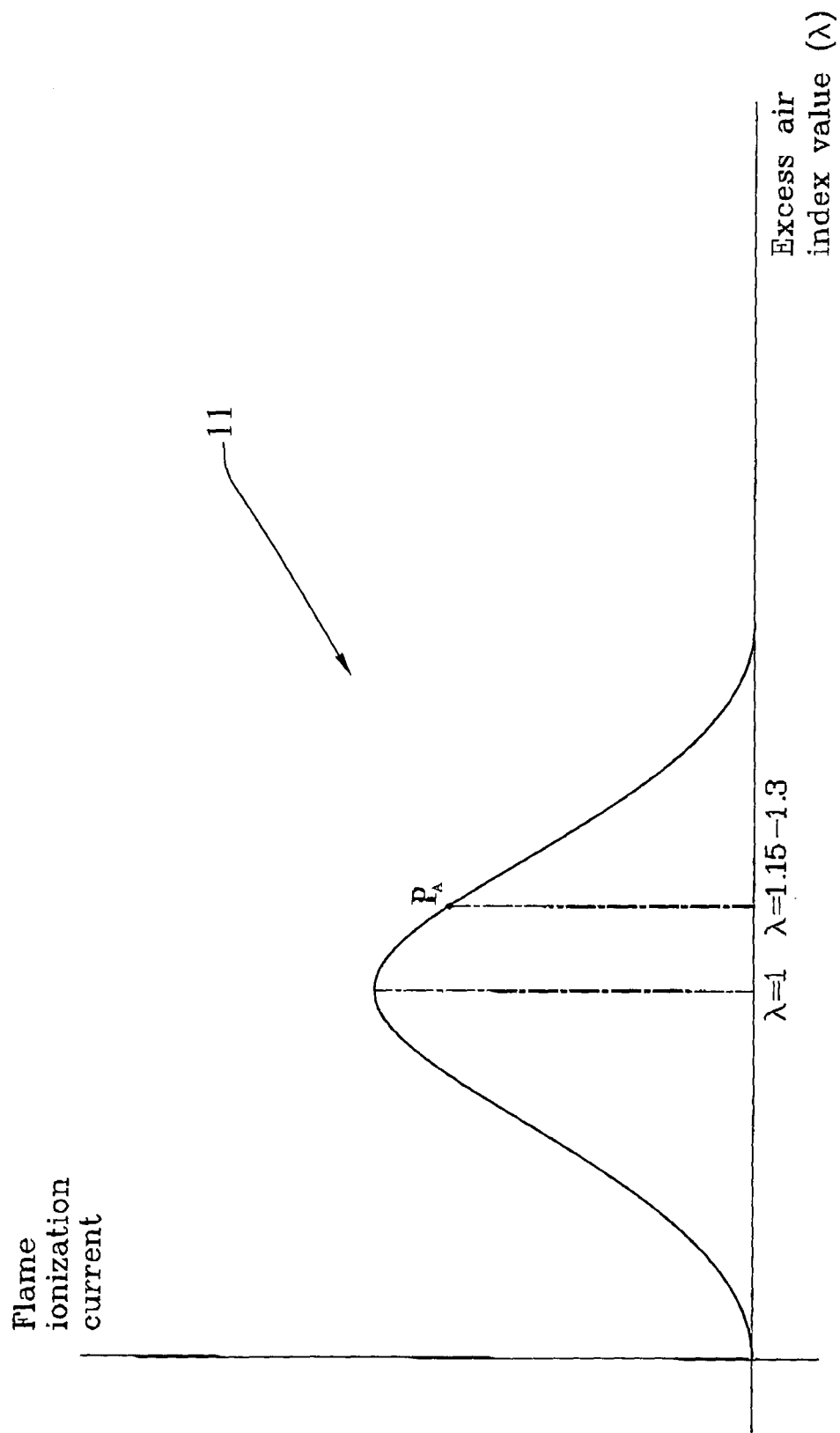


FIG 1

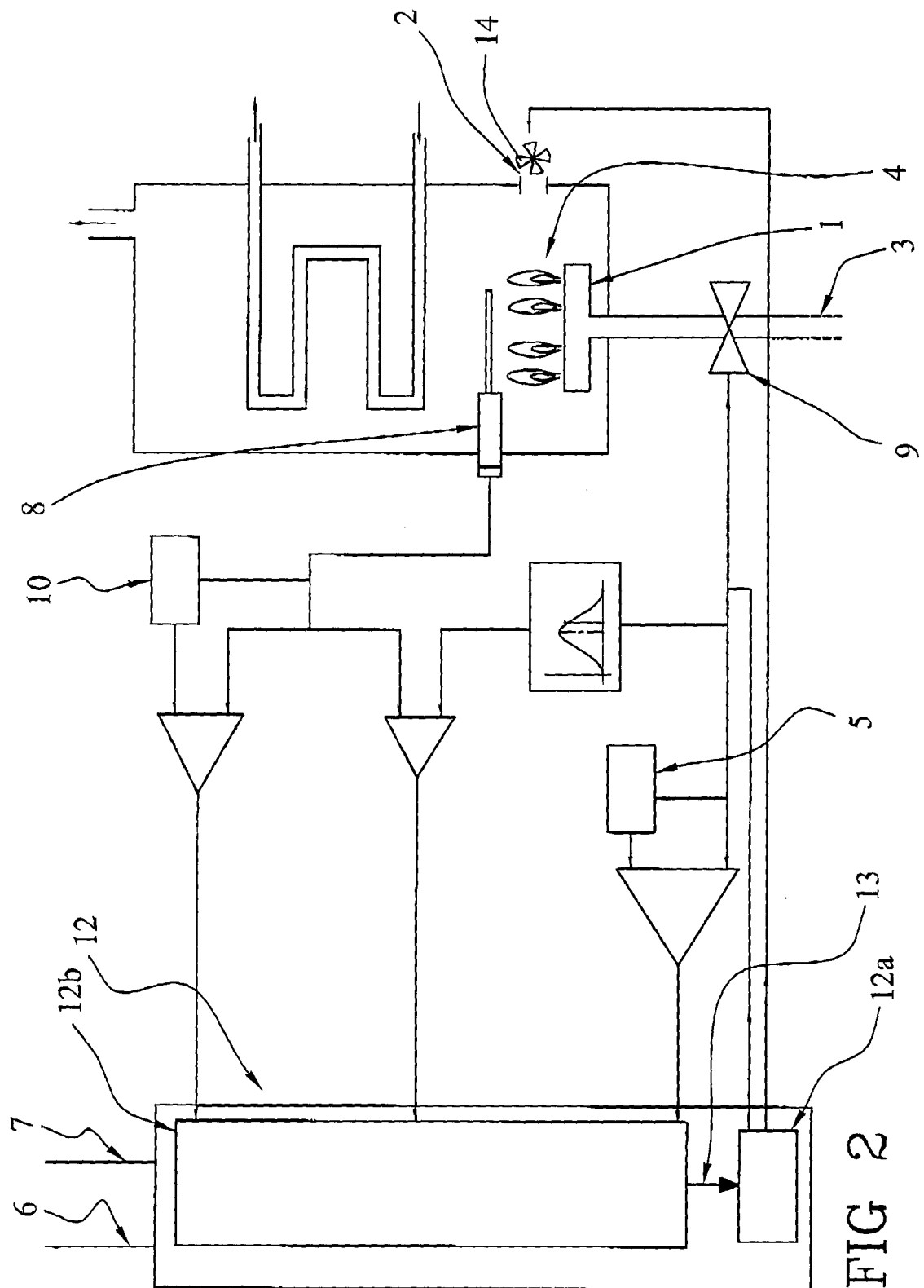


FIG 2

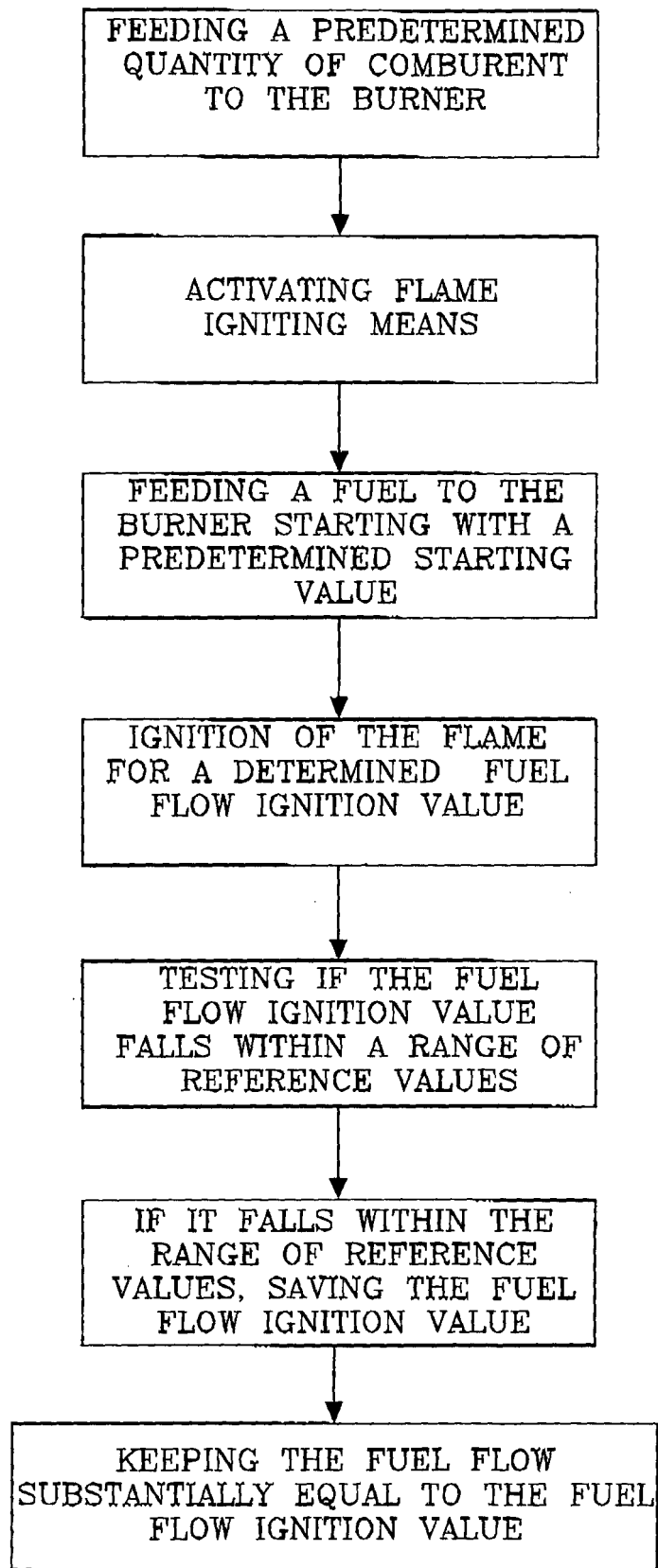


FIG 3

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 102006006964 [0001]
- US 5924859 A [0007]
- WO 2011117896 A [0007]