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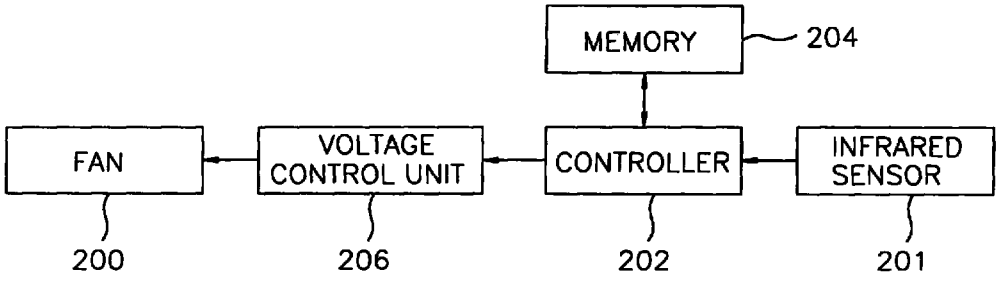
(54) Combustion control method for gas boiler

(57) A combustion control method for a gas boiler capable of maintaining a stable combustion state by using a flame voltage by means of an infrared sensor is provided. In the method, it is judged whether a flame voltage is higher than a reference forward wind flame voltage when combustion occurs in the gas boiler. A fan voltage is firstly controlled awhen the flame voltage is higher than the reference forward wind flame voltage and it is judged whether the flame voltage is lower than a reference reverse wind flame voltage when the flame voltage is lower than or equal to the reference forward wind flame voltage. The fan voltage is secondly controlled awhen the flame voltage is lower than the reference reverse wind flame voltage, and the first controlled fan voltage to an original fan voltage according to change amount of the fan voltage by the first control of the fan voltage or the second control of the fan voltage when the flame voltage is equal to or higher than the reference reverse wind flame voltage is compensated. According to the method, when a combustion is imperfect due to external environment such a forward or reverse wind, it can maintain a stable combustion by controlling a fan voltage.

FIG.2



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a gas boiler, more particularly, to a method for controlling a combustion state by using a flame voltage sensed by an infrared sensor when gas combustion occurs.

2. Prior Art

[0002] An infrared sensor serves to detect a temperature of a flame generated at a burner and generate a flame voltage corresponding to the temperature of the flame.

[0003] U.S. Patent No. 5,332,386(issued to Hosome Kazunari et al. on July 24, 1994) discloses a combustion control method.

[0004] FIG. 1 shows a configuration of a conventional gas boiler. As shown in FIG. 1, the conventional gas boiler includes a gas valve 104, a controller 105, a burner 106, a spark plug 107, a water tank 114, a cross valve 116, a heat exchanger 118, a hot-water feeding tube 120, a flow valve 130, and a cycle pump 132.

[0005] When gas is fed into a burner 106 by switching the gas valve 104, a spark generated by the spark plug 107 lights the gas. Then, a flame is generated at the burner 106. At this time, the infrared sensor 109 detects the temperature of the flame and outputs combustion temperature corresponding to the temperature of the flame to the controller 105. That is, information of combustion is outputted to the controller 105.

[0006] A combustion gas of high temperature rises. The heat exchanger 118 is installed at an upper part of the burner 106 through which the combustion gas flows to heat the warm water and cold water. The warm water circulates in the heat exchanger 111. The cold water, which goes through the cold water feeding tube 126, is heated in the heat exchanger 118. As a result, both cold water and warm water are heated by the combustion in the burner 106.

[0007] The cross valve 116 is controlled to circulate the warm water in a heating mode, and to feed warm water in a hot-water mode. Detection of the hot-water mode is determined by detecting the cold water being fed to the flow valve 130.

[0008] At the heating mode, the warm water heated by the heat exchanger 118 is fed to a warm water tube (not shown) through the hot-water feeding tube 120. Then the warm water is returned to the water tank 114 through the warm water return tube 112. The warm water loses heat while the warm water flows through warm water tube (not shown). The returned warm water is again fed to the heat exchanger 118 through the cross valve 116 and the cycle pump 132. The warm water being fed is again heated at the heat exchanger 118 and is outputted through the hot-water feeding tube 126. The cross valve 116 is provided to control water flow. At the heating mode, the flow cycle of the warm water includes the water tank 114 and the heat exchanger 118. Meanwhile, at the water warming mode, the flow cycle of the warm water includes the cycle pump 132 and the heat exchanger 118.

[0009] With the conventional gas boiler, defective combustion or oxygen over-combustion occurs due to some outside influences, that is, a forward wind or a reverse wind. In addition, when the forward or reverse wind strengthens, the conventional gas boiler is often extinguished. As a result, the life cycle of the conventional boiler is shortened. Also, the warming operation malfunctions.

SUMMARY OF THE INVENTION

[0010] Therefore, it is an object of the present invention, for the purpose of solving the above mentioned problems, to provide a combustion control method for a gas boiler capable of maintaining a stable combustion state by using a flame voltage by means of an infrared sensor.

[0011] In order to attain the object, according to the present invention, there is provided a combustion control method for a gas boiler, said method comprising the steps of:

(a) judging whether a flame voltage is higher than a reference forward wind flame voltage when combustion occurs in the gas boiler;
(b) firstly controlling a fan voltage when the flame voltage is higher than the reference forward wind flame voltage and judging whether the flame voltage is lower than a reference reverse wind flame voltage when the flame voltage is lower than or equal to the reference forward wind flame voltage; and
(c) controlling the fan voltage when the flame voltage is lower than the reference reverse wind flame voltage, and compensating the first controlled fan voltage to an original fan voltage according to change amount of the fan voltage by the first control of the fan voltage or the second control of the fan voltage when the flame voltage is equal to or higher than the reference reverse wind flame voltage, in step (b).

[0012] Also, there is provided a combustion control method for a gas boiler,combustion control method for a gas boiler, said method comprising the steps of:

(i) setting a forward wind sensing flag, a reverse wind sensing flag, and a fan voltage change amount to a first logical value, the first logical value, and a predetermined value, respectively;
(ii) judging whether the forward wind sensing flag is

set to a second logical value or whether a combustion flame voltage is higher than a reference forward wind combustion voltage;

(iii) firstly controlling a combustion fan voltage when the forward wind sensing flag is set to the second logical value or the combustion flame voltage is higher than the reference forward wind combustion voltage, and judging whether the reverse wind sensing flag is set to the second logical value or whether the combustion flame voltage is lower than a reference reverse wind combustion voltage when the forward wind sensing flag is set to the first logical value and the combustion flame voltage is lower than or equal to the reference forward wind combustion voltage;

(iv) secondly controlling the combustion fan voltage when the reverse wind sensing flag is set to the second logical value or the combustion flame voltage is lower than the reference reverse wind combustion voltage, and compensating the combustion fan voltage to an original fan voltage according to a fan voltage amount by the first and second control of the combustion fan voltage when the reverse wind sensing flag is set to the first logical value and the combustion flame voltage is equal to or higher than the reference reverse wind combustion voltage.

[0013] According to the present invention, when a combustion is imperfect due to external environment such a forward or reverse wind, it can maintain a stable combustion by controlling a fan voltage. The present invention controls a control time of a fan voltage to thereby control the flame voltage. The present invention has a variety of change widths of a flame voltage by using both a reference flame voltage and a threshold flame voltage to thereby maintain a stable combustion state sensitively.

[0014] Other objects and further features of the present invention will become apparent from the detailed description when read in conjunction with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Other features and advantages of the present invention will become more apparent from the following description taken in connection with the accompanying drawings, wherein:

FIG. 1 is a view, for showing a configuration of a conventional gas boiler;

FIG. 2 is a block diagram for showing a configuration of a combustion control apparatus according to an embodiment of the present invention;

FIG. 3 is a graph for showing a combustion state according to the relationship between a gas consumption amount and a flame voltage in accordance with a first embodiment of the present invention;

FIG. 4 is a flow chart for illustrating a combustion control method according to the first embodiment of the present invention;

FIG. 5 is a graph for showing a combustion state according to the relationship between a gas consumption amount and a flame voltage in accordance with a second embodiment of the present invention; and

FIG. 6 is a flow chart for illustrating a combustion control method according to the second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0016] The preferred embodiment of the present invention will hereinafter be described in detail with reference to the accompanying drawings.

[0017] FIG. 2 shows a configuration of a combustion control apparatus 20 according to an embodiment of the present invention. The combustion control apparatus 20 includes an infrared sensor 201, a controller 202, a memory 204, and a voltage control unit 206.

[0018] The infrared sensor 201 detects a temperature of a flame generated at a burner and generates a flame voltage corresponding to the temperature of the flame.

[0019] The controller 202 judges whether a flame voltage is higher than a reference forward wind flame voltage when combustion occurs in the gas boiler. The controller 202 firstly controls a fan voltage when the flame voltage is higher than the reference forward wind flame voltage and judges whether the flame voltage is lower than a reference reverse wind flame voltage when the flame voltage is lower than or equal to the reference forward wind flame voltage, in the step. The controller 202 controls the fan voltage when the flame voltage is lower than the reference reverse wind flame voltage, and compensates the first controlled fan voltage to an original fan voltage according to the change amount of the fan voltage by the first control of the fan voltage or the second control of the fan voltage when the flame voltage is equal to or higher than the reference reverse wind flame voltage. The memory 204 stores the change amount of the fan voltage by the first or second control of the fan voltage under of the controller 202. The voltage control unit 206 adjusts a fan voltage which is applied to the fan 200 under control of the controller 202.

[0020] FIG. 3 is a graph for showing a combustion state according to the relationship between a gas consumption amount and a flame voltage in accordance with a first embodiment of the present invention. The flame voltage Vc is defined as the voltage which is transferred from the temperature of the flame generated during the combustion. In general, the flame voltage

varies according to the color variance of the flame being generated during the combustion. In an embodiment of the present invention, the flame voltage preferably ranges from 0 to 5 volts. As shown in FIG. 3, at a predetermined gas consumption amount, the excess combustion voltage indicates that the present combustion situation is in the forward wind situation. However, the deficient combustion voltage indicates that the present combustion situation is in the reverse wind situation. The forward wind situation is defined as the situation that too much air is supplied so that oxygen-over combustion occurs. The reverse wind situation is defined as the situation that some exhaust gas flows backward so that incomplete combustion occurs. The normal combustion region shown in FIG. 3 is divided by the upper combustion voltage line (Vfmax) and the lower combustion voltage line (Vfmin).

[0021] Hereinafter, the combustion control method according to the first embodiment of the present invention will be described referring to FIG. 4. FIG. 4 is a flow chart for illustrating a combustion control method according to the first embodiment of the present invention.

[0022] In step S401, the controller 202 judges whether or not a combustion flame voltage Vf sensed by an infrared sensor 201 is higher than a reference forward wind voltage Vfmax for 2 seconds when combustion occurs in the gas boiler.

[0023] As a result of the judgement in step S401, when the combustion flame voltage Vf is higher than the reference forward wind voltage Vfmax, the controller 202 judges that a present combustion of gas boiler is in a forward state and controls a voltage control unit 206 to subtract an alternating current power(AC) 10 volts from a combustion fan voltage V_F (step S402). Then the controller 202 controls a memory 204 to store a fan voltage change amount ΔV_F with respect to the combustion fan voltage Vf according to subtraction of step S402(step S403). Then the routine returns to step S401.

[0024] To the contrary, when it is judged that the combustion flame voltage Vf is lower than or equal to the reference forward wind voltage Vfmax, the controller 202 judges whether or not the combustion flame voltage Vf is lower than a reference reverse wind voltage Vfmin for 2 seconds (step S404).

[0025] As a result of the judgement in step S404, when the combustion flame voltage Vf is lower than the reference reverse wind voltage Vfmin, the controller 202 judges that a combustion of gas boiler is in a reverse wind state and controls a voltage control unit 206 to add an alternating current power(10 volts) to the combustion fan voltage V_F (step S405). Then the controller 202 controls a memory 204 to store a voltage change amount ΔV_F with respect to the combustion fan voltage V_F according to the addition of step S405 (step S406). Then the routine returns to step S401.

[0026] To the contrary, when it is judged that the combustion flame voltage Vf is equal to or higher than the reference reverse wind voltage Vfmin, that is, when $Vfmin \leq Vf \leq Vfmax$, the controller 202 judges that a combustion of gas boiler is a normal state and judges whether a voltage change amount ΔV_F which is stored in memory 204 is zero(step S407).

[0027] As a result of the judgement in step S407, when the stored voltage change amount ΔV_F is zero, the routine returns to step S401. When it is judged that the stored voltage change amount ΔV_F is not zero in step S407, the controller 202 judges whether or not the stored voltage change amount ΔV_F is larger than zero (step S408).

[0028] As a result of the judgement in step S408, the controller 202 controls the voltage control unit 206 to subtract the voltage change amount ΔV_F from the combustion fan voltage V_F(step S409). That is, since it is judged the present combustion of the gas boiler is in a reverse wind state in step S404 so that an AC 10 volts is added to the combustion fan voltage V_F in step S405, the combustion fan voltage V_F increased in the reverse wind state is compensated by the voltage change amount ΔV_F in step S409. When it is judged that the stored voltage change amount ΔVf is less than zero in step S408, the controller 202 adds the voltage change amount ΔVf to the combustion fan voltage V_F. That is, since it is judged the combustion of the gas boiler is in a forward wind state in step S401 so that an AC 10 volts is subtracted from the combustion fan voltage V_F in step S402, the combustion fan voltage V_F reduced in the forward wind state is compensated by the voltage change amount ΔV_F in step S410. After performing step S409 or step S410, the routine returns to step S401.

[0029] FIG. 5 is a graph for showing a combustion state according to the relationship between a gas consumption amount and a flame voltage in accordance with a second embodiment of the present invention. The flame voltage Vc is defined as the voltage which is transferred from the temperature of the flame generated during the combustion. In general, the flame voltage varies according to the color variance of the flame being generated during the combustion. In an embodiment of the present invention, the flame voltage preferably ranges from 0 to 5 volts. As shown in FIG. 5, at a predetermined gas consumption amount, the excess combustion voltage indicates that the present combustion situation is in the forward wind situation. However, the deficient combustion voltage indicates that the present combustion situation is in the reverse wind situation. The forward wind situation is defined as the situation that too much air is supplied so that oxygen over-combustion occurs. The reverse wind situation is defined as the situation that some exhaust gas flows backward so that incomplete combustion occurs. The normal combustion region shown in FIG. 5 is divided by the upper combustion voltage line (Vfmax) and the lower combustion voltage line (Vfmin). V_{FT} and V_{RT} are forward and reverse wind threshold flame voltages, respectively. In an embodiment of the present invention, preferably,

V_{FT} = Vfmax-DC 0.2V and V_{RT} = Vfmin + DC 0.2V .

[0030] Hereinafter, the combustion control method according to the second embodiment of the present invention will be described referring to FIG. 6. FIG. 6 is a flow chart for illustrating a combustion control method according to the second embodiment of the present invention.

[0031] In step S601, the controller 202 sets a forward wind sensing flag F_f and a reverse wind sensing flag F_r to "0" and sets a fan voltage change amount ΔV_F to zero volts. In an embodiment of the present invention, when a combustion flame voltage Vf < a forward wind threshold flame voltage V_{FT}, a forward wind sensing flag F_f is set to a first logical value, that is, "0", and when Vf $\geq V_{FT}$, a forward wind sensing flag F_f is set to a second logical value, that is, "1". Also, when a combustion flame voltage Vf > a reverse wind threshold flame voltage V_{RT}, a reverse wind sensing flag F_r is set to "0" and when Vf $\leq V_{RT}$, a reverse wind sensing flag F_r is set to "1".

[0032] In step S602, the controller 202 judges whether or not a forward wind sensing flag F_f is set to "1" or whether or not a combustion flame voltage Vf sensed by an infrared sensor 201 is higher than a reference forward wind flame voltage Vfmax for 2 seconds when combustion occurs in the gas boiler.

[0033] As a result of the judgement in step S602, when the forward wind sensing flag F_f is set to "1" or the combustion flame voltage Vf is higher than the reference forward wind flame voltage Vfmax, the controller 202 judges that a combustion of gas boiler is in a forward wind state and judges whether or not the combustion flame voltage Vf is lower than or equal to a forward wind threshold flame voltage V_{FT} (step S603).

[0034] As a result of the judgement in step S603, when the combustion flame voltage Vf is lower than or equal to the forward wind threshold flame voltage V_{FT}, the controller 202 sets the forward wind sensing flag F_f to "0" (step S604) and the routine returns to step S602. To the contrary, when it is judged that the combustion flame voltage Vf is higher than the forward wind threshold flame voltage V_{FT} in step S603, the controller 202 sets the forward wind sensing flag F_f to "1", controls a voltage control unit 206 to subtract an alternating current power(AC) 10 volts from a combustion fan voltage V_F, controls the voltage control unit 206 to subtract a voltage of 10 volts from the fan voltage change amount ΔV_F set in step S601 and stores the subtracted fan voltage change amount in the memory 204(step S605). Then the routine returns to step S602.

[0035] To the contrary, when it is judged the forward wind sensing flag F_f is set to "0" and the combustion flame voltage Vf is lower than or equal to the reference forward wind flame voltage Vfmax, the controller 202 judges whether or not a reverse wind sensing flag F_r is set to "1" or whether or not the combustion flame voltage Vf is lower than a reference reverse wind voltage Vfmin for 2 seconds when combustion occurs in the gas boiler (step S606).

[0036] As a result of the judgement in step S606, when the reverse wind sensing flag F_r is set to "1" or the combustion flame voltage Vf is lower than the reference reverse wind voltage Vfmin, the controller 202 judges that the combustion of gas boiler is in a reverse wind state and judges whether or not the combustion flame voltage Vf is equal to or higher than a reverse wind threshold flame voltage V_{RT} (step S607).

[0037] As a result of the judgement in step S607, when the combustion flame voltage Vf is higher than or equal to the reverse wind threshold flame voltage V_{RT}, the controller 202 sets the reverse wind sensing flag F_r to "0" (step S608) and the routine returns to step S602. To the contrary, when it is judged that the combustion flame voltage Vf is higher than the forward wind threshold flame voltage V_{FT} in step S607, the controller 202 sets the reverse wind sensing flag F_r to "1", controls a voltage control unit 206 to add an AC power of 10 volts to the combustion fan voltage V_F, controls the voltage control unit 206 to add a voltage of 10 volts to the fan voltage change amount ΔV_F set in step S601 and stores the added fan voltage change amount in the memory 204 (step S609). Then the routine returns to step S602.

[0038] To the contrary, when it is judged that the reverse wind sensing flag F_r is set to "0" and the combustion flame voltage Vf is equal to or higher than the reference reverse wind voltage Vfmin (that is, $V_{RT} \leq$ Vf $\leq$ Vfmax), the controller 202 judges that the combustion of gas boiler is in a normal state and judges whether a voltage change amount ΔVf which is stored in memory 204 is zero volt (step S610).

[0039] As a result of the judgement in step S610, when the stored voltage change amount ΔV_F is zero volt, the routine returns to step S602. When it is judged that the stored voltage change amount ΔV_F is not zero in step S610, the controller 202 judges whether or not the stored voltage change amount ΔV_F is higher than zero volts (step S611).

[0040] As a result of the judgement in step S611, when the stored fan voltage change amount ΔV_F is lower than zero volt, the controller 202 judges whether or not the combustion flame voltage Vf is lower than or equal to a forward wind threshold flame voltage V_{FT}(step S612).

[0041] As a result of the judgement in step S612, when the combustion flame voltage Vf is lower than or equal to the forward wind threshold flame voltage V_{FT}, the controller 202 controls the voltage control unit 206 to add a voltage of AC 10 volts to the combustion fan voltage V_F to thereby compensate the fan voltage change amount reduced in step S605 by it, and adds a voltage of 10 volts to the stored fan voltage change amount (step S613).

[0042] That is, it is judged that the combustion of the gas boiler is in the forward wind state in step S602 and the combustion flame voltage Vf is higher than the forward wind threshold flame voltage V_{FT} in step S603, so that a voltage of AC 10 volts is subtracted from the

combustion flame voltage Vf in step S605. Then it is judged that the stored fan voltage change amount ΔV_F is lower than zero volt and the combustion flame voltage Vf in step S612 is lower than or equal to the forward wind threshold flame voltage V_{FT}. Accordingly, in step S613, a voltage corresponding to the fan voltage change amount reduced in step S605 is compensated . Then 1 second passes (step S614) and the routine returns to step S602.

[0043] To the contrary, when it is judged that the combustion flame voltage Vf is higher than the forward wind threshold flame voltage V_{FT} in step S612, the controller 202 judges that $V_{FT} \leq Vf \leq Vfmax$ and adds a voltage of AC 5 volts to the combustion flame voltage Vf so that the fan voltage change amount reduced in step S605 is compensated by a half thereof, and adds a voltage of 5 volts to the fan voltage change amount ΔV_F (step S615).

[0044] That is, it is judged that the combustion of the gas boiler is in the forward wind state in step S602 and the combustion flame voltage Vf is higher than the forward wind threshold flame voltage V_{FT}, so that a voltage of AC 10 volts is subtracted from the combustion flame voltage Vf in step S605. Then it is judged that the stored fan voltage change amount ΔV_F is lower than zero volt step S611 and the combustion flame voltage Vf in step S612 is higher than the forward wind threshold flame voltage V_{FT}. Accordingly, in step S615, a half by a half of a voltage corresponding to the fan voltage change amount reduced in step S605 is gradually compensated. In other words, since $V_{FT} \leq Vf \leq Vfmax$ in step S612, the combustion fan voltage reduced in step S605 is gradually compensated by a half by a half of the reduced fan voltage change amount. Then 2 seconds pass (step S616) and the routine returns to step S602.

[0045] As a result of the judgement in step S611, when the stored fan voltage change amount ΔV_F is higher than zero volt, the controller 202 judges whether or not the combustion flame voltage Vf is equal to or higher than the reverse wind threshold flame voltage V_{RT}(step S617).

[0046] As a result of the judgement in step S617, when the combustion flame voltage Vf is equal to or higher than the reverse wind threshold flame voltage V_{RT}, the controller 202 controls the voltage control unit 206 to subtract a voltage of AC 5 volts from the combustion fan voltage V_F to thereby compensate the fan voltage change amount increased in step S609 by it, and subtracts a voltage of 10 volts from the stored fan voltage change amount(step S618).

[0047] That is, it is judged that the combustion of the gas boiler is in the reverse wind state in step S602 and the combustion flame voltage Vf is lower than the reverse wind threshold flame voltage V_{RT} in step S607, so that a voltage of AC 10 volts is added to the combustion flame voltage Vf in step S609. Then it is judged that the stored fan voltage change amount ΔV_F is higher than zero volt in step S611 and the combustion flame voltage Vf in step S617 is equal to or higher than the reverse wind threshold flame voltage V_{RT}. Accordingly, in step S618, a voltage corresponding to the fan voltage change amount increased in step S609 is compensated. Then 1 second is passed (step S619) and the routine returns to step S602.

[0048] To the contrary, when it is judged that the combustion flame voltage Vf is lower than the reverse wind threshold flame voltage V_{RT} in step S617, the controller 202 judges that $Vfmin \leq Vf \leq V_{RT}$ and subtracts a voltage of AC 5 volts from the combustion flame voltage Vf so that the fan voltage change amount increased in step S605 is compensated by a half thereof, and subtracts a voltage of 5 volts to the fan voltage change amount ΔV_F (step S620).

[0049] That is, it is judged that the combustion of the gas boiler is in the reverse wind state in step S606 and the combustion flame voltage Vf is lower than the reverse wind threshold flame voltage V_{RT} in step S607 so that a voltage of AC 10 volts is added to the combustion flame voltage Vf in step S609. Then it is judged that the stored fan voltage change amount ΔV_F is higher than zero volt in step S611 and the combustion flame voltage Vf in step S617 is lower than the reverse wind threshold flame voltage V_{RT}. Accordingly, in step S620, a half by a half of a voltage corresponding to the fan voltage change amount increased in step S609 is gradually compensated. In other words, since $Vfmin \leq Vf \leq V_{RT}$ in step S617, the combustion fan voltage increased in step S609 is gradually compensated by a half by a half of the reduced fan voltage change amount. Then 2 seconds are passed(step S621) and the routine returns to step S602.

[0050] In accordance with the present invention, when a combustion is imperfect due to external environment such a forward or reverse wind, it can maintain a stable combustion by controlling a fan voltage. The present invention controls a control time of a fan voltage to thereby control the flame voltage. The present invention has a variety of change widths of a flame voltage by using both a reference flame voltage and a threshold flame voltage to thereby maintain a stable combustion state sensitively.

[0051] The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

Claims

1. A combustion control method for a gas boiler, said method comprising the steps of:

(a) judging whether a flame voltage is higher than a reference forward wind flame voltage when combustion occurs in the gas boiler;

(b) firstly controlling a fan voltage when the flame voltage is higher than the reference forward wind flame voltage and judging whether the flame voltage is lower than a reference reverse wind flame voltage when the flame voltage is lower than or equal to the reference forward wind flame voltage; and

(c) controlling the fan voltage when the flame voltage is lower than the reference reverse wind flame voltage, and compensating the first controlled fan voltage to an original fan voltage according to change amount of the fan voltage by the first control of the fan voltage or the second control of the fan voltage when the flame voltage is equal to or higher than the reference reverse wind flame voltage, in step (b).

2. The method as defined in claim 1, wherein the first control step of the combustion flame voltage in step (b) includes subtracting a predetermined voltage from the combustion fan voltage and storing voltage change amount with respect to the combustion fan voltage according to the subtraction;

the second control step of the combustion flame voltage in step (c) includes adding a predetermined voltage to the combustion fan voltage and storing voltage change amount with respect to the combustion fan voltage according to the addition.

3. The method as defined in claim 1, wherein when the change amount of the fan voltage by the first or second control of the fan voltage is positive and negative, the compensating step in step (c) includes subtracting the fan voltage change amount from the combustion fan voltage and adding the fan voltage change amount to the combustion fan voltage, respectively.

4. A combustion control method for a gas boiler, said method comprising the steps of:

(i) setting a forward wind sensing flag, a reverse wind sensing flag, and a fan voltage change amount to a first logical value, the first logical value, and a predetermined value, respectively;

(ii) judging whether the forward wind sensing flag is set to a second logical value or whether a combustion flame voltage is higher than a reference forward wind combustion voltage;

(iii) firstly controlling a combustion fan voltage when the forward wind sensing flag is set to the second logical value or the combustion flame voltage is higher than the reference forward wind combustion voltage, and judging whether the reverse wind sensing flag is set to the second logical value or whether the combustion flame voltage is lower than a reference reverse wind combustion voltage when the forward wind sensing flag is set to the first logical value and the combustion flame voltage is lower than or equal to the reference forward wind combustion voltage; and

(iv) secondly controlling the combustion fan voltage when the reverse wind sensing flag is set to the second logical value or the combustion flame voltage is lower than the reference reverse wind combustion voltage, and compensating the combustion fan voltage to an original fan voltage according to a fan voltage amount by the first and second control of the combustion fan voltage when the reverse wind sensing flag is set to the first logical value and the combustion flame voltage is equal to or higher than the reference reverse wind combustion voltage.

5. The method as defined in claim 4, wherein step (iii) judging whether the combustion flame voltage is lower than or equal to a forward wind threshold flame voltage, and setting the forward wind sensing flag to the first logical value when the combustion flame voltage is lower than or equal to a forward wind threshold flame voltage, and setting the forward wind sensing flag to the second logical value, subtracting a predetermined value from the combustion fan voltage and subtracting a predetermined voltage from the fan voltage change amount; and

the second control step of the combustion fan in step (iv) includes judging whether the combustion flame voltage is equal to or equal to a reverse wind threshold flame voltage, and setting the reverse wind sensing flag to the first logical value when the combustion flame voltage is equal to or higher than the reverse wind threshold flame voltage, and setting the reverse wind sensing flag to the second logical value, adding the predetermined value to the combustion fan voltage and adding the predetermined voltage to the fan voltage change amount.

6. The method as defined in claim 4, wherein when the change amount of the fan voltage by the first or second control of the fan voltage is positive, the compensating step in step (iv) includes (iv-1) judging whether the combustion flame voltage is lower than or equal to a forward wind threshold flame voltage, and (iv-2) adding a predetermined voltage or a half of the predetermined voltage to the fan voltage

according to the judgement result in step (iv-1), adding the predetermined voltage or the half of the predetermined voltage to the fan voltage amount set in step (i), executing step (ii) after a first or second predetermined time passes; and when the change amount of the fan voltage by the first or second control of the fan voltage is negative, the compensating step in step (iv) includes (iv-i) judging whether the combustion flame voltage is higher than or equal to a reverse wind threshold flame voltage, and (iv-ii) subtracting the predetermined voltage or the half of the predetermined voltage to the fan voltage according to the judgement result in step (iv-i), subtracting the predetermined voltage or the half of the predetermined voltage to the fan voltage amount set in step (i), and executing step (ii) after the first or second predetermined time passes.

FIG. 1
PRIOR ART

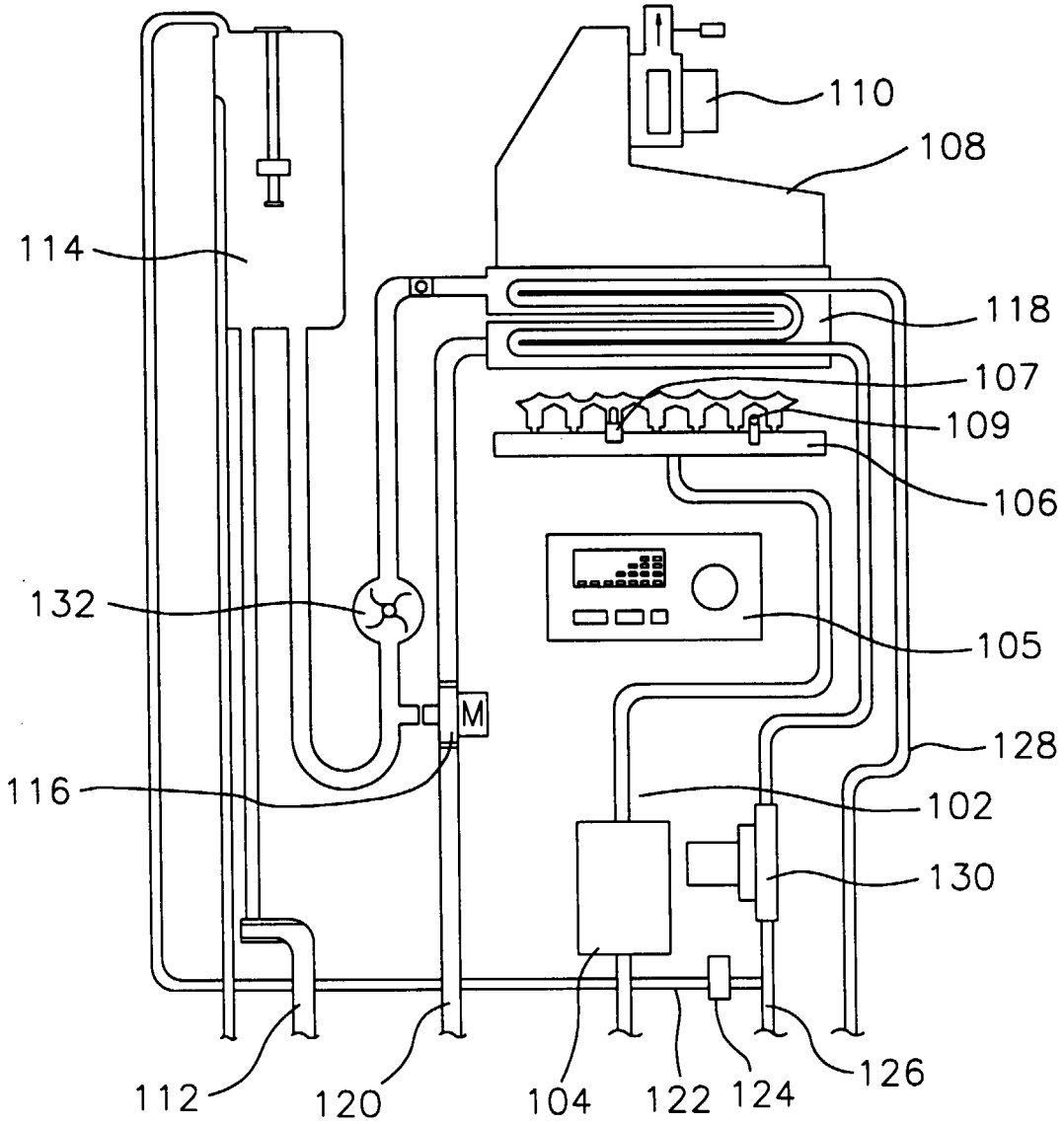


FIG.2

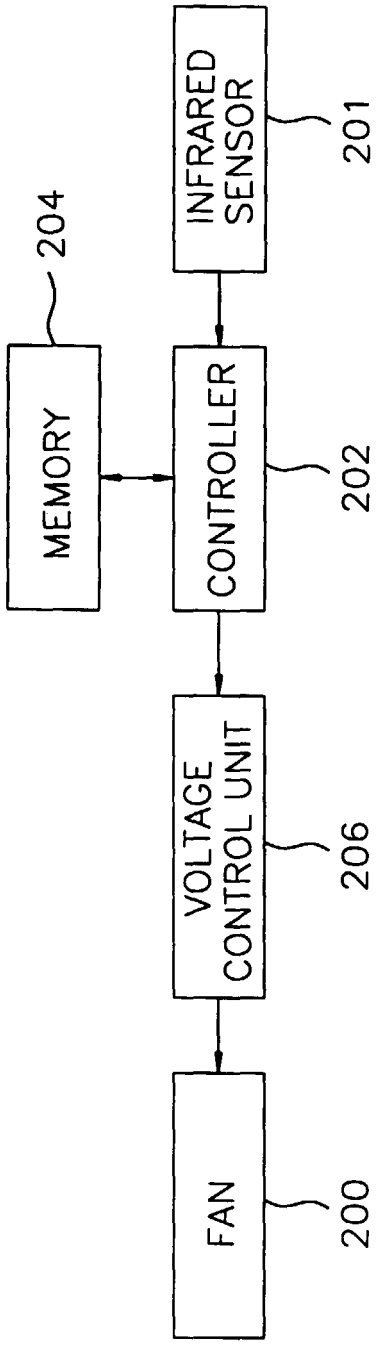

INFRARED SENSOR
201
204
MEMORY
CONTROLLER
202
VOLTAGE CONTROL UNIT
206
FAN
200

FIG.3

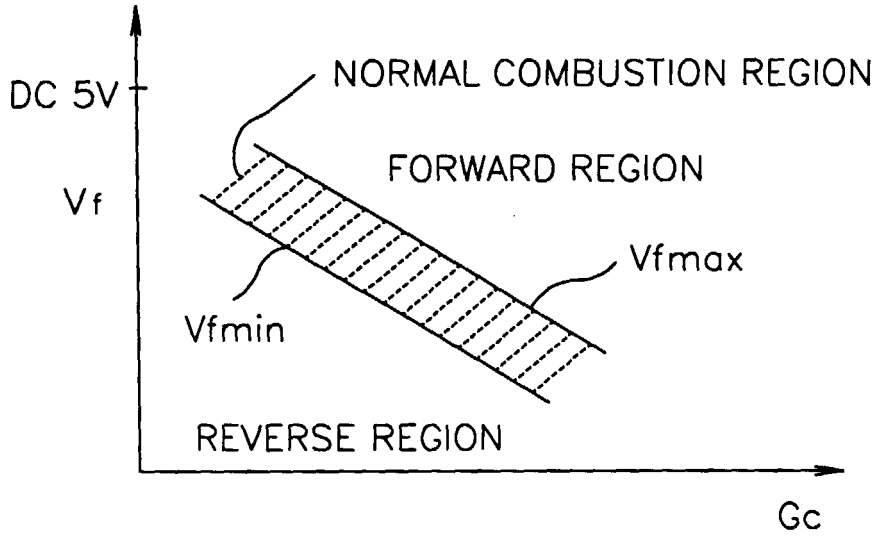

DC 5V
Vf
NORMAL COMBUSTION REGION
FORWARD REGION
Vfmax
Vfmin
REVERSE REGION
Gc

FIG.4

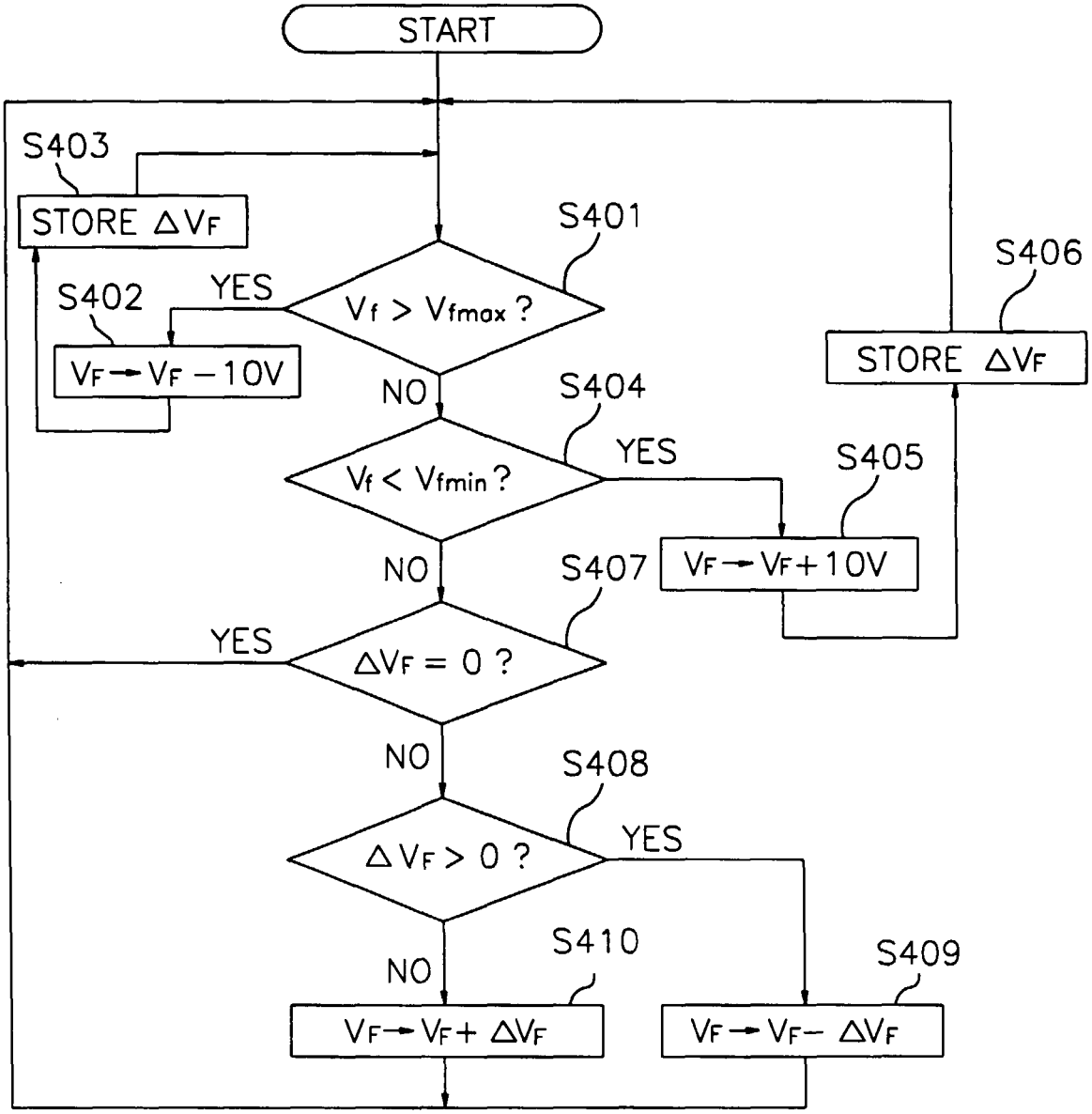

START
S403
STORE ΔVF
S401
Vf > Vfmax ?
YES
S402
VF → VF − 10V
NO
S404
Vf < Vfmin ?
YES
S405
VF → VF + 10V
NO
S407
ΔVF = 0 ?
YES
NO
S408
ΔVF > 0 ?
YES
S410
VF → VF + ΔVF
NO
S409
VF → VF − ΔVF
S406
STORE ΔVF

FIG.5

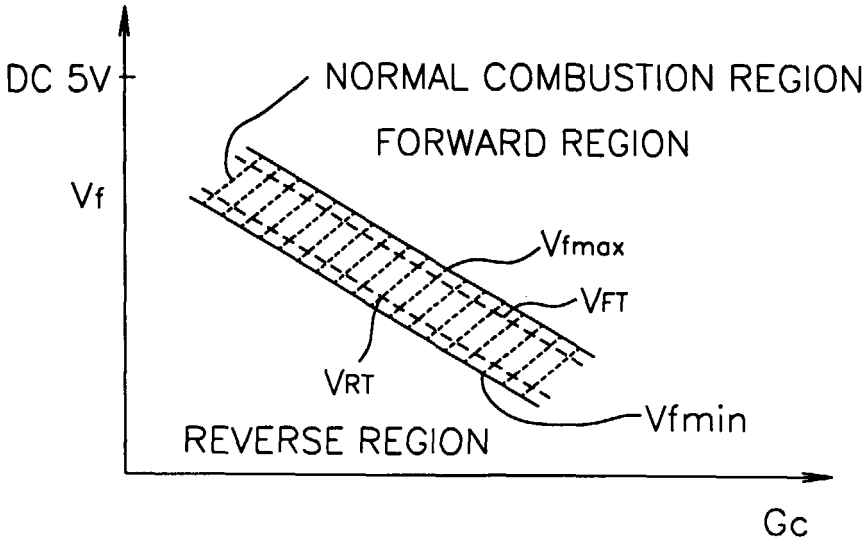
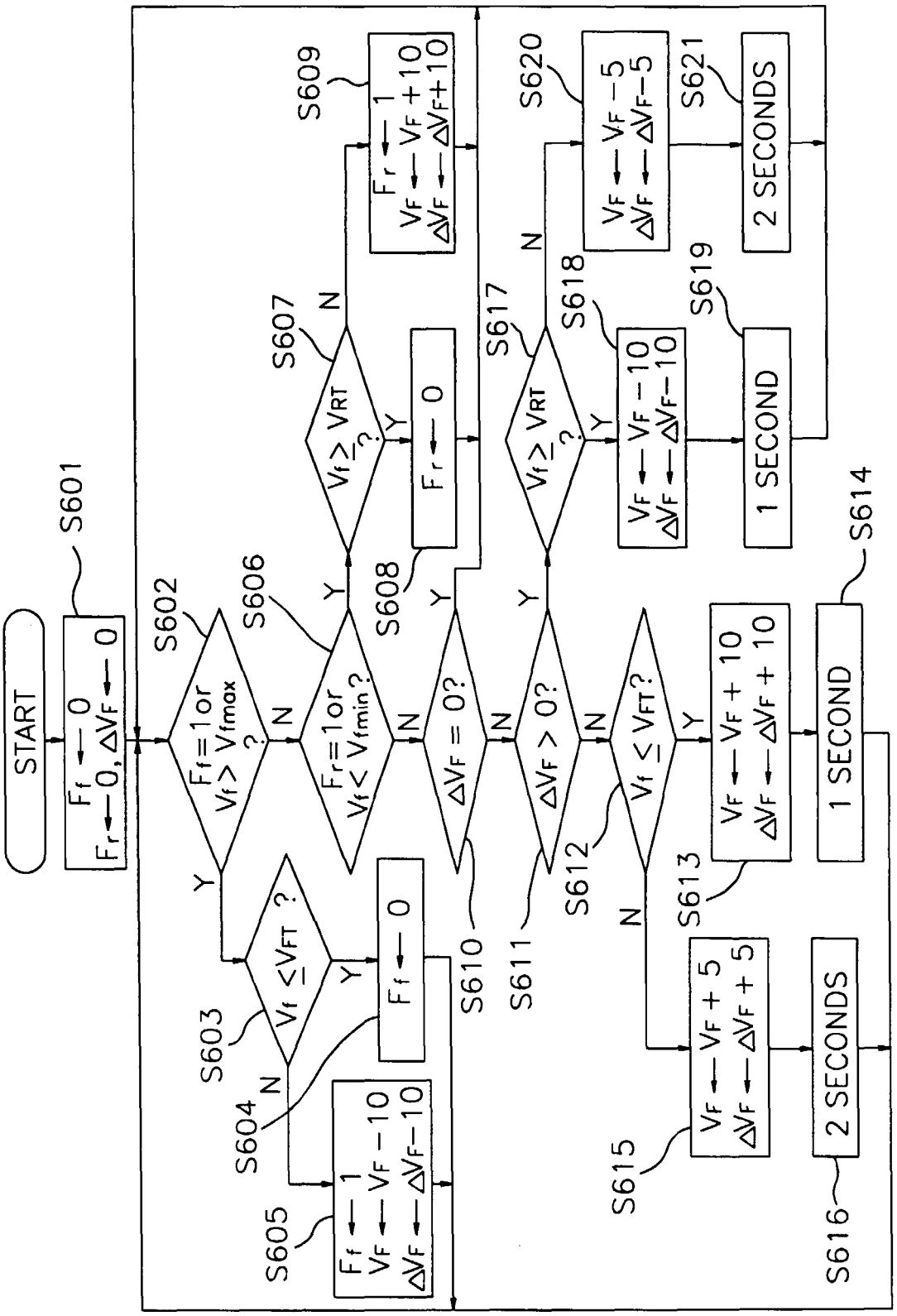

DC 5V
Vf
NORMAL COMBUSTION REGION
FORWARD REGION
Vfmax
VFT
VRT
Vfmin
REVERSE REGION
Gc

FIG.6


START
S601
Ff ← 0
Fr ← 0, ΔVF ← 0
S602
Ff=1 or Vf > Vfmax ?
S603
Vf ≤ VFT ?
S604
S605
Ff ← 1
VF ← VF − 10
ΔVF ← ΔVF−10
Ff ← 0
S606
Fr=1 or Vf < Vfmin ?
S607
Vf ≥ VRT ?
S608
Fr ← 0
S609
Fr ← 1
VF ← VF + 10
ΔVF ← ΔVF+10
S610
ΔVF = 0?
S611
ΔVF > 0?
S612
Vf ≤ VFT?
S613
VF ← VF + 10
ΔVF ← ΔVF + 10
S614
1 SECOND
S615
VF ← VF + 5
ΔVF ← ΔVF + 5
S616
2 SECONDS
S617
Vf ≥ VRT ?
S618
VF ← VF − 10
ΔVF ← ΔVF−10
S619
1 SECOND
S620
VF ← VF −5
ΔVF ← ΔVF−5
S621
2 SECONDS
Y
N