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(54) **A DEVICE FOR MEASURING FLAME INTENSITY**

VORRICHTUNG ZUR MESSUNG DER FLAMMENINTENSITÄT

DISPOSITIF DE MESURE DE L'INTENSITÉ DE LA FLAMME

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Description

Field of the invention

[0001] The present invention relates to a device for measuring flame intensity having the characteristic features set out in the preamble of the main claim. Such a device is disclosed in GB 2 367 172 A.

Technological background

[0002] The invention is applied in particular, but not exclusively, in the sector of systems for the control of the gas supply to burners of appliances for heating in general, whose flame is adapted to heat the environment or an intermediate fluid circulating in a boiler plant.

[0003] A typical application is in systems controlling the gas supply to burners of boilers for domestic heating and/or heating of domestic hot water.

[0004] In the technical sector of the invention it is known to equip the above-mentioned appliances, for safety reasons, with devices which detect the presence of a flame by measuring a current flowing in a flame sensor, currently known in the sector as "ionisation current", as disclosed for instance in Patent Specifications US 5 599 180, US 6 060 719 and JP 4 244 922.

[0005] It has nevertheless proved necessary in this field to provide devices not only for detection but also for the measurement of flame intensity in order to optimise the combustion parameters and therefore to reduce pollution and consumption.

[0006] In the reference technical sector it is preferably required for these devices to be substantially invariable with respect to temperature variations, at least in the temperature range in which the device is used, to the dispersion of the properties of components and to variations in the supply voltage, without production costs and times and design complexity being greatly affected.

Description of the invention

[0007] A main object of the present invention is to provide a device for measuring flame intensity which is structurally and functionally adapted to satisfy the above-mentioned requirements and at the same time to remedy the drawbacks described with reference to the cited prior art.

[0008] These and other objects described in detail below are achieved by a device for measuring flame intensity in accordance with the accompanying claims.

Brief description of the drawings

[0009] Further characteristic features and advantages of the present invention are set out in the following detailed description of a preferred embodiment thereof, given solely by way of non-limiting example, with reference to the accompanying drawings, in which:

Fig. 1 is a circuit diagram of a preferred embodiment of a device for measuring flame intensity of the present invention;

Fig. 2 shows the duty cycle variation (in %) of the voltage V as a function of the ionisation current (in μA) of five different examples of a flame sensor at predetermined temperature, in accordance with the diagram of Fig. 1;

Fig. 3 shows the temperature dispersion (in $^{\circ}\text{C}$) of the magnitudes shown in Fig. 2;

Fig. 4 shows a preferred embodiment of the input/output signal to various components of the device of Fig. 1;

Fig. 5 diagrammatically shows a preferred embodiment of a control system of the invention comprising the device of Fig. 1.

Preferred embodiment of the invention

[0010] With reference first to Fig. 1, a device for measuring flame intensity, adapted for instance to measure the flame intensity within burners, in accordance with the present invention, is shown overall by 1.

[0011] The device for measuring flame intensity 1 comprises a flame sensor U1 disposed within the burner so as to come into contact with the flame when the latter is present, and to generate an ionisation current proportional to the intensity of this flame.

[0012] The sensor U1 is preferably produced using conventional techniques in the sector and comprises, for instance, two electrodes. In a preferred embodiment of the invention, the operation of the flame sensor may be compared with that of a current generator connected to a one-way member, for instance a diode in series with a resistor (see diode D2 and resistor R10 in Fig 1): the current generated by the sensor as a result of the presence of the flame in practice flows in only one direction. This is in particular due to the fact that the burner is often connected to earth in boilers embodied according to the prior art, with the result that when current is flowing in the sensor U1 as a result of the presence of a flame, this current "drains" towards earth.

[0013] Generally, the currents generated by flame sensors coupled to known burners in the sector are of the order of microamperes. By way of example in the applications in question, the ionisation current generated in the sensor U1 preferably varies within a range of 0.8 μA to 7.5 μA . The device of the invention may nevertheless also be used in the case of ionisation currents having different orders of magnitude.

[0014] The term "flame intensity" has the following meaning in the preferred embodiment described below: a "low" flame is a flame which licks the sensor partially from a volumetric point of view and a "high" flame is when the sensor is completely surrounded by the flame. Various flame levels from low to high therefore correspond to a flame which licks an increasingly greater portion of the sensor until it is completely surrounded.

[0015] The device for measuring flame intensity 1 is supplied not just with the current signal from the flame sensor U1 but also with an alternating voltage signal V1 having a first predetermined duty cycle, for instance a voltage having a zero-centred duty cycle of 50%. The voltage V may for instance be the mains voltage from which the direct component is eliminated by means of a capacitor C1 (see Fig. 1, in which a resistor R1, the capacitor C1 and two further resistors R2 and R4 are disposed in series, this being one of the possible embodiments of the invention) in order to obtain a sinusoidal signal having a first duty cycle of 50% and substantially centred on 0 (i.e. having a mean value which is substantially zero). The voltage V1 may also be supplied by an alternating signal generator or by batteries (not shown).

[0016] According to a main characteristic feature of the invention, the device for measuring flame intensity 1 further comprises means 2 for varying the first predetermined duty cycle of the signal V1 whose input is supplied with both the ionisation current generated by the sensor U1 downstream of a resistor R6 and the alternating voltage signal V1. These means 2 generate as output an alternating voltage signal V having a second duty cycle which is a function of the first duty cycle (which is known and set when the device 1 is installed) and the ionisation current U1, as will be explained below. In particular, the second duty cycle of the output signal V increases as the ionisation current increases. By measuring the second duty cycle it is therefore possible to deduce the flame intensity as the intensity of the ionisation current is proportional to the intensity of the flame.

[0017] The variation means 2 comprise a switch member, preferably a transistor Q1, whose base is supplied by the signal V1 and by the ionisation current.

[0018] A positive supply voltage, shown in Fig. 1 as a direct voltage Vcc, is supplied to the collector of the transistor Q1. The collector resistor is also shown by R5 in Fig. 1.

[0019] The potential difference between the base and emitter of the transistor Q1 is determined by the base input signal (the emitter is preferably connected to earth). The values of the various components of the device 1, the values of the ionisation current and the value of the alternating current signal V1 having a first duty cycle are such that the input signal of the base of the transistor Q1 has a value which oscillates between saturation values (when the input signal of the base of the transistor is maximum) and cut-off values for the transistor Q1, causing the latter to operate substantially as a "switch".

[0020] It will be appreciated that, operating between saturation and cut-off and not in the linear zone, the transistor Q1 is substantially invariable with respect to temperature variations, which would not be the case if the transistor were operating in the linear zone. Moreover, as the transistor gain is not a relevant parameter, extremely economic transistors may be used in the device of the invention.

[0021] The measuring device 1 further comprises op-

tional filter means 3 by means of which the alternating voltage signal V1 and the current signal from the flame sensor (if a flame is present) are advantageously filtered and then supplied as input to the base of the transistor Q1.

[0022] The optional filter means 3 preferably comprise a low-pass filter 3 which is more preferably formed by two low-pass filters in parallel, a first low-pass filter 4, for instance in series with a resistor R8' and a capacitor C3, and a second low-pass filter 5, for instance in series with a resistor R9 and a capacitor C2. One terminal of both the capacitor C3 and the capacitor C2 is preferably connected to earth.

[0023] A low-pass filter 3 comprising the two low-pass filters 4 and 5 in parallel is preferred in order to make it possible to lower the overall signal cut-off frequency by using commercially available, economic and reliable components. Disposing two low-pass filters in parallel in practice makes it possible to use resistors and capacitors of a lower value than in the case of a single low-pass filter. For the same reason, i.e. for cost savings and ease of location of components, the resistor R8' preferably comprises two resistors R7 and R8 in series.

[0024] It will be appreciated that the input signal to the low-pass filter 3 has a negative offset with respect to the signal V1, which offset depends on the value of the ionisation current through the flame sensor U1 to earth. Therefore, starting from the duty cycle of the signal V1, the signal supplied as input to the filter 3 and therefore to the base of the transistor Q1 has a duty cycle lower than that of the signal V1 as a result of the ionisation current which, when present, entails a negative offset of the signal V1, i.e. its "translation" by a particular value, determined by the intensity of the ionisation current, to negative voltage values.

[0025] The low-pass filter 3 is electrically connected as output to the base of the transistor Q1 by regulation means 6 of the base voltage of the transistor Q1. The regulation means 6 of the base voltage of the transistor Q1 for instance comprise a diode D4 in parallel with the base, i.e. joining the base and emitter of the transistor Q1, in order to limit the base voltage below a maximum limit authorised for the transistor Q1, so as to prevent damage to this transistor. It is preferable for the diode D4 to be disposed in parallel with the base (although this diode D4 may also be disposed in series with the base of the transistor) as this arrangement enables better temperature behaviour of the device 1. The diode D4 is further connected in parallel with a resistor R11 which is adapted to connect the base to earth.

[0026] The transistor Q1 further preferably comprises a collector resistor R5 and has a collector voltage V which represents the output signal from the measuring device 1: the output signal V substantially comprises a two-level voltage (for simplicity, known in short as "high" and "low") with a second duty cycle depending on the alternation of saturation (to which a "low" voltage V corresponds) and cut-off (to which a "high" voltage V corresponds) in the transistor Q1. The value of the duty cycle of the signal V

depends, as the value of the first duty cycle of V1 is set and remains set, on the negative offset proportional to the ionisation current generated by the flame sensor U1 of the signal supplying the base of the transistor Q1.

[0027] Advantageously, the resistors R1-R11 are of the type which do not vary with variations in temperature, for instance resistors of the SMD (Surface Mounting Device) type, in order to ensure, together with the use of the transistor Q1 outside the linear zone, that the performance of the device 1 is reproducible in a predetermined temperature range equivalent to the range of use of the burner, for instance in the range between -40°C and 80°C.

[0028] Solely by way of example, the resistors used have the following value: R1=100 kΩ, R2=R4=470 kΩ, R3=2.2 MΩ, R5=R6=R7=1 MΩ, R8=22 MΩ, R9=15 MΩ, R10= 47 MΩ. The values of the capacitors used are as follows: C1=2.2 nF, C3=C2=1 nF, Lastly, Vcc = 5 V.

[0029] The alternating signal voltage V1 depends, however, on the type of mains supply to which the device is connected, i.e. a signal of 50 Hz in Italy. If the voltage varies, i.e. a mains voltage of 60 Hz, all that is needed is a software modification as the device may be used with any mains voltage.

[0030] A control system 7 of the invention, shown in Fig. 5, comprises the device for measuring flame intensity 1 and means 8 for comparing the second duty cycle of the output signal from the device 1 with a plurality of predetermined levels so as to assign a flame intensity to a specific value of the second duty cycle.

[0031] According to a preferred embodiment, there are four flame levels. A control function therefore assigns a predetermined level to specific values of the second duty cycle.

[0032] According to a preferred embodiment, the ionisation current generated in the sensor U1 may vary in a range of 0.8 μA to 7.5 μA which leads to a substantially linear variation of the second duty cycle (minimal when there is no flame and then increasing as the ionisation current increases).

[0033] The comparison means 8 preferably comprise a microprocessor μP having as input the collector voltage V sampled at high frequency, typically every 64 μs, which value may nevertheless be varied and depends, *inter alia*, on the frequency of the alternating signal V1 and on the ionisation current.

[0034] Preferably, the control system 7 further comprises, if the device 1 is supplied directly from the electrical mains, an isolation transformer 9 adapted to make the alternating signal V1 independent from the mains supply. The isolation transformer 9 has a supplementary winding on the secondary (not shown), isolating the "high voltage" part of the variation circuit 2 making it unnecessary to use photocouplers for the interface with the microprocessor.

[0035] The device 1 of the present invention operates as follows.

[0036] In the absence of a flame, the flame sensor U1

has no ionisation current flowing through it and therefore the input and output signals of the filter means 3, which attenuate solely the amplitude of the signal but do not change its duty cycle, are the alternating voltage signals V1 having a predetermined duty cycle, for instance that of the mains. In a preferred embodiment, the first duty cycle is 50%.

[0037] The potential difference between the base and emitter of the transistor Q1 therefore alternates between cut-off and saturation values during time intervals depending on the signal V1 and the second duty cycle of the collector voltage V is proportional and "inverted" with respect to the first reference duty cycle. In particular, when there is a positive input signal at the base of the transistor Q1, the signal V is negative, and when there is a negative signal at the base, the signal V is positive. In the absence of a flame, however, the signal V does not have a duty cycle coinciding with the duty cycle V1 because of the presence of the resistor R3 (of 2.2 MΩ in the preferred embodiment) in order to ensure more accurate detection of the signal V.

[0038] In the preferred embodiment of a device 1 having an output illustrated in Fig. 2, the duty cycle of the signal V at zero flame is set to be equal to 20%, although the duty cycle of the signal V at zero flame can be set as desired.

[0039] If there is a flame, the ionisation current in the flame sensor U1 is responsible for a negative offset with respect to the alternating signal V1 at the input of the low-pass filter 3 proportional to the intensity of this current: the greater the current, the greater will be the negative offset, i.e. the "translation" of the signal V1 to negative voltage values, and therefore the duty cycle of the signal supplied to the base of the transistor Q1 will be proportionally reduced. Reference should be made for instance to Fig. 4 which shows an example of the signal present as input/output at various points (in particular points A, B, C, D in the presence and absence of a flame) of the device 1. Although the embodiment illustrated shows a sinusoidal signal V1 with a duty cycle of 50%, it will be appreciated that the signal V1 may be any alternating signal having a predetermined set duty cycle.

[0040] In a first preferred embodiment, the signal V1 is sinusoidal with a duty cycle of 50%.

[0041] In a further preferred embodiment, the signal V1 is a triangular signal with a duty cycle of 50%. A triangular wave generator is in particular preferred in cases in which it is necessary to use an alternating current generator (for instance in cases in which connection to the electrical mains is impossible and it is therefore necessary to use, for instance, an appropriate battery). As a result of the negative offset, the potential difference between the base and emitter of the transmitter Q1 is such as to cut off the transistor Q1 for a time interval greater than the saturation interval as the signal supplying the base of the transistor is in negative voltage for a period longer than the period in which the base is supplied with positive voltage. The output signal V of the device 1 is

therefore "high" for a longer period than when it is "low" with the result that its duty cycle increases (see the signals of Fig. 4). Consequently, the more the duty cycle of the input signal of the base of the transistor Q1 decreases, the more the duty cycle of the collector signal (i.e. the voltage V) increases.

[0042] The second duty cycle of the collector voltage V, determined by the passage of saturation current of the transistor Q1 into the resistor R5, is therefore proportional to the flame intensity detected, as shown in Fig. 2: the abscissa shows the ionisation current (proportional to the flame intensity) and the ordinate shows the resulting duty cycle of the signal V. The greater the current, the greater is the duty cycle until "saturation" is reached (the signal V is always "high"). The various curves shown in Fig. 2 refer to a plurality of different devices 1, in particular including different sensors U1, in order to verify that their behaviour is analogous.

[0043] The device 1 is appropriately dimensioned so that the saturation value is reached for the maximum flame levels generally encountered in the burners in which it is applied.

[0044] As a result of the use of fully SMD components and the fact that the transistor Q1 does not operate in the linear zone, the Applicants have been able to ascertain that there are maximum variations of 2% of the duty cycle of the signal V for temperature variations from -40 to +80, making the device 1 substantially invariable with respect to temperature in the normal temperature range of use. Fig. 3 shows a graph similar to that of Fig. 2 obtained for three different operating temperatures of the device 1 equal to -20°C, 25°C and 70°C (in this case as well, simulations of different devices 1 including different sensors are given for each temperature).

[0045] In the control system 7, the collector voltage V is sampled at high frequency and the sample values are compared by the microprocessor with the predetermined levels of the control function.

[0046] The invention thus achieves the proposed objects and provides the above-described advantages with respect to known solutions.

[0047] It will be appreciated in particular that the device for measuring flame intensity is invariable with respect to temperature variations, dispersions of the characteristics of components and variations of the supply voltage.

Claims

1. A device (1) for measuring flame intensity in a burner, this device (1) being supplied by a first alternating signal (V1) with a first predetermined duty cycle, comprising:
 - a flame sensor (U1) generating an ionisation current proportional to the intensity of the flame in the burner;
 - means (2) for varying the first duty cycle as a

function of the ionisation current, these variation means (2) being supplied as input with the first alternating signal (V1) and the ionisation current and generating as output an alternating signal (V) having a second duty cycle which is a function of this ionisation current, the variation means (2) comprising at least one switch member (Q1), characterised in that the at least one switch member (Q1) is supplied as input with a second alternating signal having a negative offset with respect to the first alternating signal (V1), this offset depending on the value of the ionisation current to earth.

2. A device (1) for measuring flame intensity as claimed in claim 1, wherein the second duty cycle increases as the ionisation current increases.
3. A device (1) for measuring flame intensity as claimed in claim 2, wherein the second duty cycle increases as the ionisation current increases in a substantially linear manner at least in one section
4. A device (1) for measuring flame intensity according to any of the preceding claims, wherein the switch member (Q1) comprises a transistor and the second alternating input signal is supplied to the base of this transistor (Q1).
5. A device (1) for measuring flame intensity as claimed in claim 4, wherein the second alternating input signal of the base of the transistor (Q1) is such that the potential difference between the base and emitter of the transistor (Q1) alternates between saturation and cut-off values.
6. A device (1) for measuring flame intensity as claimed in claim 4 or 5, wherein the output signal (V) from the variation means (2) corresponds to the collector voltage of the transistor (Q1) having the second duty cycle, depending on the alternation of saturation and cut-off of the transistor (Q1) under the action of this negative offset.
7. A device (1) for measuring flame intensity as claimed in any one of the preceding claims, wherein the variation means (2) comprise filter means (3) supplied as input by the second alternating signal and are connected as output to the base of the switch member (Q1).
8. A device (1) for measuring flame intensity as claimed in claim 7, wherein the filter means (3) comprise at least one low-pass filter (4; 5).
9. A device (1) for measuring flame intensity as claimed in claim 8, wherein the low-pass filter (3) comprises two low-pass filters in parallel (4, 5).

10. A device (1) for measuring flame intensity as claimed in one or more of claims 7 to 9, wherein the output of the filter means (3) is electrically connected as output to the transistor (Q1) by means of regulation means of the base voltage of the transistor (Q1) which limit the base voltage below a maximum limit authorised for the transistor (Q1). 5
11. A device (1) for measuring flame intensity as claimed in claim 10, wherein the regulation means of the base voltage (6) comprise a diode (D6) connected between the base and the emitter of the transistor (Q1). 10
12. A device (1) for measuring flame intensity as claimed in one or more of claims 4 to 11, wherein the variation means (2) are supplied by a generator of direct voltage (Vcc) supplied to the collector of the transistor (Q1) and comprise a resistor (R5) at the collector of the transistor (Q1). 15
13. A device (1) for measuring flame intensity as claimed in one or more the preceding claims, wherein the variation means (2) comprise resistors of a type which does not vary with temperature variations. 20
14. A flame intensity control system (7) comprising: 25
- a device (1) for measuring flame intensity as claimed in one or more of claims 1 to 13, generating as output an alternating signal (V) having a second duty cycle; 30
 - means (8) for comparing the second duty cycle of the output signal (V) from the measuring device (1) with a plurality of levels predetermined by a control function. 35
15. A flame intensity control system (7) as claimed in claim 14, comprising an isolation transformer (9) with respect to the mains supply. 40
16. A flame intensity control system (7) as claimed in claims 14 or 15, wherein the comparison means (8) comprise a microprocessor (μ P) having the collector voltage (V) as input. 45

Patentansprüche

1. Vorrichtung (1) zum Messen der Flammenintensität in einem Brenner, wobei an diese Vorrichtung (1) ein erstes Wechselspannungs-Signal (V1) mit einer ersten vorgegebenen Einschaltdauer angelegt wird, umfassend 50
- einen Flammensensor (U1), der proportional zur Intensität der Flamme im Brenner einen Ionisationsstrom erzeugt, 55
 - Mittel (2) zum Variieren der ersten Einschalt-
- dauer als Funktion des Ionisationsstroms, wobei an diese Variationsmittel (2) als Eingabe das erste Wechselspannungs-Signal (V1) und der Ionisationsstrom angelegt werden und sie als Ausgabe ein Wechselspannungs-Signal (V) mit einer zweiten Einschaltdauer erzeugen, die eine Funktion dieses Ionisationsstroms ist, wobei die Variationsmittel (2) mindestens ein Schaltelement (Q1) umfassen, **dadurch gekennzeichnet, dass** an das mindestens eine Schaltelement (Q1) als Eingabe ein zweites Wechselspannungs-Signal angelegt wird, das in Bezug auf das erste Wechselspannungs-Signal (V1) ein negatives Offset aufweist, wobei dieses Offset vom Wert des Ionisationsstroms zur Erde abhängig ist.
2. Vorrichtung (1) zum Messen der Flammenintensität nach Anspruch 1, bei der die zweite Einschaltdauer zunimmt, wenn der Ionisationsstrom zunimmt.
3. Vorrichtung (1) zum Messen der Flammenintensität nach Anspruch 2, bei der die zweite Einschaltdauer im Wesentlichen linear mindestens in einem Abschnitt zunimmt, wenn der Ionisationsstrom zunimmt.
4. Vorrichtung (1) zum Messen der Flammenintensität nach einem der vorhergehenden Ansprüche, bei der das Schaltelement (Q1) einen Transistor umfasst und das zweite Wechselspannungs-Eingabesignal an der Basis dieses Transistors (Q1) angelegt wird.
5. Vorrichtung (1) zum Messen der Flammenintensität nach Anspruch 4, bei der das zweite Wechselspannungs-Eingabesignal an der Basis des Transistors (Q1) derart ist, dass die Potentialdifferenz zwischen der Basis und dem Emitter des Transistors (Q1) zwischen Sättigungs- und Sperrwerten wechselt.
6. Vorrichtung (1) zum Messen der Flammenintensität nach Anspruch 4 oder 5, bei der das Ausgabesignal (V) vom Variationsmittel (2), in Abhängigkeit vom Wechsel von Sättigung und Sperren des Transistors (Q1) unter dem Einfluss dieses negativen Offsets, zur Kollektorspannung des Transistors (Q1) mit der zweiten Einschaltdauer korrespondiert.
7. Vorrichtung (1) zum Messen der Flammenintensität nach einem der vorhergehenden Ansprüche, bei der die Variationsmittel (2) Filtermittel (3) umfassen, an die als Eingabe das zweite Wechselspannungs-Signal angelegt wird und die als Ausgabe mit der Basis des Schaltelements (Q1) verbunden sind.
8. Vorrichtung (1) zum Messen der Flammenintensität nach Anspruch 7, bei der die Filtermittel (3) mindestens einen Tiefpassfilter (4; 5) umfassen.

9. Vorrichtung (1) zum Messen der Flammenintensität nach Anspruch 8, bei der der Tiefpassfilter (3) zwei parallele Tiefpassfilter (4; 5) umfasst.
10. Vorrichtung (1) zum Messen der Flammenintensität nach einem oder mehreren der Ansprüche 7 bis 9, bei der der Ausgang der Filtermittel (3) als Ausgang zum Transistor (Q1) mittels Regulationsmitteln für die Basisspannung des Transistors (Q1) elektrisch verbunden ist, die die Basisspannung unter einen Maximalgrenzwert begrenzen, der für den Transistor (Q1) zulässig ist.
11. Vorrichtung (1) zum Messen der Flammenintensität nach Anspruch 10, bei der die Regulationsmittel für die Basisspannung (6) eine Diode (D6) umfassen, die zwischen die Basis und den Emitter des Transistors (Q1) eingeschleift ist.
12. Vorrichtung (1) zum Messen der Flammenintensität nach einem oder mehreren der Ansprüche 4 bis 11, bei der an die Variationsmittel (2) durch einen Generator Gleichspannung (Vcc) angelegt wird, die an den Kollektor des Transistors (Q1) angelegt wird, und die einen Widerstand (R5) am Kollektor des Transistors (Q1) umfassen.
13. Vorrichtung (1) zum Messen der Flammenintensität nach einem oder mehreren der vorhergehenden Ansprüche, bei der die Variationsmittel (2) Widerstände eines Typs umfassen, der sich bei Temperaturveränderungen nicht verändert.
14. Flammenintensität-Steuerungssystem (7), umfassend:
- eine Vorrichtung (1) zum Messen der Flammenintensität nach einem oder mehreren der Ansprüche 1 bis 13, die als Ausgabe ein Wechselspannungs-Signal (V) mit einer zweiten Einschaltdauer erzeugt,
 - Mittel (8) zum Vergleichen der zweiten Einschaltdauer des von der Messvorrichtung (1) ausgegebenen Signals (V) mit einer Mehrzahl von Pegeln, die durch eine Steuerungsfunktion vorgegeben sind.
15. Flammenintensität-Steuerungssystem (7) nach Anspruch 14, umfassend einen Isoliertransformator (9) für die Netzversorgung.
16. Flammenintensität-Steuerungssystem (7) nach Anspruch 14 oder 15, bei dem die Vergleichsmittel (8) einen Mikroprozessor (μ P) mit der Kollektorspannung (V) als Eingabe umfassen.

Revendications

1. Dispositif (1) pour mesurer l'intensité de la flamme dans un brûleur, ce dispositif (1) recevant un premier signal alternatif (V1) avec un premier rapport cyclique, comprenant :
 - un détecteur de flamme (U1) générant un courant d'ionisation proportionnel à l'intensité de la flamme dans le brûleur ;
 - des moyens (2) pour modifier le premier rapport cyclique en fonction du courant d'ionisation, ces moyens de modification (2) recevant, en tant qu'entrée, le premier signal alternatif (V1) et le courant d'ionisation et générant, en tant que sortie, un signal alternatif (V) ayant un deuxième rapport cyclique qui est fonction de ce courant d'ionisation, les moyens de modification (2) comprenant au moins un élément de commutation (Q1), **caractérisé en ce que** ledit au moins un élément de commutation (Q1) reçoit, en tant qu'entrée, un deuxième signal alternatif ayant un décalage négatif par rapport au premier signal alternatif (V1), ce décalage dépendant de la valeur du courant d'ionisation vers la terre.
2. Dispositif (1) pour mesurer l'intensité de la flamme selon la revendication 1, dans lequel le deuxième rapport cyclique augmente alors que le courant d'ionisation augmente.
3. Dispositif (1) pour mesurer l'intensité de la flamme selon la revendication 2, dans lequel le deuxième rapport cyclique augmente alors que le courant d'ionisation augmente d'une manière sensiblement linéaire au moins dans une section.
4. Dispositif (1) pour mesurer l'intensité de la flamme selon l'une quelconque des revendications précédentes, dans lequel l'élément de commutation (Q1) comprend un transistor et le deuxième signal d'entrée alternatif est fourni à la base de ce transistor (Q1).
5. Dispositif (1) pour mesurer l'intensité de la flamme selon la revendication 4, dans lequel le deuxième signal d'entrée alternatif de la base du transistor (Q1) est tel que la différence de potentiel entre la base et l'émetteur du transistor (Q1) alterne entre des valeurs de saturation et de coupure.
6. Dispositif (1) pour mesurer l'intensité de la flamme selon la revendication 4 ou 5, dans lequel le signal de sortie (V) provenant des moyens de modification (2) correspond à la tension de collecteur du transistor (Q1) ayant le deuxième rapport cyclique, dépendant de l'alternance de la saturation et de la coupure du transistor (Q1) sous l'action de ce décalage négatif.

7. Dispositif (1) pour mesurer l'intensité de la flamme selon l'une quelconque des revendications précédentes, dans lequel les moyens de modification (2) comprennent des moyens formant filtre (3) qui reçoivent, en tant qu'entrée, le deuxième signal alternatif et sont connectés, en tant que sortie, à la base de l'élément de commutation (Q1). 5
8. Dispositif (1) pour mesurer l'intensité de la flamme selon la revendication 7, dans lequel les moyens formant filtre (3) comprennent au moins un filtre passe-bas (4 ; 5). 10
9. Dispositif (1) pour mesurer l'intensité de la flamme selon la revendication 8, dans lequel le filtre passe-bas (3) comprend deux filtres passe-bas (4, 5) en parallèle. 15
10. Dispositif (1) pour mesurer l'intensité de la flamme selon une ou plusieurs des revendications 7 à 9, dans lequel la sortie des moyens formant filtre (3) est connectée électriquement, en tant que sortie, au transistor (Q1) par des moyens de régulation de la tension de base du transistor (Q1) qui limitent la tension de base au-dessous d'une limite maximum autorisée pour le transistor (Q1). 20 25
11. Dispositif (1) pour mesurer l'intensité de la flamme selon la revendication 10, dans lequel les moyens de régulation de la tension de base (6) comprennent une diode (D6) connectée entre la base et l'émetteur du transistor (Q1). 30
12. Dispositif (1) pour mesurer l'intensité de la flamme selon une ou plusieurs des revendications 4 à 11, dans lequel les moyens de modification (2) sont alimentés par un générateur d'une tension continue (Vcc) fournie au collecteur du transistor (Q1) et comprennent une résistance (R5) au niveau du collecteur du transistor (Q1). 35 40
13. Dispositif (1) pour mesurer l'intensité de la flamme selon une ou plusieurs des revendications précédentes, dans lequel les moyens de modification (2) comprennent des résistances d'un type qui ne varie pas avec les variations de température. 45
14. Système de commande de l'intensité de la flamme (7) comprenant : 50
- un dispositif (1) pour mesurer l'intensité de la flamme selon une ou plusieurs des revendications 1 à 13, générant, en tant que sortie, un signal alternatif (V) ayant un deuxième rapport cyclique ; 55
 - des moyens (8) pour comparer le deuxième rapport cyclique du signal de sortie (V) provenant du dispositif de mesure (1) avec une pluralité de niveaux prédéterminés par une fonction de commande.
15. Système de commande de l'intensité de la flamme (7) selon la revendication 14, comprenant un transformateur d'isolement (9) par rapport à l'alimentation secteur.
16. Système de commande de l'intensité de la flamme (7) selon les revendications 14 ou 15, dans lequel les moyens de comparaison (8) comprennent un microprocesseur (μ P) ayant la tension de collecteur (V) en tant qu'entrée.

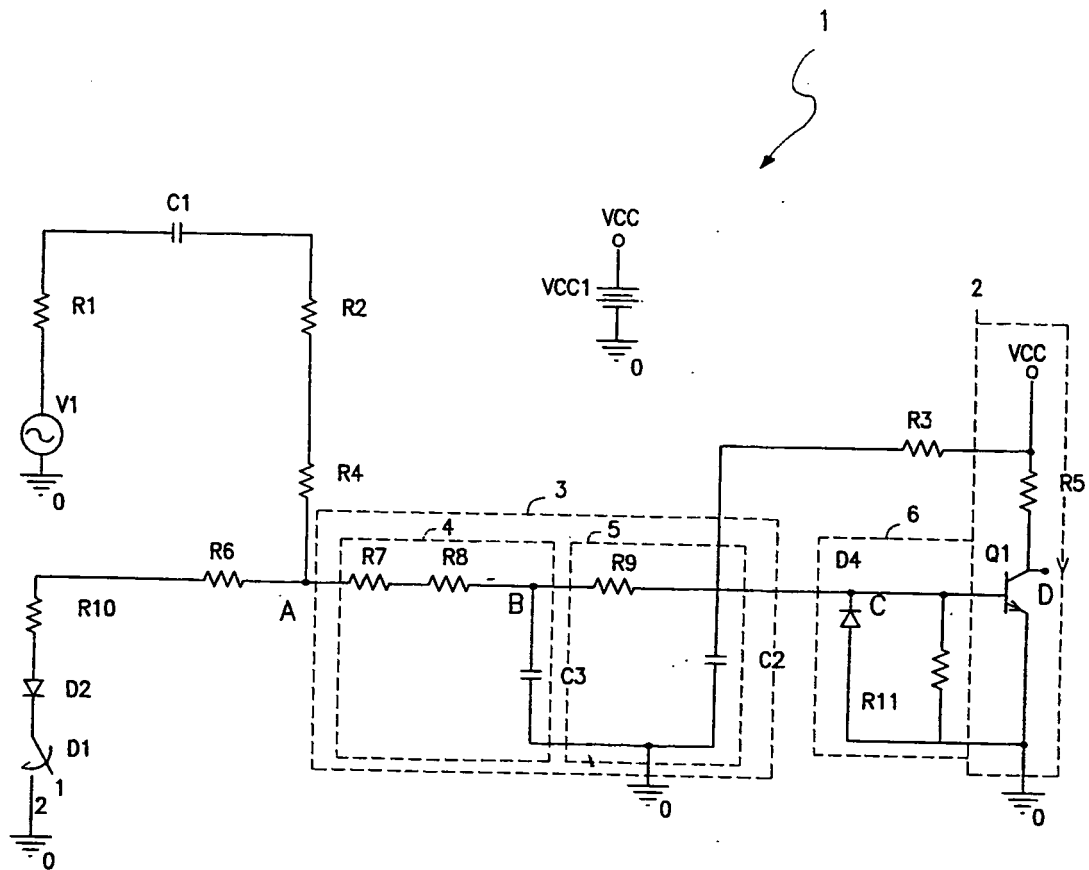


Fig. 1

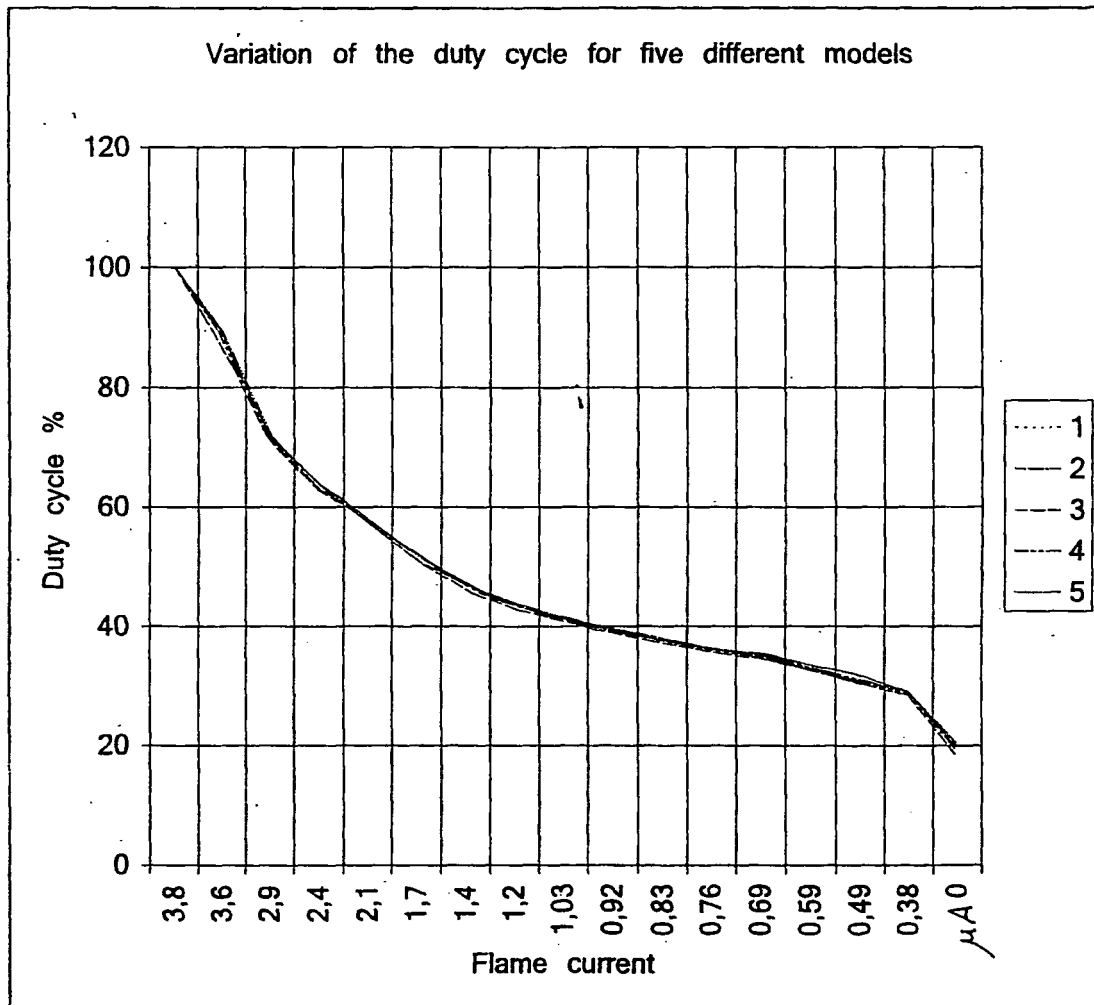


Fig. 2

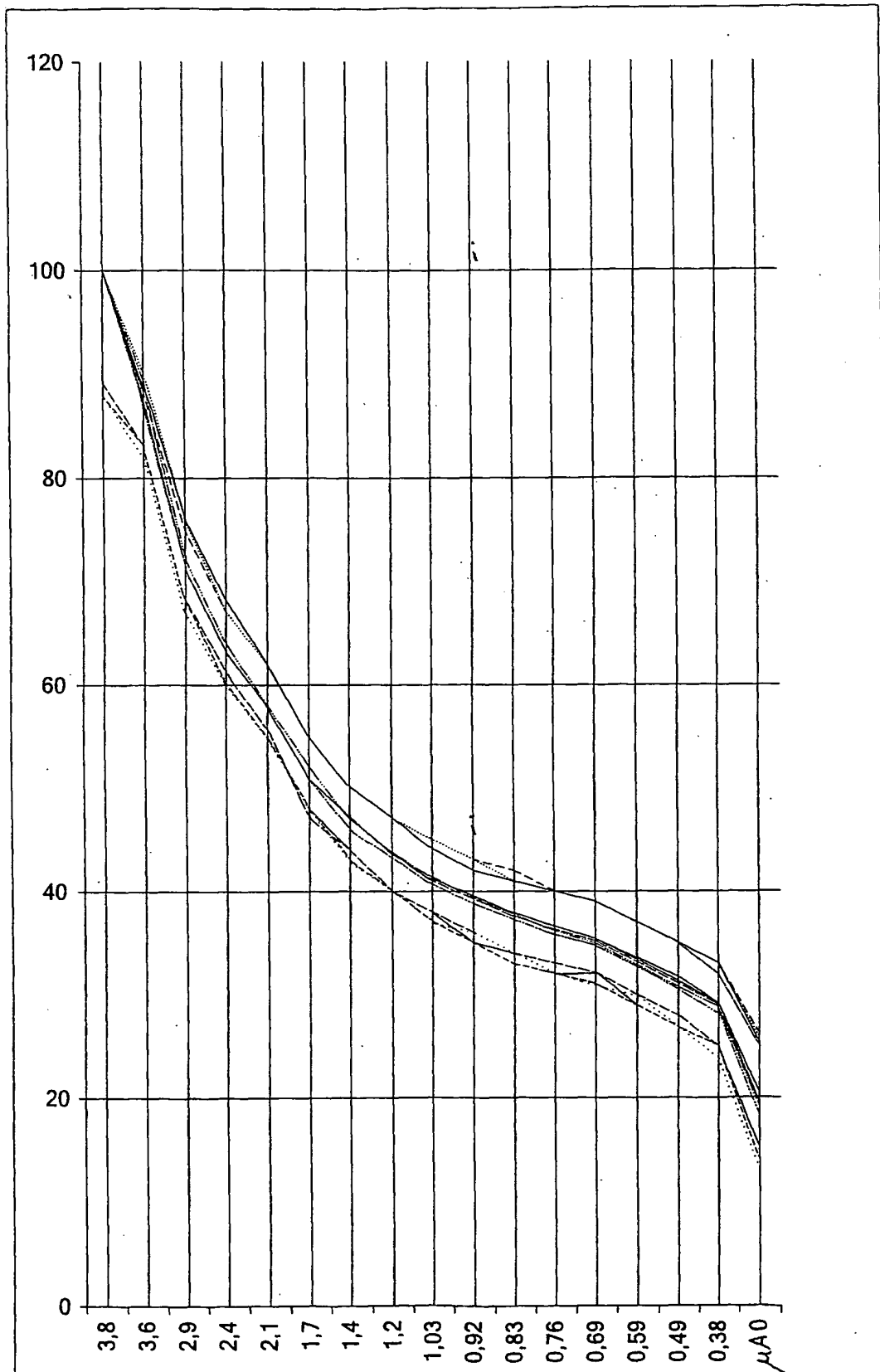


Fig. 3

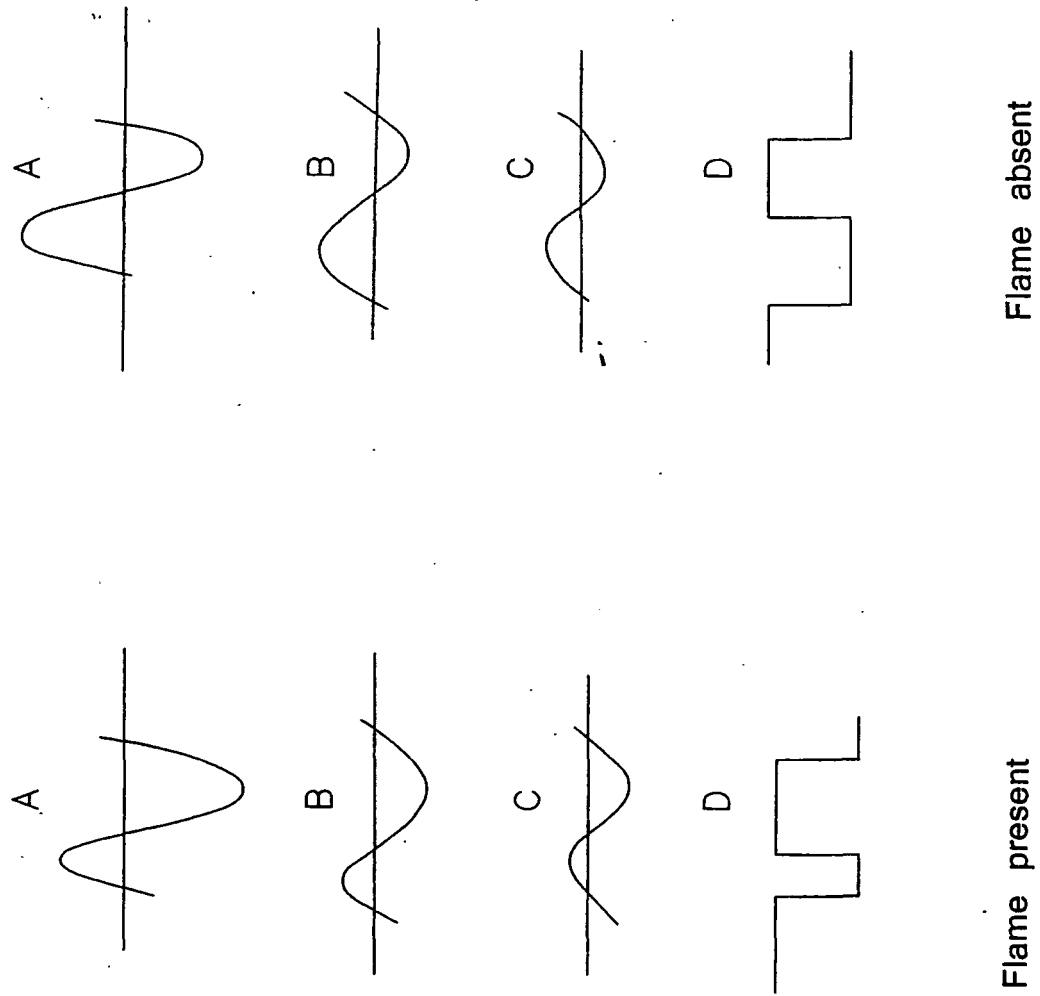


Fig. 4

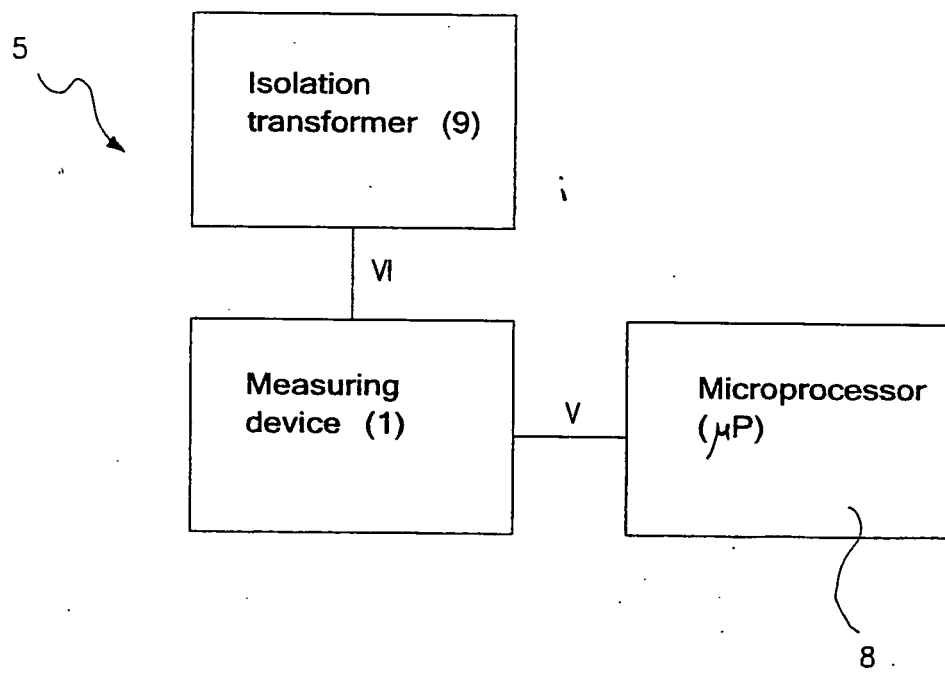


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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