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(54) **Heating apparatus.**

(57) A heating apparatus such as microwave ovens includes a gas sensor (6) sensitive to the density of water vapor and the like emanating from the food for generating a signal corresponding to the sensed density of water vapor and the like, a microcomputer-based controller (10) for controlling an output of a magnetron (3) based on a level of the signal from the gas sensor (6), a temperature sensor (4) responsive to the ambient temperature for generating a corresponding signal, and a storage (10b) storing data of a correction factor calculating equation in which the ambient temperature is set as variable. The correction factor calculating equation is provided for correcting the level of the signal generated by the gas sensor (6) so that the same becomes equal to a level of the electrical signal to be produced by the gas sensor (6) during the heating operation under the conditions of a reference ambient temperature. The controller (10) calculates a correction factor by the correction factor calculating equation, based on the electrical signal from the temperature sensor (4), when the cooking operation is initiated. The controller (10) operates to multiply the level of the electrical signal from the gas sensor by the obtained correction factor.

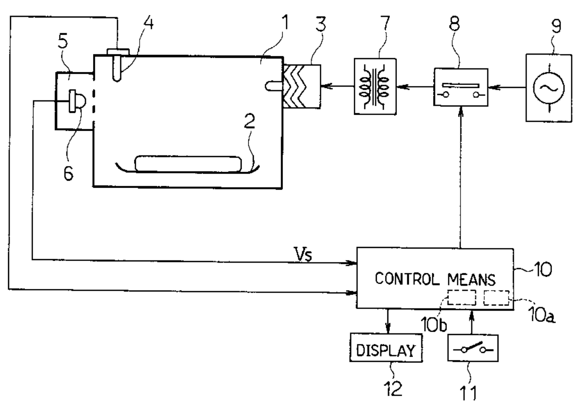

FIG.1

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This invention relates to a heating apparatus, such as microwave ovens, wherein the heating operation is executed based on the density of water vapor and the like emanating from food contained in a cooking chamber.

An output of a magnetron is adjusted based on the density of a gas such as water vapor emanating from the food to be cooked, in a microwave oven with an automatic cooking function, for example. In order to sense the gas density, a gas sensor is provided in an exhaust passage for exhausting the gas from the cooking chamber. The gas density is sensed based on an electrical signal produced by the gas sensor.

In the gas sensor as described above, its sensitivity to alcohol is set to a relatively small value so that the gas sensor is prevented from influences of the alcohol emanating from the food. Rather, its resistance value is varied with the change of the relative humidity due to the water vapor emanating from the food and further depends upon the humidity. Accordingly, the drive of the magnetron is interrupted when a level-change ratio of the signal generated by the gas sensor, that is, the ratio of the level-change of the signal from the gas sensor at the present time to that at the time of start of the heating operation, reaches a predetermined value. Alternatively, the magnetron is driven for a set period of time thereafter. Thus, the heating operation for the food is automatically executed.

However, the changes in the relative humidity due to the water vapor and the like emanating from the food are influenced both by the relative humidity in an environment where the microwave oven is disposed and by the ambient temperature in the environment, during the heating operation. Consequently, an apparent sensitivity of the gas sensor varies depending upon the circumstances. More specifically, it is humid in the cooking chamber at the time of start of the heating operation under circumstances wherein the ambient temperature is high and the humidity is high such as in the rainy spell in early summer in Japan. Even when the water vapor emanates from the food being cooked with progress of the heating, the degree of change in the density of water vapor is small in the cooking chamber since both of the temperature and the humidity are high. Therefore, the sensitivity of the gas sensor apparently becomes lower and accordingly, the cooking period is lengthened more than a suitable period, resulting in an excessive heating.

On the other hand, it is dry in the cooking chamber under circumstances wherein the ambient temperature is low and the humidity is low such as in the winter. When the water vapor emanates from the food being cooked with progress of the heating, the density of water vapor varies to a large extent in the cooking chamber since both the temperature and the humidity are low in the environment. Therefore, the sensitivity of the gas sensor apparently becomes higher and accordingly, the cooking period is shortened as compared with the suitable period, resulting in an insufficient heating.

Thus, the apparent sensitivity of the gas sensor changes depending upon the ambient temperature and the relative humidity at the time when the heating operation is initiated. Accordingly, the heating completion time varies in a range between times t_a and t_b in FIG. 14 under the influence of the ambient temperature and the relative humidity in the arrangement that the timing of completion of the heating operation is determined based on the level-change rate of the electrical signal from the gas sensor, resulting in a problem that the heating cannot be stably performed.

Additionally, the density of water vapor emanating from the food differs depending upon the weight of the food even when neither of the ambient temperature nor the relative humidity changes. Consequently, the finishing of the food differs from case to case depending upon the weight of the food.

Therefore, an object of the present invention is to provide a heating apparatus wherein the heating can be automatically executed based on the level-change ratio of the electrical signal generated by the gas sensor without any influence of the ambient temperature and the relative humidity in the circumstances and without any influence of the weight of the food to be cooked.

In one aspect, the present invention provides a heating apparatus comprising a cooking chamber, heating means provided in the cooking chamber for heating food contained therein, a gas sensor sensitive to the density of water vapor and the like emanating from the food for generating an electrical signal corresponding to the density of water vapor and the like, and control means for controlling an output of the heating means based on a level of the electrical signal generated by the gas sensor, characterized by a temperature sensor responsive to the ambient temperature for producing an electrical signal corresponding to the ambient temperature, storage means for storing data of a correction factor calculating equation in which the ambient temperature is set as variable, the correction factor calculating equation being for correcting the level of the electrical signal generated by the gas sensor so that the same becomes equal to a level of the electrical signal to be generated by the gas sensor during the heating operation under the conditions of a reference ambient temperature, calculation means for calculating a correction factor by means of the correction factor calculating equation whose data is stored in the storage means, based on the electrical signal from the temperature sensor, when the cooking operation is initiated, and correction means multiplying the level of the electrical signal from the gas sensor by the correction factor obtained by the calculation means, thereby delivering a result of the multiplication to the control means.

In another aspect, the invention provides a heating apparatus comprising a cooking chamber, heating means provided in the cooking chamber for heating food contained therein, a gas sensor sensitive to the density of water vapor and the like emanating from the food for generating an electrical signal corresponding to the density of water vapor and the like, and control means for controlling an output of the heating means based on a level of the electrical signal generated by the gas sensor, characterized by a temperature sensor responsive to the ambient temperature for generating an electrical signal corresponding to the ambient temperature, a weight sensor sensitive to the weight of the food contained in the cooking chamber for generating an electrical signal in accordance with the weight of the food, storage means for storing data of a plurality of correction factor calculating equations in each of which the ambient temperature is set as variable, the equations corresponding to different values of the weight of the food, the correction factor calculating equation being for correcting the level of the electrical signal produced by the gas sensor so that the same becomes equal to a level of the electrical signal to be generated by the gas sensor during the heating operation under the conditions of a reference ambient temperature, calculation means selecting one of the correction factor calculating equations corresponding to the weight of the food from the storage means based on the electrical signal from the weight sensor when the heating operation is initiated, the calculation means calculating a correction factor by means of the selected correction factor calculating equation, based on the electrical signal from the temperature sensor, when the cooking operation is initiated, and correction means multiplying the level of the electrical signal from the gas sensor by the correction factor obtained by the calculation means, thereby delivering a result of the multiplication to the control means.

The invention will be described with reference to the accompanying drawings, in which:

FIG. 1 is a schematic block diagram of a microwave oven according to a first embodiment of the present invention;

FIG. 2 is a flowchart explaining the operation of control means employed in the microwave oven;

FIG. 3 is a graph showing relations between the level-change ratio of an electrical signal from a gas sensor and the heating period;

FIG. 4 is a graph showing relations between the level-change ratio of the signal from the gas sensor and the ambient temperature;

FIG. 5 is a graph showing relations between the correction factor and the ambient temperature;

FIG. 6 is another graph showing relations between the level-change ratio of the signal from the gas sensor and the heating period;

FIG. 7 is further another graph showing relations between the level-change ratio of the signal from the gas sensor and the heating period;

FIG. 8 is a view similar to FIG. 1 showing the microwave oven of a second embodiment of the invention;

FIG. 9 is a graph showing relations between the level-change ratio of the signal from the gas sensor and the heating time period under the condition of different values of weight of the food;

FIG. 10 is a view similar to FIG. 4 under the condition of different values of weight of the food;

FIG. 11 is a view similar to FIG. 5 under the condition of different values of weight of the food;

FIG. 12 is a graph showing relations between the level-change ratio of the signal from the gas sensor and the heating time period when a bowl of rice is reheated;

FIG. 13 is a view similar to FIG. 12 when three cups of rice is reheated; and

FIG. 14 is a graph showing the relations between the level-change ratio of the signal from the gas sensor and the heating time period in the prior art.

A first embodiment, in which the present invention is applied to a microwave oven, will now be described with reference to FIGS. 1 to 7. Referring to FIG. 1 showing an electrical arrangement of the microwave oven, the microwave oven has a cooking chamber 1 defined therein and a turntable 2 is rotatably mounted in the cooking chamber 1. A magnetron 3 serving as heating means and an oven thermistor 4 serving as a temperature sensor are provided so as to face the interior of the cooking chamber 1. The cooking chamber 1 is provided with an exhaust passage 5 in which a gas sensor 6 is mounted. The gas sensor 6 is provided for sensing the density of water vapor and the like exhausted through the exhaust passage 5 from the cooking chamber 1, thereby generating an electrical signal V_s in accordance with the sensed density of water vapor and the like.

A primary winding of a high voltage transformer 7 is connected through a DC relay 8 to an AC power supply 9. A secondary winding of the transformer 7 is connected to the magnetron 3.

Microcomputer-based control means 10 operates to display a set cooking menu or cooking condition on a display 12 and executes the heating operation in accordance with the contents set when a start key 11 is turned on. The control means 10 is provided with a random access memory (RAM) 10a and a read only memory (ROM) 10b. Data of a correction factor calculating equation having a temperature value as variable is stored in ROM 10b. This correction factor calculating equation is used for correcting the level of the electrical signal V_s generated by the gas sensor 6, as will be described in detail later.

The operation of the foregoing arrangement will be described with reference to FIG. 2. Food to be cooked is first contained in the cooking chamber 1 and then, a suitable cooking menu is selected. When the start key 11 is turned on in this state, the control means 10 advances from step S1 to step S2 in which the electrical signal V_{s0} from the gas sensor 6 is input. Data of the level of the input signal V_{s0} is stored in RAM 10a (step S3). The control means 10 then operates to detect the ambient temperature or the room temperature based on a temperature signal from the thermistor 4 (step S4). More specifically, the atmospheric temperature in the cooking chamber 1 is equal to the ambient temperature when the heating has not been executed long. Accordingly, the atmospheric temperature in the cooking chamber 1 can be regarded as equal to the ambient temperature. Then, the control means 10 inputs the data of the correction factor calculating equation from ROM 10b (step S5) and operates to calculate a correction factor for correcting the output of the gas sensor 6 by substituting the value of the sensed ambient temperature in the correction factor calculating equation (step S6).

The above-mentioned correction factor calculating equation will now be described in detail. The gas sensor 6 has a characteristic that its resistance value is varied when brought into contact with the water vapor or the like emanating from the food. This characteristic is shown by the following equation:

$$R(t) = R_0 \text{x} \text{exponent}\{\alpha(T_x - T_0) + \beta(H_x - H_0)\}$$

where R_0 is an initial resistance value of the gas sensor, α is temperature factor of the gas sensor, β is the humidity factor of the gas sensor, T_0 and H_0 are the ambient temperature and the relative humidity respectively when the heating is initiated, and T_x and H_x are the atmospheric temperature in the cooking chamber and the relative humidity during the heating operation. As obvious from the foregoing equation, the resistance value of the gas sensor 6 is influenced by the initial resistance value R_0, the ambient temperature T_0 at the time of initiation of the heating operation and the ambient temperature H_0.

FIG. 3 shows the relations between the level-change ratio of the signal V_s from the gas sensor 6 and the heating time period in the circumstances where the ambient temperature and the relative humidity differ from case to case. In FIG. 3, the curve $R_1(t)$ designates the characteristic of the level-change ratio ΔV of the signal V_s in the condition that the ambient temperature is 5°C and the relative humidity is 50%, the curve $R_2(t)$ the characteristic of the level-change ratio ΔV of the signal V_s in the condition that the ambient temperature is 25°C and the relative humidity is 70%, and the curve $R_3(t)$ the level-change ratio ΔV of the signal V_s in the condition that the ambient temperature is 35°C and the relative humidity is 70%. As obvious from FIG. 3, the apparent sensitivity of the gas sensor 6 is reduced as the ambient temperature rises.

FIG. 3 shows that each of the rates of the respective level-change ratios shown by $R_1(t)$, $R_2(t)$ and $R_3(t)$ in a predetermined heating time period is approximately constant over the whole heating time period. Accordingly, the level-change ratios in the different conditions can correspond to the level-change ratio in the reference condition by multiplying the level-change ratio ΔV with regard to the predetermined ambient temperature and relative humidity by a predetermined correction factor (ratio).

Consider now the case where the above-mentioned $R_1(t)$ and $R_3(t)$ are corrected into $R_2(t)$. Based on the above-described relations, $R_2(t)$ can be shown by the following equations:

$$R_2(t) = K_1 \text{x} R_1(t) \text{ and}$$

$$R_2(t) = K_2 \text{x} R_3(t)$$

where K_1 is a correction factor for converting $R_1(t)$ to $R_2(t)$ and K_2 is a correction factor for converting $R_3(t)$ to $R_2(t)$. The correction factor K_1 is a ratio between $R_1(t)$ and $R_2(t)$ and the correction factor K_2 is a ratio between $R_3(t)$ and $R_2(t)$. These ratios are constant regardless of the heating time period. Accordingly, K_1 and K_2 can be represented by the equations with the ambient temperature and-relative humidity as variables, respectively. Furthermore, since the relative humidity can be represented by an equation with the ambient temperature as a variable, the correction factors K_1 and K_2 can be represented by a calculating equation, $K(T)(=K_1=K_2)$, with the ambient temperature as a variable. Accordingly, $K(T)$ can be obtained from the respective ratios of $R_1(t)$, $R_2(t)$ and $R_3(t)$ at times t_1, t_2 and t_3 as shown in FIG. 3. Now, the correction factor $K_1(T)$ at time t_1 will be obtained based on the level-change ratio ΔV_{11} of the electrical signal V_s at time t_1 at the ambient temperature of 5°C. In this case the relation between the level-change ratio ΔV_{11} of the signal V_s and the ambient temperature T can be shown as follows as the result of experimentation:

$$\Delta V_{11} = - 0.0042 T + 0.245.$$

A level-change ratio ΔV_{11} is obtained from the above-mentioned equation. In order that the level-change ratio ΔV_{11} is corrected to correspond to the level-change ratio ΔV_{21} in the reference condition at the ambient temperature of 25°C, $R_1(t)$ is multiplied by the ratio, $\Delta V_{21}/\Delta V_{11}$ (see FIG. 4). Thus, $\Delta V_{21}/\Delta V_{11}$ is the correction factor $K_1(T)$ at time t_1.

The correction factors $K_2(T)$ and $K_3(T)$ at the respective times t_2 and t_3 can be regarded substantially as the same as the correction factor $K_1(T)$ at time t_1. Consequently, the correction factor $K(T)$ is obtained as follows for converting the level-change ratio $R_1(t)$ at the ambient temperature of 5°C to the level-change ratio $R_2(t)$ at the reference ambient temperature of 25°C:

$$K(T) = \Delta V_{21}/\Delta V_{11} = \Delta V_{21}/(- 0.0042 T + 0.245).$$

In this case the correction factor $K(T)$ at the ambient temperature of 25°C becomes 1 and accordingly, the value of ΔV_{21} can be determined from the value of the correction factor $K(T)$.

FIG. 5 shows a characteristic curve of the correction factor $K(T)$ obtained with the ambient temperature as variable as described above. As obvious from FIG. 5, the level-change ratio ΔV of the signal V_s needs to be corrected to a larger extent as the ambient temperature deviates farther from the reference temperature.

Returning now to FIG. 2, the control means 10 operates to turn on the DC relay 8 when the correction factor K(T) is obtained based on the ambient temperature (step S7). A high AC voltage is then applied to the magnetron 3 and high frequency waves are delivered from the magnetron 3 to the food, thereby heating the same. Subsequently, the control means 10 inputs the data of the electrical signal V_s from the gas sensor 6 (step S8) and compares the signal V_s with the electrical signal V_{s0} whose data is stored in RAM 10a, thereby calculating the level-change ratio ΔV (step S9). The control means 10 then operates to correct the level-change ratio ΔV of the signal V_s by multiplying the rate by the correction factor K(T) (step S10). The control means 10 then operates to determine whether or not the corrected level-change ratio ΔV has reached the predetermined value (step S11). When determining that the corrected level-change ratio ΔV has reached the predetermined value, the control means 10 advances to step S12 where the DC relay 8 is turned off. As a result, the magnetron 3 is deenergized, thereby completing the heating operation.

FIG. 6 shows the level-change ratio ΔV of the signal V_s from the gas sensor 6 in the cases where the ambient temperature is high and low and the correction has been made and has not been made when boiled rice is reheated. FIG. 7 shows the level-change ratio ΔV of the signal V_s in the cases where the ambient temperature is high and low and the correction has been made and not been made when Japanese "miso" soup is reheated. As obvious from FIGS. 6 and 7, the level-change ratio ΔV can be corrected into an approximately constant value as the result of correction by means of the correction factor K(T) regardless of the ambient temperature.

In accordance with the above-described arrangement, the level-change ratio ΔV of the signal V_s generated by the gas sensor 6 is corrected according to the ambient temperature so as to correspond to the reference level-change ratio ΔV of the signal V_s generated by the gas sensor 6 at the ambient temperature of 25°C. Although the level-change ratio of the signal from the gas sensor varies depending upon the ambient temperature in the prior art, the heating by means of the magnetron can be completed at desired timing without any influence of the ambient temperature in the foregoing embodiment of the invention.

FIGS. 8 to 13 illustrate a second embodiment of the invention. The identical parts are labeled by the same reference numerals as in the foregoing embodiment. In the second embodiment, a weight sensor 13 is provided for measuring the weight of the food placed on the turntable 2 of the microwave oven. The weight sensor 13 senses the weight of the food and generates a corresponding weight signal, which signal is supplied to the control means 10. The control means 10 operates to calculate the correction factor K(T) for the level-change ratio ΔV of the signal V_s from the gas sensor 6 based on the ambient temperature at the time of start of the heating operation in the same manner as in the foregoing embodiment. The correction factor K(T) is finally determined based on the weight of the food sensed by the weight sensor 13. More specifically, FIG. 9 shows the various values of the signal V_s from the gas sensor 6 in the different conditions that the values of the ambient temperatures and the weight of the food differ from one another, as is obvious from FIG. 9. The density of the water vapor emanating from the food takes different values depending upon the different values of the weight of the food. Accordingly, the weight of the food changes the time-dependent characteristics of the signal V_s even when the ambient temperature does not change. Consequently, the level-change ratio ΔV of the signal V_s varies depending upon the weight of the food, as shown in FIG. 10. The correction factor K(T) is so set as to take different values in accordance with different values of the food's weight. In this case the control means 10 detects the value of weight of the food based on the weight signal from the weight sensor 13 when the start key 11 is turned on. When the sensed weight of the food is smaller than a predetermined weight, the correction factor K(T) is calculated by means of the correction factor calculating equation, $K(T)=\Delta V_{21}/(-0.0042xT+0.245)$. On the other hand, when the weight of the food is larger than the predetermined weight, the correction factor K(T) is calculated by means of the correction factor calculating equation, $K(T)=\Delta V_{22}/(-0.0075xT+0.416)$. For example, the weight of a bowl of rice to be heated is smaller than the predetermined weight and the total weight of three bowls of rice is larger than the predetermined weight.

FIG. 12 shows the level-change ratios ΔV of the signal V_s from the gas sensor 6 in the cases where the ambient temperature is high and low and the correction has been made and has not been made when a bowl of rice is reheated. FIG. 7 shows the level-change ratios ΔV of the signal V_s in the cases where the ambient temperature is high and low and the correction has been made and not been made when three bowls of rice is reheated. As obvious from FIGS. 12 and 13, the apparent sensitivity of the gas sensor 6 can be prevented from being varied in accordance with the weight of the food to be heated.

In accordance with the second embodiment, the level-change ratio ΔV of the signal from the gas sensor 6 is corrected based on the weight of the food as well as based on the ambient temperature. Consequently, the heating operation can be completed at a suitable timing irrespective of the weight of the food.

Although the ambient temperature is sensed by the oven thermistor 4 in the foregoing embodiments, an independent temperature sensor may be provided for sensing the ambient temperature.

The foregoing disclosure and drawings are merely illustrative of the principles of the present invention and are not to be interpreted in a limiting sense. The only limitation is to be determined from the scope of the appended claims.

Claims

1. A heating apparatus comprising a cooking chamber (1), heating means (3) provided in the cooking chamber (1) for heating food contained therein, a gas sensor (6) sensitive to the density of water vapor and the like emanating from the food for generating an electrical signal corresponding to the density of water vapor and the like, and control means (10) for controlling an output of the heating means (3) based on a level of the electrical signal generated by the gas sensor (6), characterized by a temperature sensor (4) responsive to the ambient temperature for producing an electrical signal corresponding to the ambient temperature, storage means (10b) for storing data of a correction factor calculating equation in which the ambient temperature is set as variable, the correction factor calculating equation being for correcting the level of the electrical signal generated by the gas sensor so that the same becomes equal to a level of the electrical signal to be generated by the gas sensor (6) during the heating operation under the conditions of a reference ambient temperature, calculation means (10) for calculating a correction factor by means of the correction factor calculating equation whose data is stored in the storage means (10b), based on the electrical signal from the temperature sensor (4), when the cooking operation is initiated, and correction means (10) multiplying the level of the electrical signal from the gas sensor (6) by the correction factor obtained by the calculation means (10), thereby delivering a result of the multiplication to the control means (10).

2. A heating apparatus comprising a cooking chamber (1), heating means (3) provided in the cooking chamber (1) for heating food contained therein, a gas sensor (6) sensitive to the density of water vapor and the like emanating from the food for generating an electrical signal corresponding to the density of water vapor and the like, and control means (10) for controlling an output of the heating means (3) based on a level of the electrical signal generated by the gas sensor (6), characterized by a temperature sensor (4) responsive to the ambient temperature for generating an electrical signal corresponding to the ambient temperature, a weight sensor (13) sensitive to the weight of the food contained in the cooking chamber (1) for generating an electrical signal in accordance with the weight of the food, storage means (10b) for storing data of a plurality of correction factor calculating equations in each of which the ambient temperature is set as variable, the equations corresponding to different values of the weight of the food, the correction factor calculating equation being for correcting the level of the electrical signal produced by the gas sensor (6) so that the same becomes equal to a level of the electrical signal to be generated by the gas sensor (6) during the heating operation under the conditions of a reference ambient temperature, calculation means (10) selecting one of the correction factor calculating equations corresponding to the weight of the food from the storage means (10b) based on the electrical signal from the weight sensor (13) when the heating operation is initiated, the calculation means (10) calculating a correction factor by means of the selected correction factor calculating equation, based on the electrical signal from the temperature sensor (4), when the cooking operation is initiated, and correction means (10) multiplying the level of the electrical signal from the gas sensor (6) by the correction factor obtained by the calculation means (10), thereby delivering a result of the multiplication to the control means (10).

3. A heating apparatus according to claim 1, characterized in that a temperature sensor provided for sensing the atmospheric temperature in the cooking chamber (1) is also used as the temperature sensor (4).

4. A heating apparatus according to claim 2, characterized in that a temperature sensor provided for sensing the atmospheric temperature in the cooking chamber (1) is also used as the temperature sensor (4).

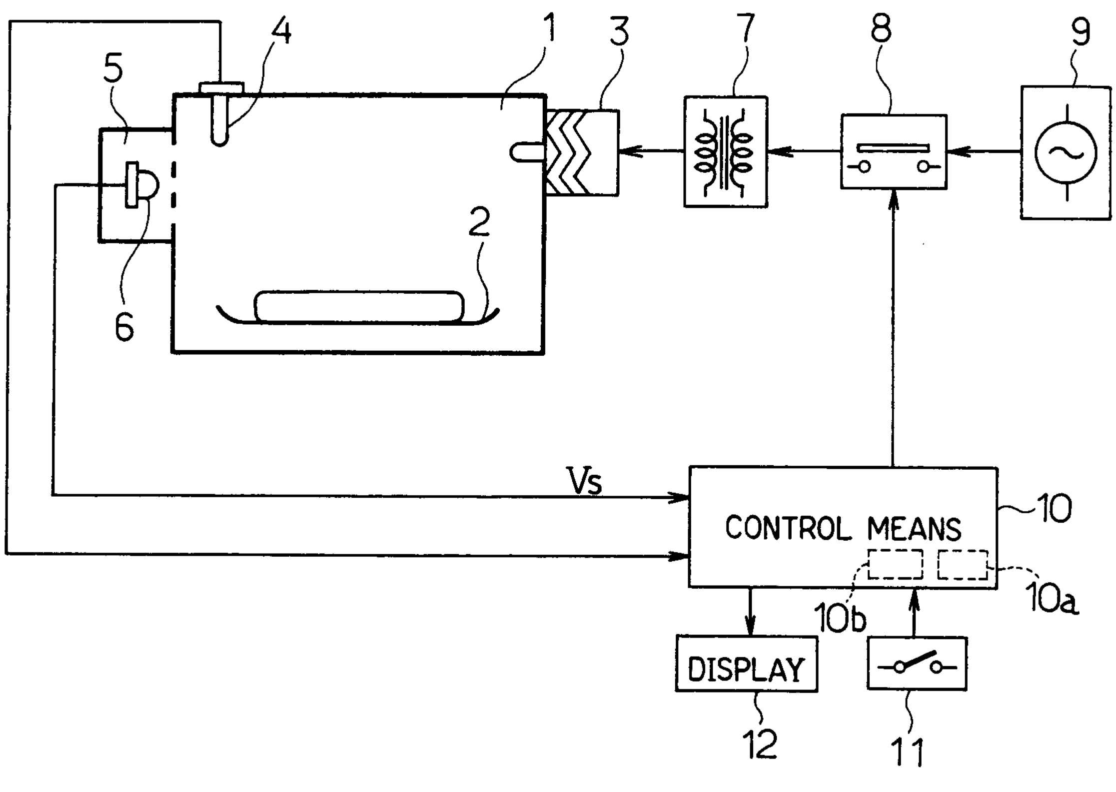

FIG.1

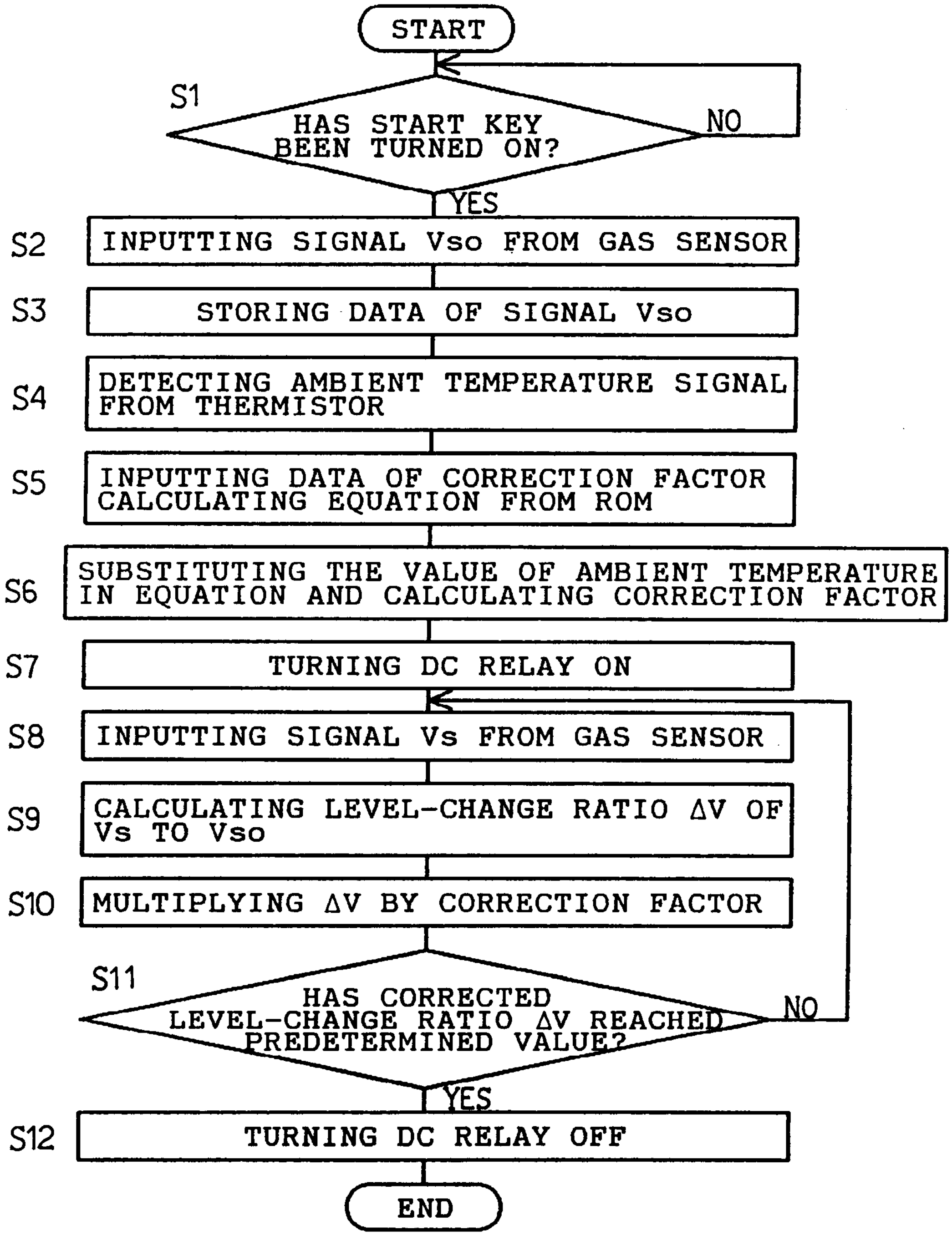
START
S1
HAS START KEY BEEN TURNED ON?
NO
YES
S2
INPUTTING SIGNAL Vso FROM GAS SENSOR
S3
STORING DATA OF SIGNAL Vso
S4
DETECTING AMBIENT TEMPERATURE SIGNAL FROM THERMISTOR
S5
INPUTTING DATA OF CORRECTION FACTOR CALCULATING EQUATION FROM ROM
S6
SUBSTITUTING THE VALUE OF AMBIENT TEMPERATURE IN EQUATION AND CALCULATING CORRECTION FACTOR
S7
TURNING DC RELAY ON
S8
INPUTTING SIGNAL Vs FROM GAS SENSOR
S9
CALCULATING LEVEL-CHANGE RATIO ΔV OF Vs TO Vso
S10
MULTIPLYING ΔV BY CORRECTION FACTOR
S11
HAS CORRECTED LEVEL-CHANGE RATIO ΔV REACHED PREDETERMINED VALUE?
NO
YES
S12
TURNING DC RELAY OFF
END

FIG. 2

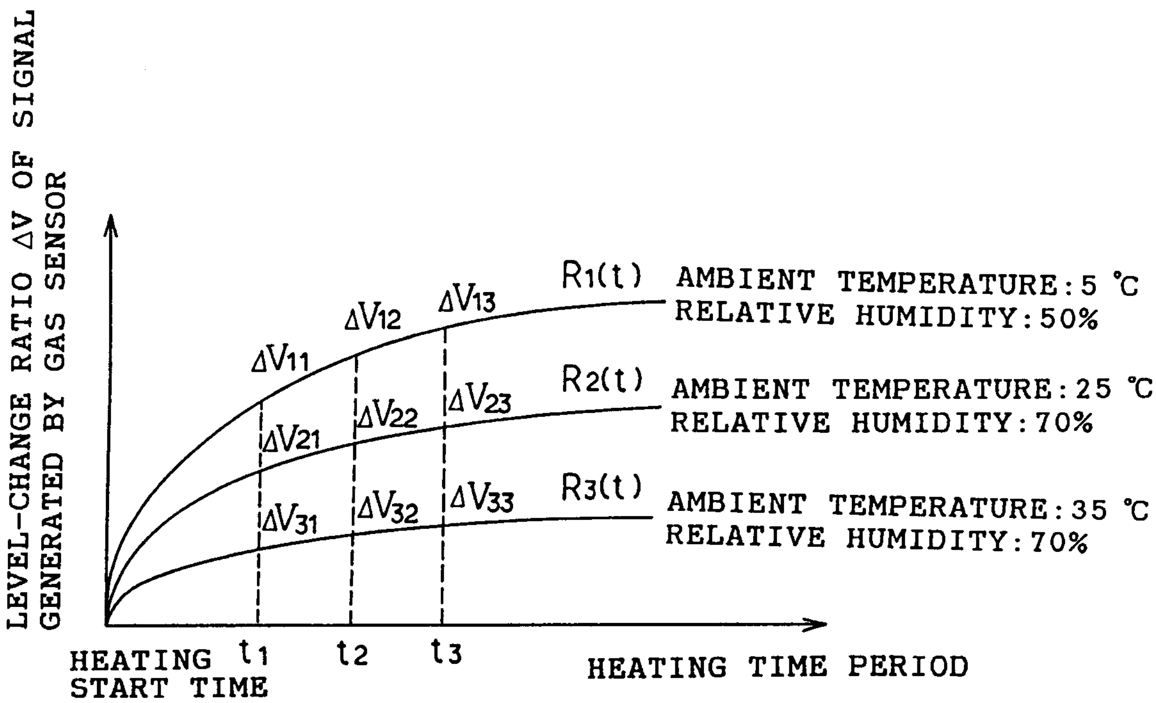
LEVEL-CHANGE RATIO ΔV OF SIGNAL GENERATED BY GAS SENSOR
ΔV11
ΔV12
ΔV13
R1(t)
AMBIENT TEMPERATURE: 5 ℃
RELATIVE HUMIDITY: 50%
ΔV21
ΔV22
ΔV23
R2(t)
AMBIENT TEMPERATURE: 25 ℃
RELATIVE HUMIDITY: 70%
ΔV31
ΔV32
ΔV33
R3(t)
AMBIENT TEMPERATURE: 35 ℃
RELATIVE HUMIDITY: 70%
HEATING START TIME
t1
t2
t3
HEATING TIME PERIOD

FIG.3

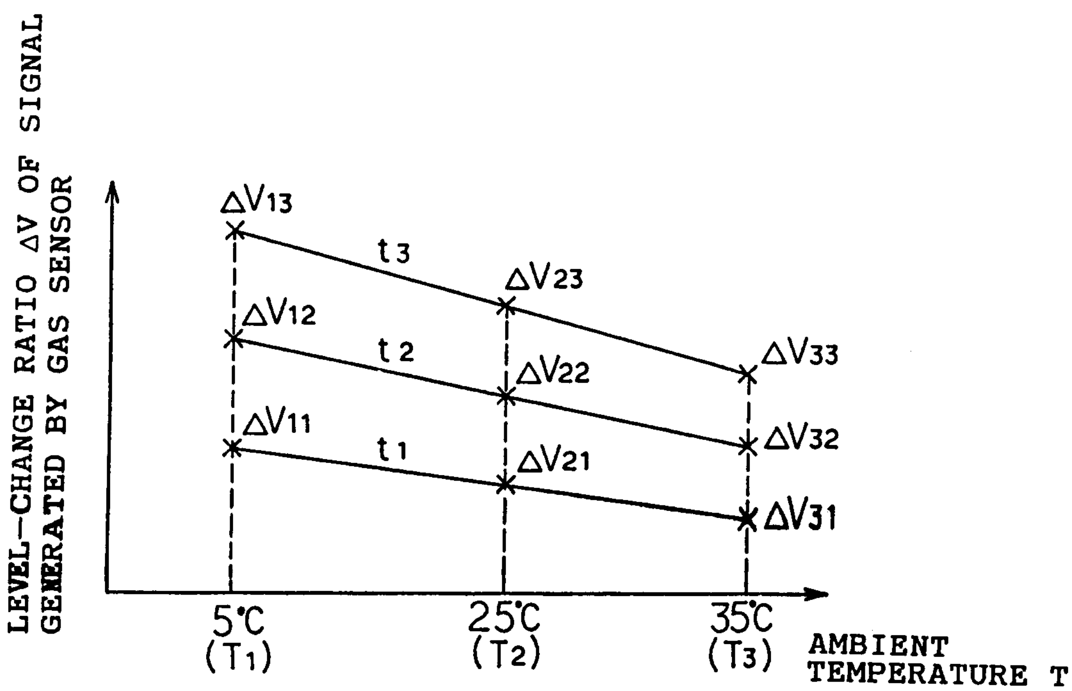
LEVEL-CHANGE RATIO ΔV OF SIGNAL GENERATED BY GAS SENSOR
ΔV13
t3
ΔV23
ΔV33
ΔV12
t2
ΔV22
ΔV32
ΔV11
t1
ΔV21
ΔV31
5℃ (T1)
25℃ (T2)
35℃ (T3)
AMBIENT TEMPERATURE T

FIG.4

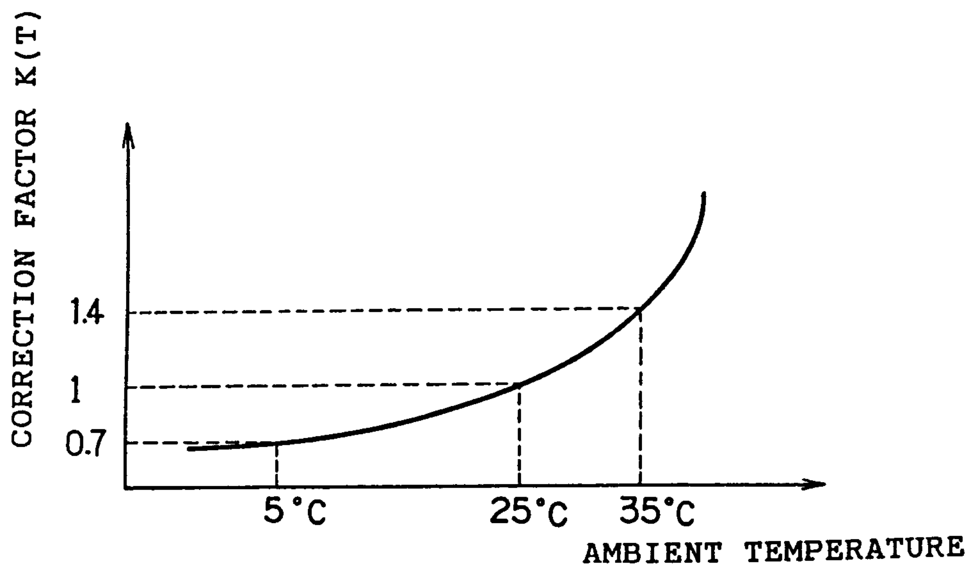
CORRECTION FACTOR K(T)
1.4
1
0.7
5°C
25°C
35°C
AMBIENT TEMPERATURE

FIG.5

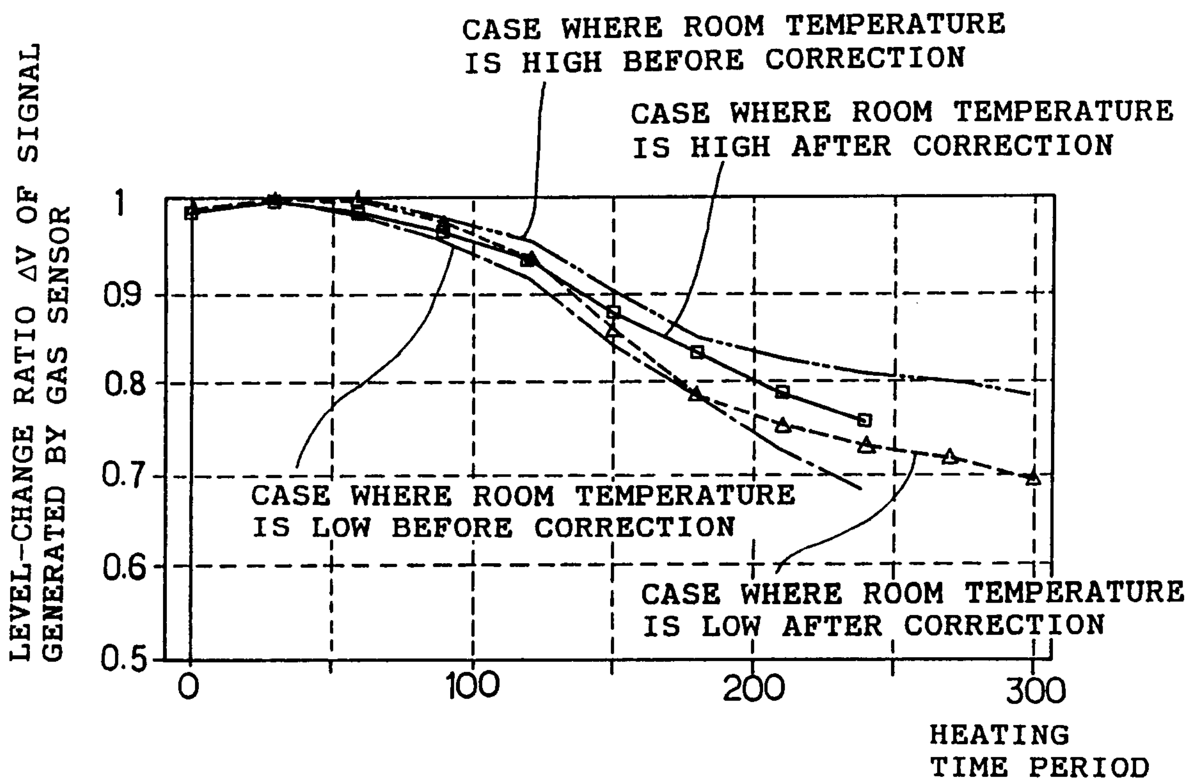
CASE WHERE ROOM TEMPERATURE IS HIGH BEFORE CORRECTION
CASE WHERE ROOM TEMPERATURE IS HIGH AFTER CORRECTION
LEVEL-CHANGE RATIO ΔV OF SIGNAL GENERATED BY GAS SENSOR
1
0.9
0.8
0.7
0.6
0.5
CASE WHERE ROOM TEMPERATURE IS LOW BEFORE CORRECTION
CASE WHERE ROOM TEMPERATURE IS LOW AFTER CORRECTION
0
100
200
300
HEATING TIME PERIOD

FIG.6

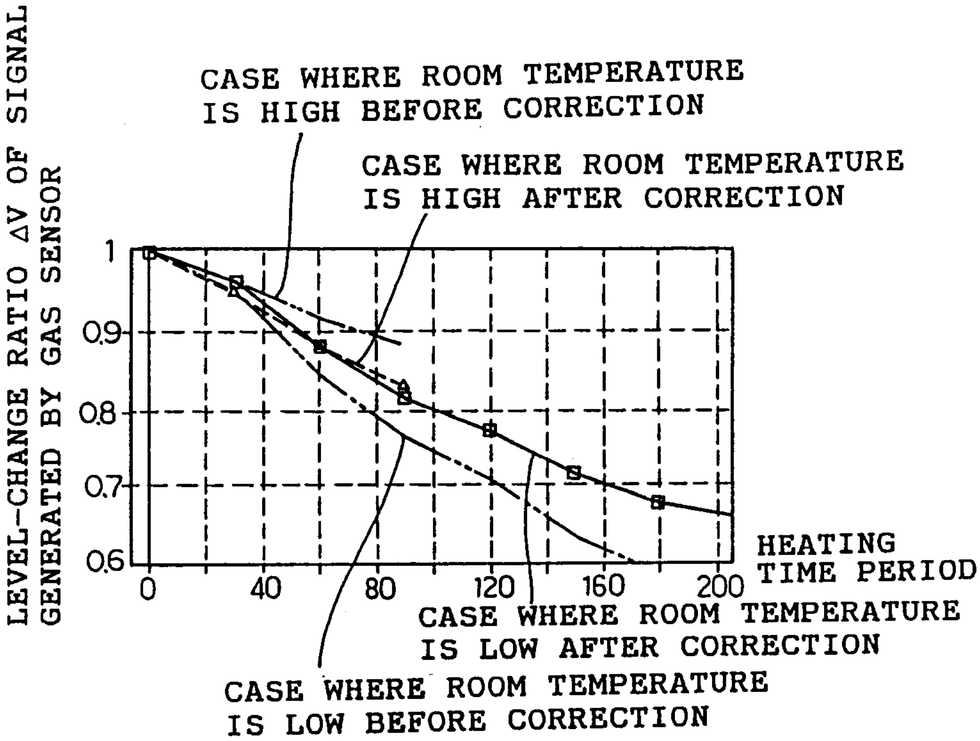
LEVEL-CHANGE RATIO ΔV OF SIGNAL
GENERATED BY GAS SENSOR
CASE WHERE ROOM TEMPERATURE
IS HIGH BEFORE CORRECTION
CASE WHERE ROOM TEMPERATURE
IS HIGH AFTER CORRECTION
1
0.9
0.8
0.7
0.6
0
40
80
120
160
200
HEATING
TIME PERIOD
CASE WHERE ROOM TEMPERATURE
IS LOW AFTER CORRECTION
CASE WHERE ROOM TEMPERATURE
IS LOW BEFORE CORRECTION

FIG.7

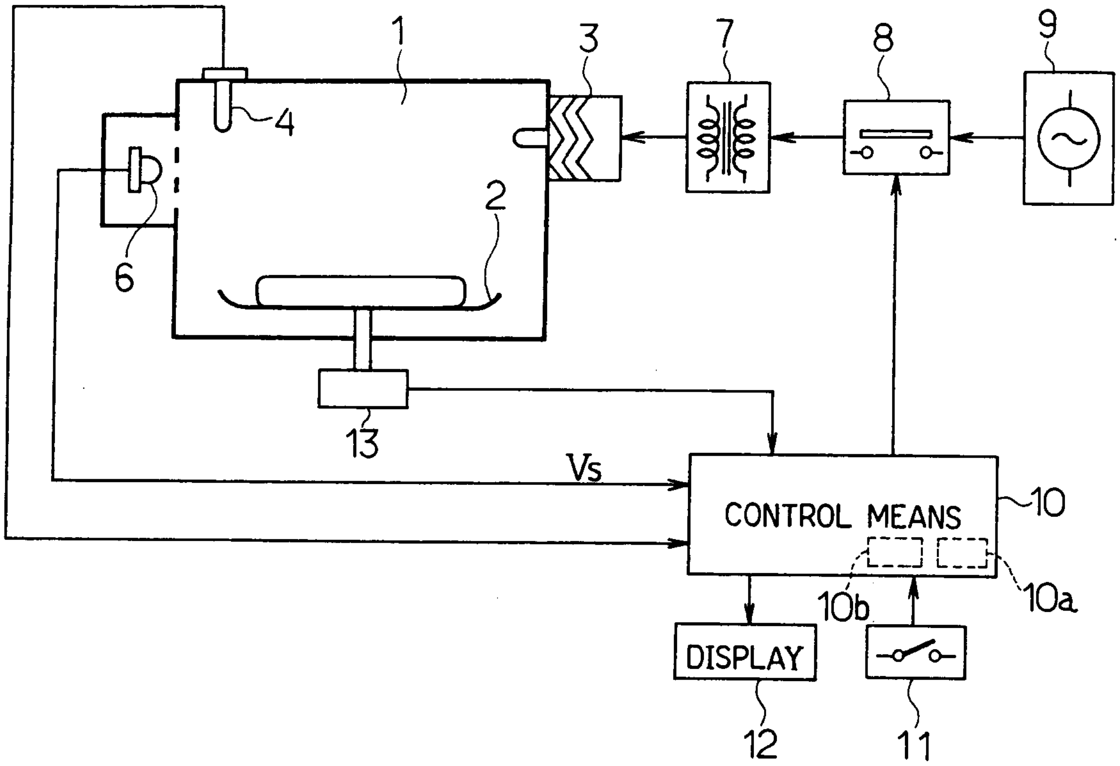

FIG.8

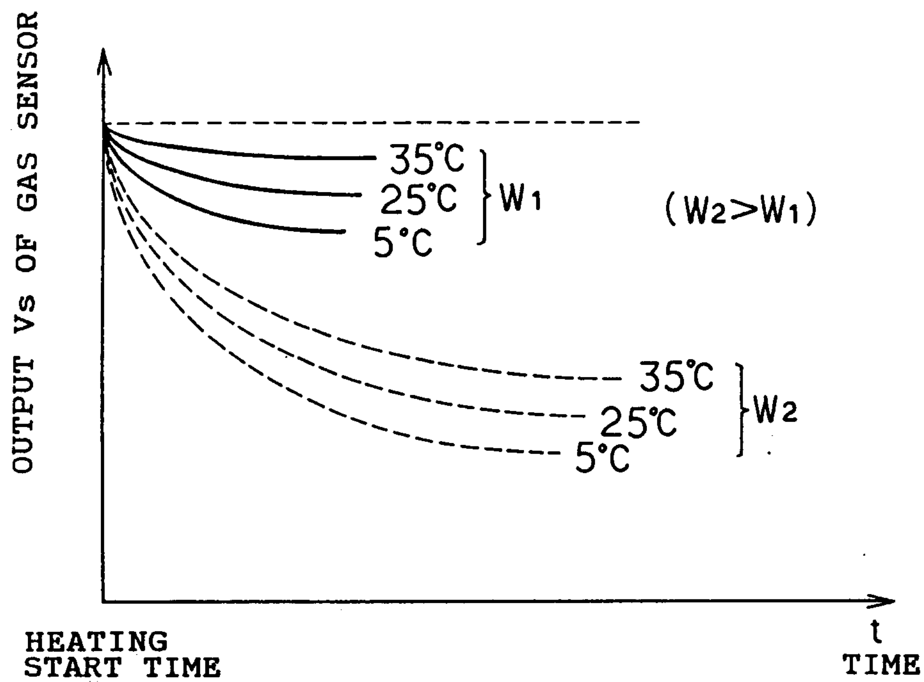
OUTPUT Vs OF GAS SENSOR
35°C
25°C
5°C
W1
(W2>W1)
35°C
25°C
5°C
W2
HEATING
START TIME
t
TIME

FIG.9

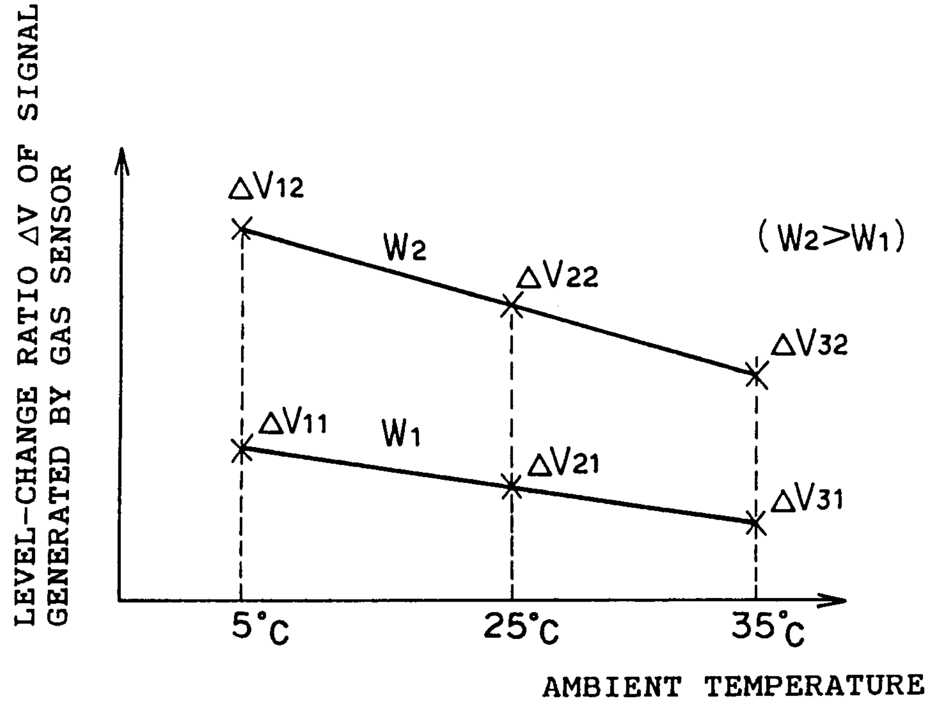
LEVEL-CHANGE RATIO ΔV OF SIGNAL GENERATED BY GAS SENSOR
ΔV12
W2
ΔV22
(W2>W1)
ΔV32
ΔV11
W1
ΔV21
ΔV31
5°C
25°C
35°C
AMBIENT TEMPERATURE

FIG.10

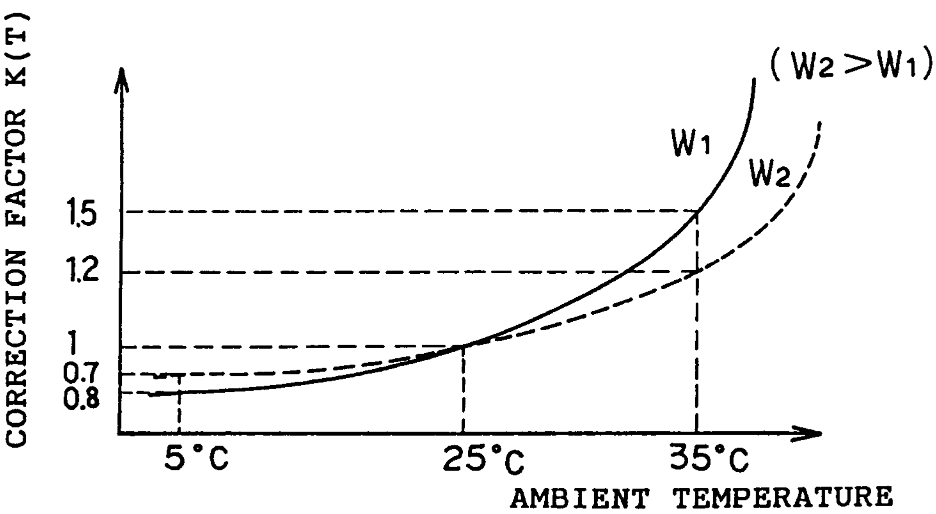
CORRECTION FACTOR K(T)
(W2>W1)
W1
W2
1.5
1.2
1
0.7
0.8
5°C
25°C
35°C
AMBIENT TEMPERATURE

FIG.11

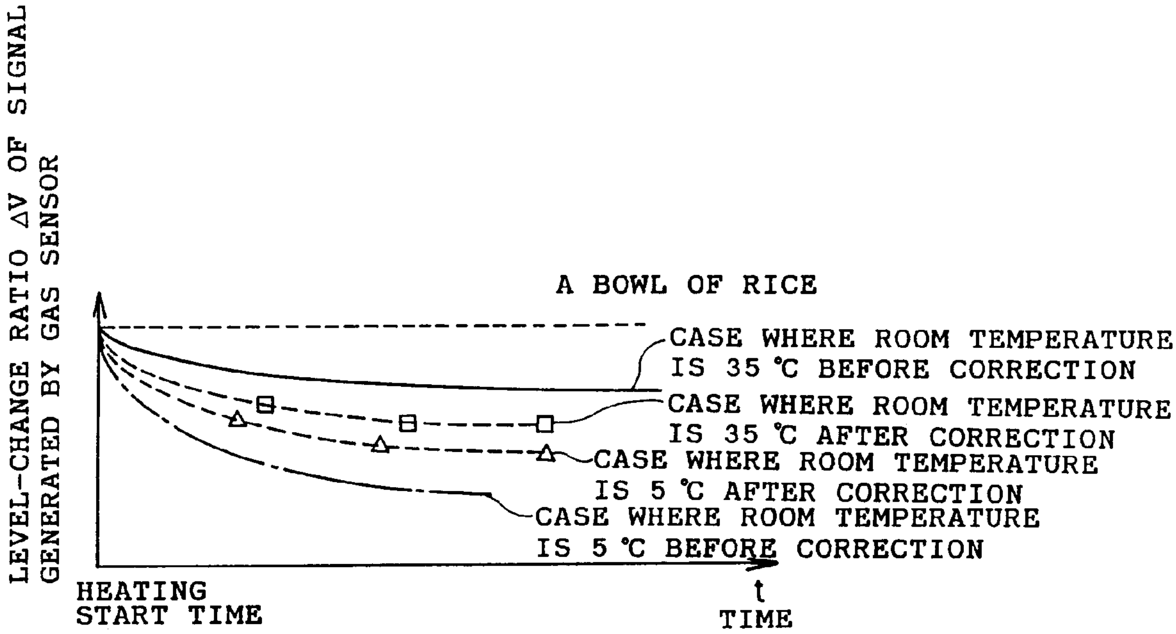
LEVEL-CHANGE RATIO ΔV OF SIGNAL GENERATED BY GAS SENSOR
A BOWL OF RICE
CASE WHERE ROOM TEMPERATURE IS 35 ℃ BEFORE CORRECTION
CASE WHERE ROOM TEMPERATURE IS 35 ℃ AFTER CORRECTION
CASE WHERE ROOM TEMPERATURE IS 5 ℃ AFTER CORRECTION
CASE WHERE ROOM TEMPERATURE IS 5 ℃ BEFORE CORRECTION
HEATING START TIME
t
TIME

FIG.12

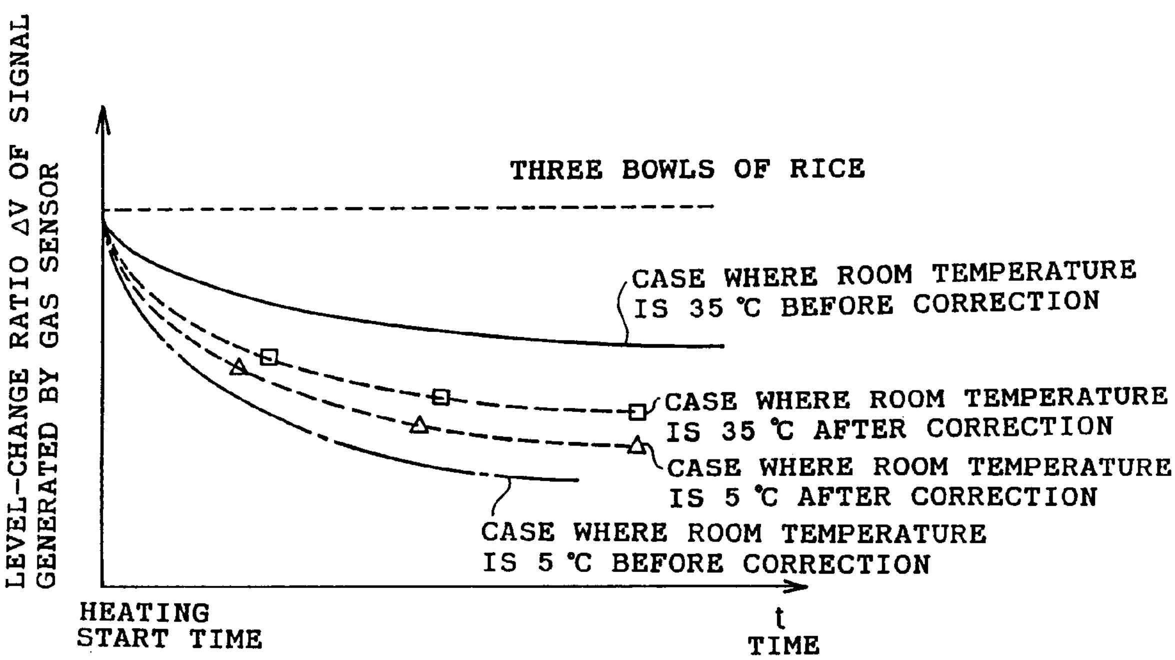
LEVEL-CHANGE RATIO ΔV OF SIGNAL GENERATED BY GAS SENSOR
THREE BOWLS OF RICE
CASE WHERE ROOM TEMPERATURE IS 35 ℃ BEFORE CORRECTION
CASE WHERE ROOM TEMPERATURE IS 35 ℃ AFTER CORRECTION
CASE WHERE ROOM TEMPERATURE IS 5 ℃ AFTER CORRECTION
CASE WHERE ROOM TEMPERATURE IS 5 ℃ BEFORE CORRECTION
HEATING START TIME
t
TIME

FIG.13

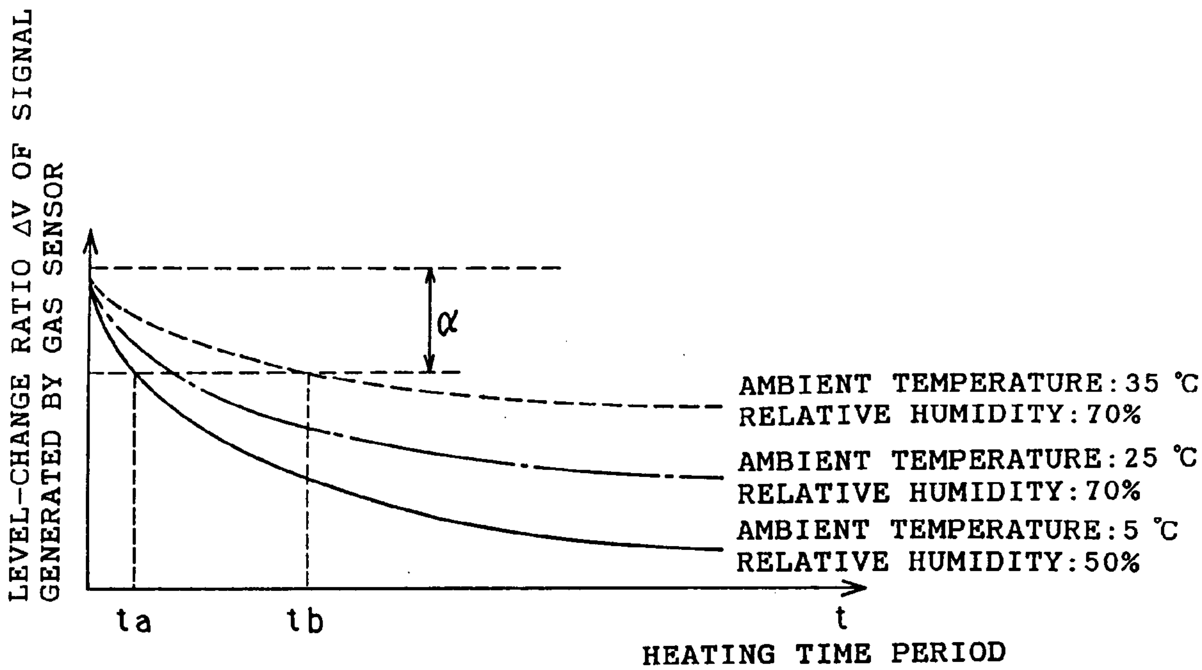

FIG.14 (PRIOR ART)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT

EP 92304878.9

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP - A - 0 093 173 (MATSUSHITA) * Abstract; claims 1-3; fig. 8 * --	1-4	F 24 C 7/08 H 05 B 6/68 H 05 B 1/02
A	DE - A - 3 226 938 (SHARP) * Abstract; claim 1; fig. 6,9 * --	1-4	
A	US - A - 4 316 068 (TANABE) * Abstract; claims 1-5; fig. 9 * --	1-4	
A	EP - A - 0 000 957 (LITTON) * Abstract; claims 5,11; fig. 8 * --.	1-4	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	GB - A - 2 171 223 (SHARP) * Abstract; claim 1; fig. 1 * --	1-4	F 24 C 7/00 H 05 B 1/00 H 05 B 6/00
A	US - A - 4 133 995 (BUCK) * Abstract; claims 1,2; fig. 1 * ----	1-4	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	31-08-1992	TSILIDIS

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document