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(54) **DRIVING DEVICE OF A FLAME CIRCUIT FOR BURNERS**

(57) A driving device of a flame circuit of a burner, in particular a gas burner, comprising a feedback control by means of which it is possible to compensate for possible variations in the input voltage so as to ensure that the flame circuit, whether it is used to ignite the burner or to detect the presence of a flame therein, works within optimal operating specifications so as to improve the operation and increase the safety level of the system.

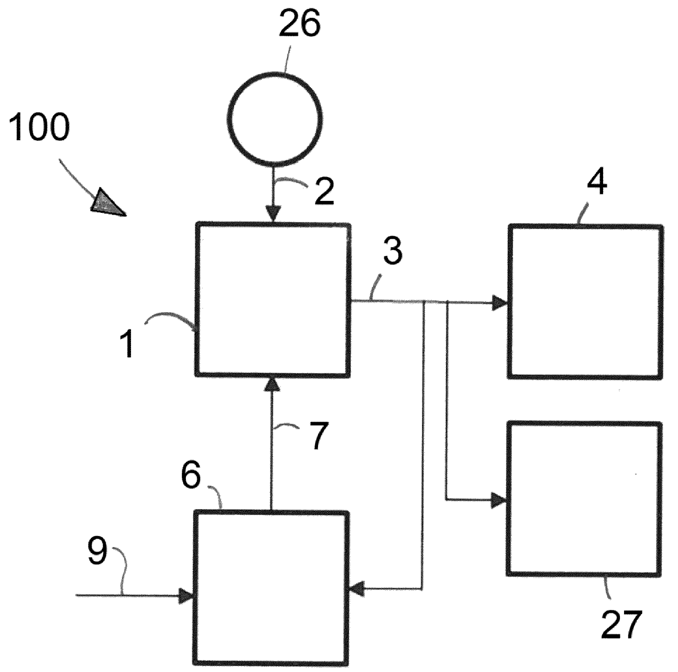

Fig. 1

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Description

Field of the invention

[0001] The present invention relates to a device for generating a driving signal of a flame circuit intended to be used for igniting and/or detecting a flame on a burner, in particular a gas burner.

Background art

[0002] The system according to the invention finds a particular, although not exclusive, application in the technical field of apparatuses adapted to generate a spark for igniting a flame on gas burners, in particular of boilers. Apparatuses are known in such a technical field, comprising a voltage booster connected at the input to a source of electricity and at the output to a circuit for generating an electric discharge for igniting a flame.

[0003] The invention may also find a particular application in the technical field of flame detection devices on gas burners.

[0004] Generally, the voltage booster contained in such apparatuses is designed to raise a DC Ultra Low Voltage (ULV), typically between 12 V and 24 V, providing a DC voltage in the order of 200 V at the output. A battery, or a battery backup connected to the electrical network, is electrically connected to the voltage booster to feed the latter by means of the DC ULV.

[0005] The Applicant noted that the level of electrical voltage present at the input to the voltage booster may greatly affect the correct generation of the electric discharge. In particular, in a condition where the voltage booster is fed by means of a battery which is discharged, or in any case not sufficiently charged, or in a condition where the electric charge of the battery backup varies due to energy instability of the electrical network, the powering of the circuit for generating an electric discharge may prove insufficient, with a consequent lack of ignition of the flame in the burner.

[0006] Similar considerations may be suggested in relation to those flame detection devices which require a source of electricity to generate an alternating signal which is used to detect the presence of a flame on gas burners.

Brief description of the invention

[0007] It is the object of the present invention to provide a driving device of a flame circuit intended to be used for igniting and/or detecting a flame on a burner, which is structurally and functionally designed to overcome at least one limit of the above-mentioned prior art.

[0008] This object is achieved by a driving device of a flame circuit of a burner, in particular a gas burner, constructed in accordance with the independent claim attached to the present description.

[0009] By virtue of the use of a feedback control, it is possible to compensate for possible variations in the input voltage so as to ensure that the flame circuit, whether it is used to ignite the burner or to detect the presence of a flame therein, works within optimal operating specifications thus also increasing the safety level of the system.

[0010] Preferred features of the invention are defined in the dependent claims.

Brief description of the figures

[0011] The features and further advantages of the invention will better become apparent from the following detailed description of preferred, although not exclusive, embodiments thereof, which are described, by way of indicative and non-limiting example, with reference to the accompanying drawings, in which:

- Figure 1 is a diagrammatic depiction of a device according to an embodiment of the invention,
- Figure 2 is a partial electrical diagram of the device in Figure 1,
- Figures 3 and 4 are electrical diagrams of a first electrical circuit and a second electrical circuit of the device in Figure 1, and
- Figure 5 is a diagrammatic depiction of a burner and a boiler comprising the device according to an embodiment of the invention.

[0012] The following description of exemplary embodiments refers to the accompanying drawings. The same reference numerals in the various drawings identify the same elements or similar elements. The following detailed description does not limit the invention. The scope of the invention is defined by the appended claims.

Detailed description of the invention

[0013] With initial reference to Figure 1, numeral 100 indicates as a whole a device for generating an output signal 3 intended to be used for igniting and/or detecting a flame on a gas burner.

[0014] According to a first aspect of the invention, the device 100 comprises a voltage-booster circuit 1 comprising an input 8 intended to be fed by a DC voltage input signal 2 and an output 31.

[0015] The voltage-booster circuit 1 is configured to convert the input signal 2 into the output signal 3, so that the output signal 3 has a higher voltage than that of the input signal 2, and to provide the output signal 3 at the output 31.

[0016] The output signal 3 is intended to power a flame circuit, which, in the embodiment shown in the Figures, comprises both a first electrical circuit 4, arranged to generate an electric discharge adapted to ignite a flame on a gas burner 200, as well as a second electrical circuit 27 arranged to detect a flame on the gas burner 200. Obviously, it is possible that the output signal drives only the flame generation circuit or only the flame detection circuit or both circuits.

[0017] Preferably, the voltage of the input signal 2 is between 3 V and 24 V.

[0018] According to an embodiment of the invention, the device 100 comprises a control circuit 6 connected to the voltage-booster circuit 1 so as to define a closed loop control system (preferably with negative feedback) of the voltage-booster circuit 1.

[0019] The control circuit 6 is configured to control the voltage-booster circuit 1 by means of a control signal 7 generated based on the output signal 3 and a desired DC voltage 9, so that the voltage of the output signal 3 substantially corresponds the desired DC voltage 9.

[0020] Specifically, the output signal 3 is a DC voltage signal.

[0021] The output signal 3 may consist of a DC voltage and a voltage ripple superimposed on the DC voltage. In this case, the value of the voltage ripple is limited and the output signal 3 may be considered as a substantially DC voltage.

[0022] Such features are particularly advantageous for ensuring the stability of the output signal 3 even in the presence of variations in the input signal 2, in particular for ensuring a voltage of the output signal 3 which is substantially constant over time despite possible variations in the voltage of the input signal 2 with respect to the initial DC voltage value thereof.

[0023] Preferably, the control signal 7 generated by the control circuit 6 is a voltage signal.

[0024] In particular, the control circuit 6 is configured to generate the control signal 7 based on at least one difference between the voltage value of the output signal 3 and the desired DC voltage 9.

[0025] Preferably, the desired DC voltage 9 is equal to 200 V, therefore the voltage of the output signal 3 will be substantially equal to 200 V.

[0026] Figure 2 shows an embodiment of the voltage-booster circuit 1 and the control circuit 6 belonging to the device 100 according to the invention.

[0027] According to an embodiment of the invention, the voltage-booster circuit 1 comprises a transformer 10 which comprises a primary circuit 11 connected to the input 8 to be fed by the input signal 2 and a secondary circuit 12 connected to the output 31 for generating the output signal 3 when it is powered by the primary circuit 11. The primary circuit 11 comprises a switching device 13 connected to the control circuit 6.

[0028] According to an aspect of the invention, the primary circuit 11 and the secondary circuit 12 comprise a primary winding 14 and a secondary winding 15, respectively.

[0029] Preferably, the ratio of coils between the primary winding 14 and the secondary winding 15 is equal to 1:10.

[0030] The control circuit 6 is configured to control the opening and/or closing of the switching device 13 by means of the control signal 7 to open and / or close the primary circuit 11.

[0031] The opening of the switching device 13 places the primary circuit 11 in an open state with a consequent decrease in the current circulating in such a primary circuit 11.

[0032] The closure of the switching device 13 places the primary circuit 11 in a closed state. This allows the passage and increase of current circulating in the primary circuit 11 when this is fed by the input signal 2, determining an energy charge in the primary circuit 11.

[0033] The variation in the open/closed state of the switching device 13 thus causes a variation over time in the intensity of the current circulating in the primary circuit 11, and therefore a variation in the energy transferred to the secondary circuit 12.

[0034] This variation thus allows controlling the voltage of the output signal 3 so that it substantially corresponds to the desired constant voltage 9.

[0035] According to an embodiment of the invention, the device 100 comprises a capacitor 53 connected to the voltage-booster circuit 1 between the secondary circuit 12, in particular the secondary winding 15, and the output 31 to accumulate the energy transferred from the primary circuit 11 to the secondary circuit 12 and provide it to the output 31.

[0036] Specifically, the voltage at the ends of the capacitor 53 corresponds to the output signal 3 intended to feed the first electrical circuit 4 and/or the second electrical circuit 27.

[0037] According to an embodiment of the invention, the control signal 7 is a rectangular wave. The control signal 7 may thus vary over time alternatively taking a high voltage level and a low voltage level.

[0038] Preferably, the control signal 7 has a constant frequency.

[0039] Preferably, the high voltage level is between 3.3 and 5 V.

[0040] Preferably, the low voltage level is substantially equal to 0 V.

[0041] According to an aspect of the invention, the control circuit 6 comprises a processing unit 16. Preferably, the processing unit 16 is configured to generate the control signal 7.

[0042] Preferably, the processing unit 16 is configured to vary the duty cycle of the control signal 7 based on the output signal 3 and the desired DC voltage 9. Preferably, the processing unit 16 comprises a microcontroller adapted to generate the control signal 7.

[0043] Preferably, the duty cycle is varied by the control unit 16 according to an automatic control logic in which the duty cycle is varied at least based on the difference (error) between the output signal 3 and the desired DC voltage 9. By varying the duty cycle of the control signal of the switching device 13 it is possible to compensate for possible voltage variations of the input signal, for example due to the presence of a battery which is not fully charged or not perfectly functioning. Such drops, in the absence of the control circuit 6, would affect the output signal causing the flame circuit to work out of specification, with a consequent possible failure to ignite and/or detect the flame.

[0044] According to an aspect of the invention, the duty cycle is equal to 50% if the output signal 3 corresponds to the desired DC voltage 9, while it is higher or lower than 50% if the output signal 3 is lower or higher than the desired DC voltage 9, respectively.

[0045] By way of example, the automatic control logic may provide a control of the PI or PID type.

[0046] According to an aspect of the invention, the desired DC voltage 9 is an information stored in a memory included in the processing unit 16 and/or it may be set by an operator by means of an input interface of the control circuit 6.

[0047] According to an embodiment of the invention, the switching device 13 is arranged to take a closed state when the control signal 7 takes a high voltage level and to take an open state when the control signal 7 takes a low voltage level.

[0048] According to an aspect of the invention, the switching device 13 comprises a transistor 17 having a threshold voltage V_T.

[0049] Preferably, the threshold voltage V_T is lower than the high voltage level of the control signal 7.

[0050] Preferably, the transistor 17 is a Mosfet, in particular an N-channel Mosfet, having the Gate terminal 18 connected to the control circuit 6, in particular to the processing unit 16, so that the control signal 7 is applied to the Gate terminal 18, the Drain terminal 19 being connected to the primary circuit 11, in particular to a terminal of the primary winding 14, and the Source terminal 20 being grounded.

[0051] According to an aspect of the invention, when the input signal 2 feeds the voltage-booster circuit 1 and the control signal 7 takes the high voltage level, the voltage V_{GS} between the Gate 18 and the Source terminals 20 is greater than the threshold voltage V_T of the transistor 17, thus obtaining a current passage I_D between the Drain terminal 19 and the Source terminal 20.

[0052] In this operating condition, the switching device 13 is in the closed state, and therefore the current circulating in the primary circuit 11 increases.

[0053] On the contrary, i.e., when the input signal 2 feeds the voltage-booster circuit 1 and the control signal 7 takes the low voltage level, the voltage V_{GS} between the Gate 18 and Source terminals 20 is lower than the threshold voltage V_T, thus preventing a current passage I_D between the Drain terminal 19 and the Source terminal 20.

[0054] In this operating condition, the switching device 13 is in the open state, and therefore the current circulating in the primary circuit 11 decreases. According to an embodiment of the invention, the control circuit 6 comprises a voltage divider 21 connected to the voltage-booster circuit 1 and to the processing unit 16 to provide the latter with a reduced voltage signal preferably proportional to the voltage of the output signal 3 of the voltage-booster circuit 1. The processing unit 16 is configured to vary the duty cycle of the control signal 7 based on the voltage signal provided by the voltage divider 21 and the desired DC voltage 9.

[0055] In particular, the voltage divider 21 is provided with an input 22 connected to the secondary circuit 12 of the transformer 10 and an output 23 connected to the processing unit 16.

[0056] Preferably, the voltage divider 21 comprises a resistive component 24 connected to the input 22 and a capacitive-resistive component 25 connected in series to the resistive component 24.

[0057] By way of example, the resistive component 24 comprises a pair of resistors connected to each other in series and each having a resistance equal to some MΩ.

[0058] By way of example, the capacitive-resistive component 25 comprises a resistor having a resistance equal to 20 KΩ connected in parallel to a capacitor having a capacity equal to 10nF.

[0059] The output 23 of the voltage divider 21 is provided between the resistive component 24 and the capacitive-resistive component 25 so that the voltage signal present at the output 23 corresponds to the voltage on the capacitive-resistive component 25.

[0060] According to an embodiment of the invention, the device 100 comprises an electric accumulator or an electric generator 26 connected to the voltage-booster circuit 1 and adapted to generate the input signal 2 to feed the voltage-booster circuit 1. In particular, the electric accumulator or generator 26 is connected to the primary circuit 11 of the transformer 10.

[0061] According to the invention, the electric accumulator or generator 26 may be a battery or a battery backup connected to an electrical network.

[0062] According to an embodiment of the invention, the device 100 comprises a first electrical circuit 4.

[0063] According to an embodiment of the invention, the first electrical circuit 4 comprises at least one discharge electrode 5 connected to the output 31 of the voltage-booster circuit 1 to generate an electric discharge intended to ignite a flame on the gas burner 200 when the first electrical circuit 4 is powered by the output signal 3.

[0064] Such a feature is particularly useful to ensure the ignition of a flame in the gas burner 200 despite possible voltage variations in the input signal 2.

[0065] Figure 3 shows an embodiment of the first electrical circuit 4 of the device 100 according to the invention.

[0066] With reference to Figure 3, the first electrical circuit 4 comprises a transformer 28 provided with a primary winding 29 connected to the voltage-booster circuit 1 so as to be powered by the output signal 3. The transformer 28 further comprises a secondary winding 30 connected to the at least one discharge electrode 5.

[0067] The transformation ratio of the transformer 28 is preferably equal to 100.

[0068] The first electrical circuit 4 further comprises a capacitor 36 and a usually open Silicon Controlled Rectifier (SCR) 37.

[0069] The first electrical circuit 4 may lack the capacitor 36 if the device 100 is provided with the capacitor 53. In this case, the capacitor 53 performs the functions described below of the capacitor 36. With reference now to the SCR 37, it acts as a closed switch when a current (command signal 34) is provided to the Gate terminal thereof, allowing the passage of current between the Drain and Source terminals thereof.

[0070] Such a behavior is maintained by the SCR 37 as long as current flows between the Drain terminal and the Source terminal, even if the command signal on the Gate terminal is removed.

[0071] The command signal 34 is preferably generated by the control circuit 6.

[0072] When the SCR 37 is disabled, no current flows on the primary winding 29 of the transformer 28 and the capacitor 36 is charged by the output signal 3 at a voltage Vs (specifically, about 200 V).

[0073] In this condition there is no voltage at the ends of the primary winding 29, and therefore not even at the ends of the secondary winding 30.

[0074] To generate an electric discharge intended to ignite a flame in the gas burner 200, the capacitor 36 is charged and the command signal 34 is sent to the Gate terminal of the SCR 37 which thus passes to a conduction state, grounding the terminal of the primary winding 29.

[0075] Thereby, the voltage Vs is applied to the ends of the primary winding 29 of the transformer 28, and is returned to the ends of the secondary winding 30.

[0076] With the transformation ratio of the transformer 28 equal to 100, the voltage on the secondary winding 30 will thus be equal to about 20,000 V, sufficient to generate an electric discharge by means of at least one discharge electrode 5. In other words, the voltage on the secondary winding 30 allows generating a spark between two electrodes, one of which is grounded, or between an electrode and the burner.

[0077] Furthermore, the transformation ratio of the transformer 28 equal to 100 allows the primary winding 29 to have a low electrical resistance and a low inductance. This involves a rapid growth of the current in the primary winding 29 when the SCR 37 is triggered, with a consequent discharge of the capacitor 36.

[0078] The capacitor 36 with a capacitance C and the inductance L of the primary winding 29 of the transformer 28 create an oscillating circuit of the LC type, therefore, when the SRC 37 is in the conducting state, a frequency oscillation $f = {}^{1}/_{\sqrt{LC}}$ damped by the resistance of the primary winding 29 will be triggered on the circuit.

[0079] The SCR 37 returns to the rest condition (open switch) as soon as the oscillation stops (usually after a few hundred microseconds) and after having finished sending the command signal on the Gate terminal of the SCR 37. At this point, the capacitor 36 may be recharged so as to start a new cycle.

[0080] The energy of the spark is closely linked to the energy stored by the capacitor 36 (or by the capacitor 53 if the capacitor 36 is not present), therefore, it is important to keep the voltage at which such a capacitor is charged, i.e., the voltage of the output signal 3, constant.

[0081] According to an embodiment of the invention, the device 100 comprises a second electrical circuit 27 arranged to detect a flame on the gas burner 200.

[0082] According to an embodiment of the invention, the second electrical circuit 27 comprises a flame amplifier 38 connected to the output 31 of the voltage-booster circuit 1 to generate at the output point 48 thereof a predetermined signal 33 when it is powered by the output signal 3.

[0083] In particular, the predetermined signal 33 is an alternating voltage signal, preferably with a null average (without the DC component).

[0084] Specifically, the predetermined signal has a known amplitude.

[0085] The second electrical circuit 27 further comprises an ionization electrode 39 connected to the output point 48 of the flame amplifier 38 so as to be powered by the predetermined signal 33.

[0086] The ionization electrode 39 is designed to generate an ionization current 37 which causes the alteration of the predetermined signal 33 when the ionization electrode 39 is subjected to a flame.

[0087] In particular, such an alteration involves the addition of a DC component to the predetermined signal 33. Therefore, the predetermined signal 33, thus altered, has a non-null average.

[0088] The second electrical circuit 27 further comprises a detector device 49 connected to the output point 48 of the flame amplifier 38 to receive the predetermined signal 33 and configured to generate a flame signal 54 representative of the presence of a flame if the received predetermined signal is altered by the ionization current 37.

[0089] Specifically, the detector device 49 is arranged to receive the predetermined input signal 33 and to generate the output flame signal 54 if the predetermined signal received has a non-null average.

[0090] Such features are particularly useful to ensure the detection of a flame in the gas burner 200 despite possible voltage variations in the input signal 2.

[0091] In particular, the device 100 ensures a substantially constant feeding over time of the second electrical circuit 27 by means of the output signal 3.

[0092] Figure 4 shows an embodiment of the second electrical circuit 27.

[0093] With reference to Figure 4, the flame amplifier 38 of the second electrical circuit 27 comprises a voltage generator 41 adapted to generate a voltage signal Vg, preferably in the form of a square wave and with a frequency equal to about ten Hertz (for example 40 Hz), and a first transistor 42.

[0094] The first transistor 42 has the slip ring connected to the voltage-booster circuit 1 so as to be powered by the output signal 3, the base connected to the voltage generator 41 so that the voltage signal Vg is adapted to activate the first transistor 42 and the emitter connected to a resistor 43.

[0095] The system defined by voltage generator 41, first transistor 42 and resistor 43 constitutes a current generator having a value equal to the ratio between the voltage signal Vg and the resistance value of resistor 43 when the voltage signal Vg is at a high level and equal to zero when the voltage signal Vg is at a low level.

[0096] The voltage signal Vg generated by the voltage generator 41 may be controlled by the processing unit 16.

[0097] The first transistor 42 is connected to the voltage-booster circuit 1 by means of a resistor 44 and a capacitor 45 in parallel with such a resistor, so that when the first transistor 42 is active (traversed by current) the current of the slip ring thereof allows the capacitor 45 to be charged.

[0098] When the first transistor 42 is not active (not traversed by current), the capacitor 45 discharges on the resistor 44 in an exponential manner.

[0099] The flame amplifier 38 further comprises a second transistor 46 in a voltage follower configuration so as to reproduce at the emitter thereof the voltage present on the slip ring of the first transistor 42.

[0100] The flame amplifier 38 further comprises a capacitor 47 connected to the emitter of the second transistor 46 so as to remove the DC component of the signal present at such an emitter.

[0101] The other end of the capacitor 47 is connected to the output point 48 of the flame amplifier 38.

[0102] The voltage downstream of the capacitor 47 thus corresponds to the predetermined signal 33 generated by the flame amplifier 38.

[0103] The ionization electrode 39 is connected to the capacitor 47 at the output point 48, preferably by means of a corresponding resistor to limit the ionization current.

[0104] Therefore, at the output point 48, an alternating signal (in particular exponential) with a null average, i.e., without a DC component, will be there when the ionization electrode 39 is not subjected to a flame.

[0105] Given that the flame is characterized by the so-called "rectifying effect", i.e., it has a lower resistance (greater ionization current) to positive voltages than that shown for negative voltages (diode effect), in the presence of a flame the charges lost by the capacitor 47 during the positive half-wave of the voltage output from the emitter of the second transistor 46 will thus be greater than those recovered during the negative half-wave of such a voltage.

[0106] This involves a negative average voltage on the output point 48, i.e., it involves an alteration of the predetermined signal. The ionization current 37 thus alters the predetermined signal 33.

[0107] Again with reference to Figure 4, the detector device 49 of the second electrical circuit 27 comprises an operational amplifier 50 with an inverting input connected to the output point 48 by means of a resistor 51 and a noninverting input connected to the inverting one by means of a capacitor 52. The output of the operational amplifier 50 is connected to the inverting input by means of a further resistor 55 so that the operational amplifier 50 is adapted to generate an output voltage Vf representative of the presence of a flame. The flame signal 54 of the detector device 49 thus coincides with the voltage Vf generated by the operational amplifier 50.

[0108] By virtue of the particular configuration of the operational amplifier 50, the ratio between the voltage Vf and the amplitude of the voltage on the ionization electrode 39 is a function of the ratio between the flame resistance and the sum of the resistances of the resistors 51 and 55.

[0109] Specifically, in the absence of a flame on the ionization electrode 39, the voltage Vf is equal to zero.

[0110] Otherwise, in the presence of a flame on the ionization electrode 39, the voltage Vf is other than zero.

[0111] Therefore, keeping the amplitude of the voltage on the ionization electrode 39 constant over time is particularly important so as to reliably detect a flame on the gas burner 200.

[0112] This is ensured by virtue of the stability of the output signal 3, even in the presence of variations in the input signal 2.

[0113] According to an embodiment of the invention, a gas burner 200 comprises the device 100.

[0114] With reference to Figure 5, the gas burner 200 comprises a main burner 32 for generating a main flame. Preferably, the discharge electrode 5 of the first electrical circuit 4 is arranged close to the burner 32 to ignite the flame. Furthermore, the ionization electrode 39 of the second electrical circuit 27 is arranged close to the burner 32 to detect the presence of the flame on the latter during the operation thereof.

[0115] According to an embodiment of the invention, a boiler 300 comprises the gas burner 200.

[0116] Preferably, the boiler 300 comprises a main valve 35 placed upstream of the burner 32 to allow the passage and/or intercept a flow of gas directed to the burner 32.

[0117] According to the invention, the device 100 and/or the burner 200 may be associated with a space heating system or with a stove.

[0118] In accordance with the invention, the boiler 300 may be associated with a heating system for heating spaces.

[0119] The invention thus solves the suggested issue, while achieving at least one advantage mentioned above.

Claims

1. A driving device (100) of a flame circuit of a burner, in particular a gas burner (200), comprising:

    - a voltage-booster circuit (1) comprising an input (8) intended to be fed by a DC voltage input signal (2) and an output (31), said voltage-booster circuit (1) being configured to convert said input signal (2) into an output signal (3), so that said output signal (3) has a higher voltage than that of the input signal (2), and to provide said output signal (3) at said output (31), said output signal (3) being intended to power an electrical ignition circuit (4) designed to generate an electric discharge adapted to ignite a flame on the burner (200) and/or to power an electrical detection circuit (27) designed to detect a flame on the burner (200), **characterized in that** it further comprises:

• a control circuit (6) connected to said voltage-booster circuit (1) so as to define a closed loop control system of the voltage-booster circuit (1), wherein said control circuit (6) is configured to control said voltage-booster circuit (1) by means of a control signal (7) generated based on said output signal (3) and a desired DC voltage (9) so that the voltage of said output signal (3) substantially corresponds to said desired DC voltage (9).

2. A device according to claim 1, wherein said voltage-booster circuit (1) comprises a transformer (10) which comprises a primary circuit (11) connected to said input (8) to be fed by said input signal (2) and a secondary circuit (12) connected to said output (31) to generate said output signal (3) when it is powered by said primary circuit (11), said primary circuit (11) comprising a switching device (13) connected to the control circuit (6), said control circuit (6) being configured to control the opening and/or closing of said switching device (13) by means of said control signal (7) to open and/or close said primary circuit (11) so as to compensate for possible voltage drops in the output signal (3) due to voltage drops in the input signal (2).

3. A device according to claim 2, comprising a capacitor (53) connected to said voltage-booster circuit (1) between said secondary circuit (12) and said output (31) to accumulate the energy transferred by said primary circuit (11) to said secondary circuit (12) and provide it to said output (31).

4. A device according to one of the preceding claims, wherein said control signal (7) is a rectangular wave and said control circuit (6) comprises a processing unit (16) configured to vary the duty cycle of the control signal (7) based on said output signal (3) and said desired DC voltage (9).

5. A device according to claim 4, wherein said switching device (13) is arranged to take a closed state when said control signal (7) takes a high voltage level and to take an open state when said control signal (7) takes a low voltage level.

6. A device according to one of the preceding claims, comprising an electric accumulator or generator (26) connected to said voltage-booster circuit (1) and adapted to generate said input signal (2) to feed said voltage-booster circuit (1).

7. A device according to one of the preceding claims, **characterized in that** it is provided in combination with an electrical ignition circuit (4) comprising at least one discharge electrode (5) connected to the output (31) of said voltage-booster circuit (1) to generate an electric discharge intended to ignite a flame on said burner (200) when said electrical ignition circuit (4) is powered by said output signal (3).

8. A device according to claim 7, wherein the output (31) of the voltage-booster circuit (1) is connected to a terminal of the primary winding (29) of a transformer (28) having a capacitor (36) in parallel towards the ground, the other terminal of the primary winding (29) of the transformer (28) is grounded by means of an electronic switch (37), such as an SCR, for example, while the discharge electrode (5) is connected to the secondary winding (30) of the transformer (28) so that the capacitor (36) is charged up to the value of the voltage output from the elevator device (1) when the electronic switch (37) is open and discharges towards the ground when the electronic switch (37) is closed, transferring voltage to the secondary winding (30) of the transformer (28) thus powering the discharge electrode (5).

9. A device according to one of the preceding claims, **characterized in that** it is provided in combination with an electrical detection circuit (27) comprising a flame amplifier (38) connected to the output (31) of said voltage-booster circuit (1) to generate at an output point (48) a predetermined signal (33) when it is powered by said output signal (3), an ionization electrode (39) connected to said output point (48) so as to be powered by the predetermined signal (33) and designed to generate an ionization current (37) which causes the alteration of the predetermined signal (33) when said ionization electrode (39) is subjected to a flame, and a detector device (49) connected at said output point (48) to receive said predetermined signal (33) and configured to generate a flame signal (54) representative of the presence of a flame if the received predetermined signal is altered by said ionization current (37).

10. A device according to claim 9, wherein the predetermined signal (33) is an alternating signal with a null average value, with amplitude depending on the voltage output from the driving device (100), the ionization electrode (39) acting on the predetermined signal (33) by altering the average value thereof in the presence of a flame, the detector device (49) being configured to generate a flame signal (54) when the predetermined signal (33) has a non-null average value.

11. A gas burner (200) comprising a device (100) according to one of claims 1 to 10.

12. A boiler (300) comprising a gas burner (200) according to claim 11.

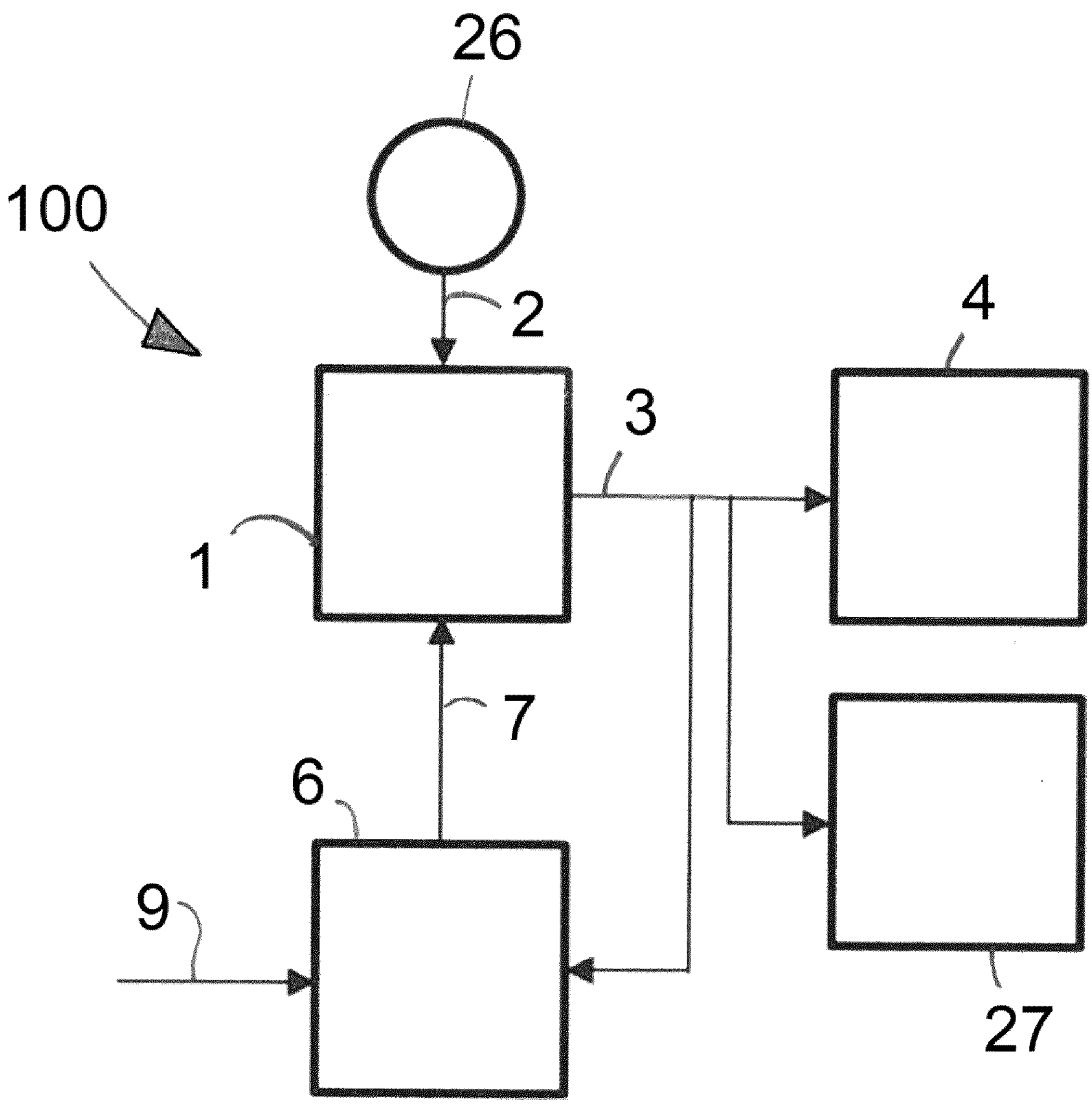

Fig. 1

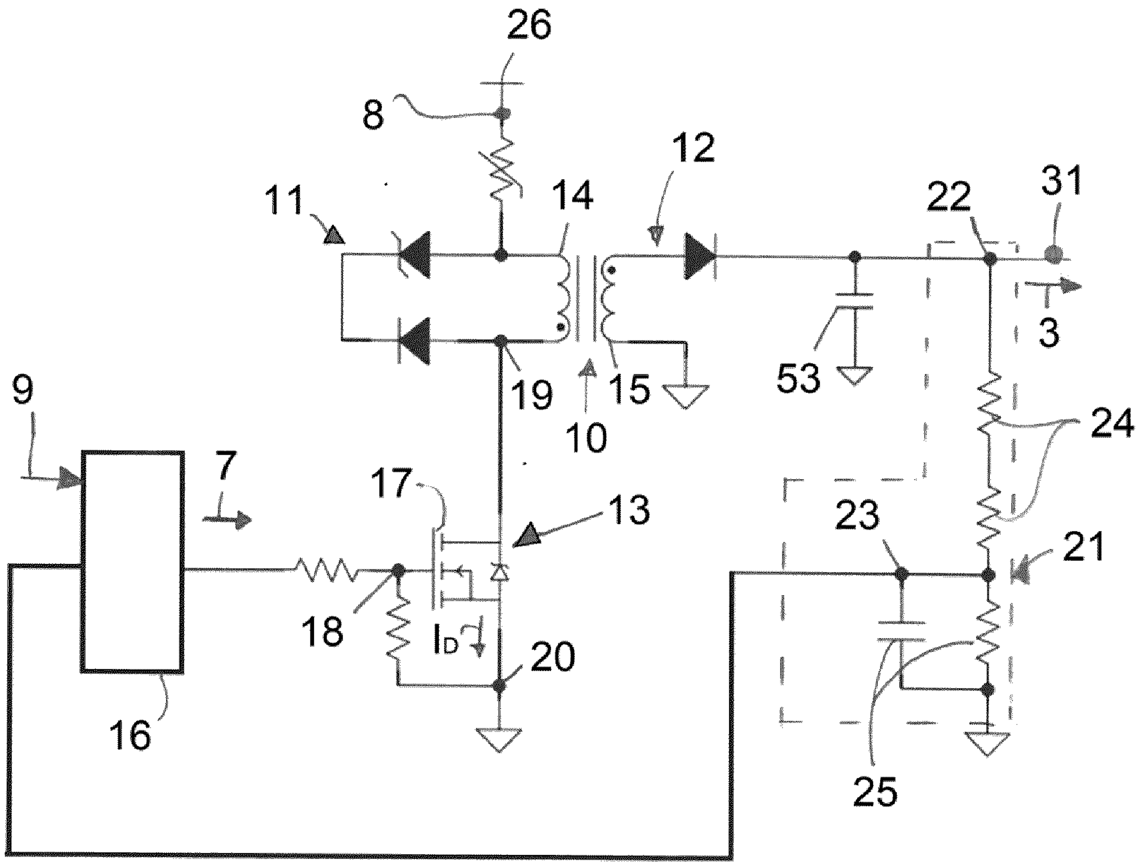

Fig. 2

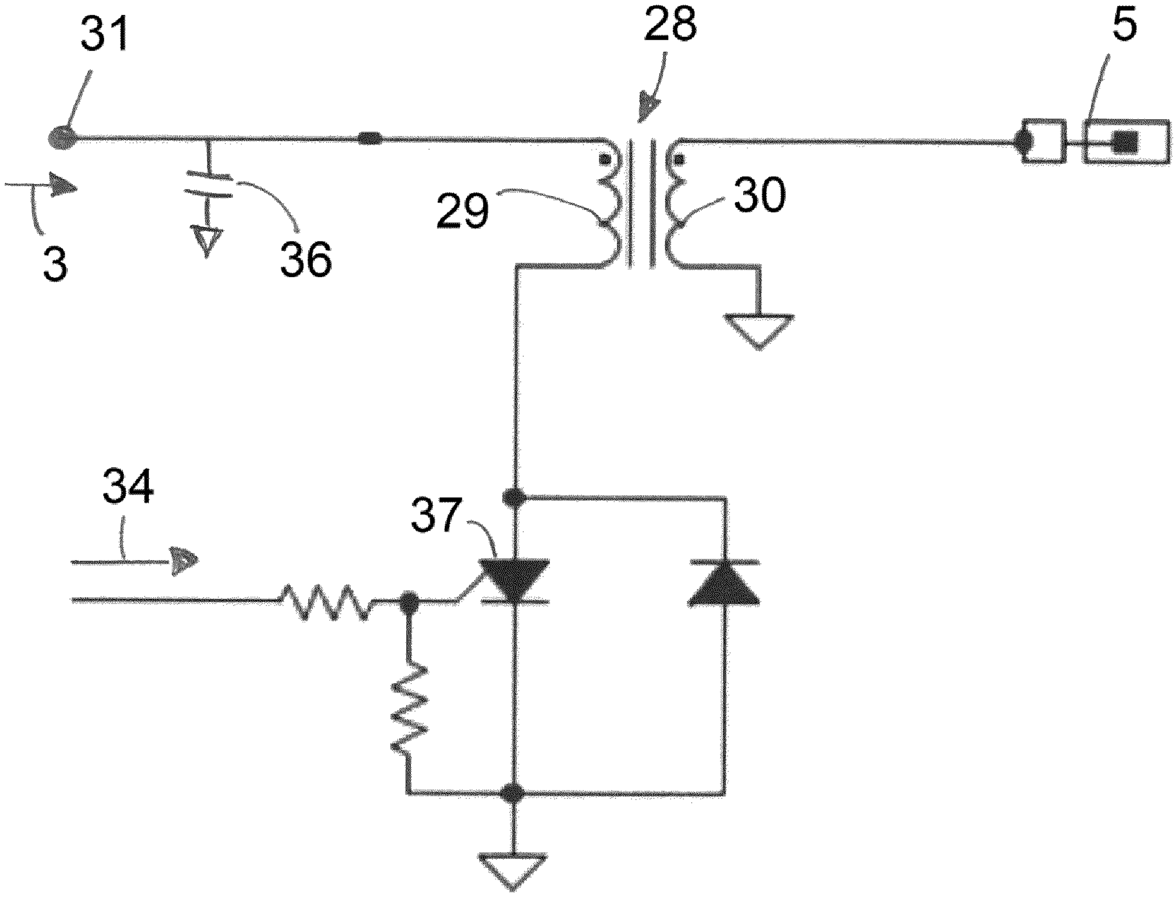

Fig. 3

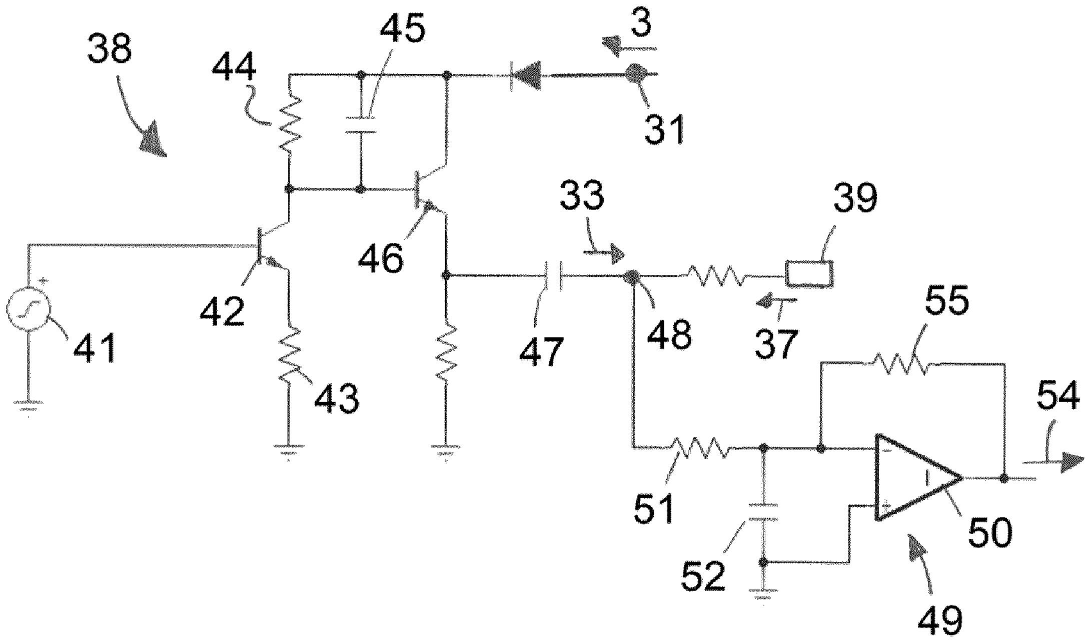

Fig. 4

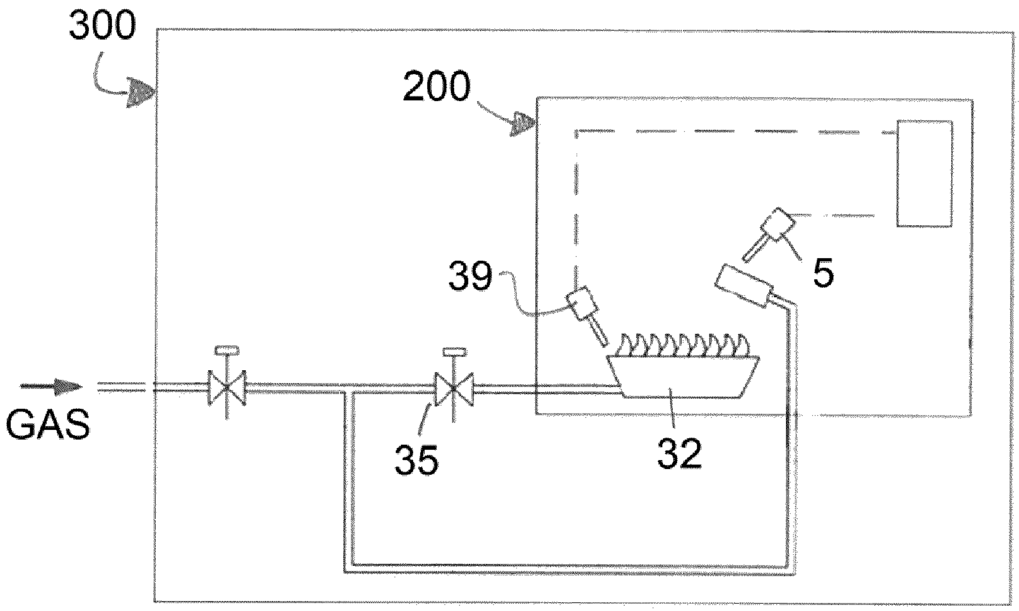

Fig. 5

EUROPEAN SEARCH REPORT

Application Number
EP 21 18 4523

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	CN 109 780 570 B (GREE ELECTRIC APPLIANCES INC ZHUHAI) 21 January 2020 (2020-01-21) * the whole document * -----	1-12	INV. F23N5/26 F23N5/12
A	US 6 222 719 B1 (KADAH ANDREW S [US]) 24 April 2001 (2001-04-24) * column 1, line 6 - line 25; figure 1 * * column 2, line 1 - line 21 * * column 3, line 48 - column 4, line 35 * -----	1-12	
A	US 2016/116170 A1 (HUANG CHUNG-CHIN [TW] ET AL) 28 April 2016 (2016-04-28) * paragraphs [0002], [0006] - [0008]; figures 2,3 * * paragraph [0014] - paragraph [0025] * -----	1-12	
			TECHNICAL FIELDS SEARCHED (IPC)
			F23N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 April 2022	Hauck, Gunther

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CATEGORY OF CITED DOCUMENTS

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04-04-2022

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CN 109780570	B	21-01-2020	NONE	
US 6222719	B1	24-04-2001	NONE	
US 2016116170	A1	28-04-2016	NONE	

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