

Description

BACKGROUND OF THE INVENTION

The present invention relates generally to automatic heating appliances, and more particularly to such an automatic heating appliance for controlling the heating temperature of an object in accordance with the kind of the object. The present invention is applicable particularly, but not exclusively, to an oven for cooking a food.

Document EP-A-0 166 997 encloses a heating appliance with a heating chamber wherein there are provided heating means for heating an object which is encased within the heating chamber and table means provided within the heating chamber on which the object is placed. A weight sensor measures the weight of an object and a state detecting sensor detects the heated state of said object. The heat is controlled on the basis of the weight of the object and the detection of a humidity sensor.

Document JP-A-61 186 725 discloses a technique wherein a height sensor comprising plural pairs of light-emitting elements and light-receiving elements disposed vertically at the walls of the heating chamber is provided to measure the height of an object, and a movable heater is provided and operated by an adjustment drive device. Furthermore, the use of an ultrasonic sensor instead of a height sensor is disclosed.

Document DE-U-8 434 370 describes a heating appliance wherein rack means are arranged stepwise within the heating chamber in order to provide an insert of different heights for table means.

Furthermore, there are known heating appliances such as electric oven and gas oven for heating an object with elevation of the temperature of air within a heating chamber and convection of the temperature-increased air. Such a heating appliance generally has a plurality of keys on an operating pannel, which are operated in accordance with the kind, or class, of the object to be heated within the heating chamber because the cooking time period and heating temperature are respectively different in accordance with the class of the object. The cooking time period and the heating temperature are respectively selected by different keys and one of a plurality of racks provided within the heating chamber is selected in accordance with the class of the object to be heated so as to obtain a desired heat distribution. The selection of the keys results in being troublesome for users and the error of selection of one of the plurality of racks causes failure of cooking of the object, and hence improvement would be required from the viewpoint of simplification of handling of the appliance and prevention of the cooking

failure.

SUMMARY OF THE INVENTION

The present invention has been developed in order to eliminate the above-mentioned drawbacks inherent to the conventional heating appliances.

It is therefore an object of the present invention to provide a new and improved automatic heating appliance which is capable of automatically and appropriately controlling the heating temperature by discriminating the kind of an object to be heated.

A feature of an automatic heating appliance according to the present invention is to detect the class of an object to be heated on the basis of the position of the object within a heating chamber or state of gas generated from the object in response to heating and automatically control the heating temperature of the object in accordance with the class of the object, resulting in reduction of the number of operating keys for cooking instruction and simplification of operation of the appliance.

According to the invention there is provided a heating appliance with a heating chamber for encasing an object to be heated comprising heating means provided for heating said object, table means provided at a predetermined height position within said heating chamber, and first sensor means for sensing an amount of vapor and/or gas generated from said object, said heating appliance being characterized by second sensor means provided at an upper portion of the heating chamber for measuring a distance to the object or the table means; and control means coupled to the second sensor means to be responsive to a detection signal indicative of the distance to the object or the table means to determine a position of the table means within the heating chamber and further coupled to the first sensor means to be responsive to a detection signal indicative of an amount of the vapor and/or gas generated from the object, the control means determining the kind of the object on the basis of detection signals from the first and second sensor means in accordance with a curve by the plotting of the outputs of said first sensor means so as to control a feed to the heating means in accordance with the determined kind of the object.

BRIEF DESCRIPTION OF THE DRAWINGS

The object and features of the present invention will become more readily apparent from the following detailed description of the preferred embodiments taken in conjunction with the accompanying drawings in which:

Fig. 1 is a perspective view showing the external form of the automatic heating appliance according to the invention;

Fig. 2 is a perspective view illustrating a table on which an object to be heated is placed;

Fig. 3 is an illustration of an indicator of the automatic heating appliance of the invention;

Fig. 4 is a graphic diagram for describing a heating temperature control method of the invention;

Fig. 5 is a cross-sectional view showing an ultrasonic sensor used in the automatic heating appliance of the invention;

Fig. 6 is a block diagram showing a drive and detection circuit to be provided for drive of the ultrasonic sensor of Fig. 5 and reception of signals from the ultrasonic sensor;

Fig. 7 is a block diagram showing an arrangement of an automatic heating appliance according to an embodiment of the present invention; and

Fig. 8 is graphic illustration for describing variation of the generating state of gas in accordance with the kind of an object.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to Fig. 7, there is illustrated an arrangement of an automatic heating appliance according to an embodiment of the present invention. In Fig. 7, a heating instruction is transmitted to a control section 5 through a full-automation key 4 on an operating pannel 3 which are illustrated in Fig. 1 which is a perspective view showing the external appearance of the automatic heating appliance and wherein numerals 1 and 2 represent a housing and a door of the appliance, respectively. In response to the heating instruction, the control section 5, maybe comprising a known microcomputer with a central processing unit (CPU) and memories, energizes a distance-measuring sensor 6 through a drive and detection circuit 18 so as to measure the distance D to a table 8 on which an object 7 is placed, the distance-measuring sensor being provided on the ceiling of a heating chamber 9. Within the heating chamber 9 are stepwise provided pairs of rack rails 10, one of which is selected in accordance with the class of the object 7. For example, the upper rack rails 10 are used for cooking of a cookie, the middle rack rails 10 are used for cooking of a bread and a chou, and the lower rack rails 10 are used for cooking of a cake. The desired position may be determined in accordance with the arrangement of the heating chamber 9, i.e., heat distribution and so on. The distance-measuring sensor 6 measures the distance D to the table 8 and this distance measurement allows detection of the position of the table 8, which may be arranged

as illustrated in Fig. 2 such that its flange-portion is placed on the pair of the rack rails 10. The detection of the position of the table 8 further allows estimation of the kind of the object 7. The result of the estimation is indicated on a display section 11 as shown in Fig. 3, the display section 12 comprising a class-indicating portion 14 and further time-indicating portion 12 and temperature-indicating portion 13. The indication of the class of the object 7 to be heated allows confirmation of the class of the object 7 by the user. After the indication, the control section 5 energizes upper and lower heaters 16 through a driver 15 so as to obtain a heating temperature corresponding to the class of the object 7 specified by the user. The heaters 16 may be of the electric type or gas type. The temperature within the heating chamber 9 is sensed by means of a temperature sensor 17 and the sensed temperature information is supplied through a detection circuit 19 with an analog-to-digital converter to the control section 5 which in turn controls the power supply to the heaters 16, i.e., distribution of the power supply to the upper and lower heaters 16 and the heating time, in accordance with the appointed object class.

Fig. 4 is a time chart illustrating one example of methods of power supply to the upper and lower heaters 16 and controlled temperature obtained as the result of the power supply. As understood from Fig. 4, the temperature is controllable by control of the energizing time period T_u to the upper heater 16 and the energizing time period T_d to the lower heater 16. For example, the heating temperature * is controlled to 160°C when the object 7 is a cookie and to 180°C when it is a puff. Furthermore, the overall heating time period T is determined in accordance with the class of the object 7. For example, the time period T is set to 15 minutes when it is a cookie and to 25 minutes when it is a puff.

A description will be made hereinbelow in terms of the distance-measuring sensor 6 and the drive and detection circuit 18 with reference to Figs. 5 and 6. Fig. 5 is a cross-sectional view showing one example of ultrasonic sensor usable as the distance-measuring sensor 6. The ultrasonic sensor 6, as shown in Fig. 5, comprises a piezoelectric device 20, a conically shaped resonator 22 coupled through a coupling shaft 21 to the piezoelectric device 20, terminals 24 coupled through lead lines 23 to the piezoelectric device 20, a terminal plate 25 for fixedly securing the terminals 24, a case 26, a beam shaping plate 27 for covering an opening of the case 26 positioned so as to face the conically shaped resonator 22, and an acoustic absorption sheet 28 provided on the terminal plate 25. A detailed description thereof will be omitted because the arrangement thereof is dis-

closed in "National Technical Report" Vol. 29, pages 504 to 514, No. 3, 1983. The distance-measuring sensor 6 is not limited to the above-mentioned ultrasonic sensor, but other sensors such as infrared sensor are applicable thereto. Fig. 8 is a block diagram showing one example of arrangements of the drive and detection circuit 18. The drive and detection circuit 18 comprises a transmitting circuit 29 and a receiving circuit 30. The transmitting circuit 29 drives the distance-measuring sensor 6 in response to a timing control signal from the control section 5 and the receiving circuit 30 receives an output signal of the distance-measuring sensor 6 corresponding to the echo wave returning from the object 7. The output signal of the receiving circuit 30 is supplied to a comparator 31 where the output signal of the receiving circuit 30 is compared with a reference signal. When level of the output signal thereof exceeds the level of the reference signal, the output signal thereof is latched and supplied to a data-processing portion of the control section 5. The control section 5 counts the time period from the transmission to the reception and calculates the distance to the table 8 or the object 7 on the basis of the propagating time of the ultrasonic wave and then to detect the position of the table 8 and the height of the object 7. The detection of the height of the object 7 allows discrimination of the kind of the object 7 even if the table 8 takes the same position. That is, at the time of the start of heating, the chou is lower in height and the bread is higher in height. Furthermore, since the condition of expansion of the object 7 can be detected, it is possible to determine the kind of the object 7 on the basis of the condition of the expansion.

Further referring to Fig. 7, there is shown an illustration of the automatic heating appliance, which is arranged so that the class of the object 7 to be heated is determined on the basis of the position of the object-mounting table 8 and the generating state of vapor or gas from the object 7. In response to operation of the full-automation key 4, the control section 5 starts heating of the object 7 placed on the table 8 positioned by rack rails 10 arranged within the heating chamber 9. The heating causes generation of vapor or gas from the object 7. The generated vapor or gas is detected by a gas sensor 32 which is located at the side wall of the heating chamber 9. The gas sensor 32 may be a humidity sensor in this embodiment and the gas sensor 32 and the detection circuit 33 can be realized in accordance with the description in Japanese Patent Provisional Publication No. 51-134951, for example. The gas-generating information is supplied through a detection circuit 33 to the control section 5 to check the generating state of the gas or vapor. The control section 5 determines the

class of the object 7 on the basis of the generating state thereof and the position of the table 8 which is measured by means of the distance-measuring sensor 6 and a drive and detection circuit 18. Fig. 8 is a time chart showing a method of determination of the class of the object 7, in which vertical axis represents variation of the output of the sensor 32, i.e., absolute humidity, and the horizontal axis represents elapsed time. As understood from Fig. 8, the gas-generating state is varied in accordance with the kind of the object 7 and therefore the kind of the object 7 can be determined by detection of the gas-generating state even if the table 8 takes the same position. Accordingly, the control section 5 plots the outputs of the gas sensor 32 with respect to time and determines the kind of the object 7 in accordance with a curve formed by the plotting of the outputs. For example, even if the cooking is started as a cake in spite of the object 7 being a bread, since the kind of the object 7 can be determined in accordance with the gas-generating state, the cooking error can be removed by changing the heating temperature at the time of the determination of the kind of the object 7.

Claims

1. A heating appliance with a heating chamber (9) for encasing an object (7) to be heated comprising
 - heating means (16) provided for heating said object (7);
 - table means (8) provided at a predetermined height position within said heating chamber (9); and
 - first sensor means (32) for sensing an amount of vapor and/or gas generated from said object (7); said heating appliance being characterized by
 - second sensor means (6) provided at an upper portion of said heating chamber (9) for measuring a distance to said object (7) or said table means (8); and
 - control means (5) coupled to said second sensor means (6) to be responsive to a detection signal indicative of the distance to said object (7) or said table means (8) to determine a position of said table means (8) within said heating chamber (9) and further coupled to said first sensor means (32) to be responsive to a detection signal indicative of an amount of the vapor and/or gas generated from said object (7), said control means (5) determining the kind of said object (7) on the basis of detection signals from said first and second sensor means (32, 6) in accordance with a curve formed by the plotting of the outputs of said first sensor means (32) so as to control a feed



closed in "National Technical Report" Vol. 29, pages 504 to 514, No. 3, 1983. The distance-measuring sensor 6 is not limited to the above-mentioned ultrasonic sensor, but other sensors such as infrared sensor are applicable thereto. Fig. 5 is a block diagram showing one example of arrangements of the drive and detection circuit 18. The drive and detection circuit 18 comprises a transmitting circuit 29 and a receiving circuit 30. The transmitting circuit 29 drives the distance-measuring sensor 6 in response to a timing control signal from the control section 5 and the receiving circuit 30 receives an output signal of the distance-measuring sensor 6 corresponding to the echo wave returning from the object 7. The output signal of the receiving circuit 30 is supplied to a comparator 31 where the output signal of the receiving circuit 30 is compared with a reference signal. When level of the output signal thereof exceeds the level of the reference signal, the output signal thereof is latched and supplied to a data-processing portion of the control section 5. The control section 5 counts the time period from the transmission to the reception and calculates the distance to the table 8 or the object 7 on the basis of the propagating time of the ultrasonic wave and then to detect the position of the table 8 and the height of the object 7. The detection of the height of the object 7 allows discrimination of the kind of the object 7 even if the table 8 takes the same position. That is, at the time of the start of heating, the chou is lower in height and the bread is higher in height. Furthermore, since the condition of expansion of the object 7 can be detected, it is possible to determine the kind of the object 7 on the basis of the condition of the expansion.

Further referring to Fig. 7, there is shown an illustration of the automatic heating appliance, which is arranged so that the class of the object 7 to be heated is determined on the basis of the position of the object-mounting table 8 and the generating state of vapor or gas from the object 7. In response to operation of the full-automation key 4, the control section 5 starts heating of the object 7 placed on the table 8 positioned by rack rails 10 arranged within the heating chamber 9. The heating causes generation of vapor or gas from the object 7. The generated vapor or gas is detected by a gas sensor 32 which is located at the side wall of the heating chamber 9. The gas sensor 32 may be a humidity sensor in this embodiment and the gas sensor 32 and the detection circuit 33 can be realized in accordance with the description in Japanese Patent Provisional Publication No. 51-134951, for example. The gas-generating information is supplied through a detection circuit 33 to the control section 5 to check the generating state of the gas or vapor. The control section 5 determines the

class of the object 7 on the basis of the generating state thereof and the position of the table 8 which is measured by means of the distance-measuring sensor 6 and a drive and detection circuit 18. Fig. 8 is a time chart showing a method of determination of the class of the object 7, in which vertical axis represents variation of the output of the sensor 32, i.e., absolute humidity, and the horizontal axis represents elapsed time. As understood from Fig. 8, the gas-generating state is varied in accordance with the kind of the object 7 and therefore the kind of the object 7 can be determined by detection of the gas-generating state even if the table 8 takes the same position. Accordingly, the control section 5 plots the outputs of the gas sensor 32 with respect to time and determines the kind of the object 7 in accordance with a curve formed by the plotting of the outputs. For example, even if the cooking is started as a cake in spite of the object 7 being a bread, since the kind of the object 7 can be determined in accordance with the gas-generating state, the cooking error can be removed by changing the heating temperature at the time of the determination of the kind of the object 7.

Claims

1. A heating appliance with a heating chamber (9) for encasing an object (7) to be heated comprising
 - heating means (16) provided for heating said object (7);
 - table means (8) provided at a predetermined height position within said heating chamber (9); and
 - first sensor means (32) for sensing an amount of vapor and/or gas generated from said object (7); said heating appliance being characterized by
 - second sensor means (6) provided at an upper portion of said heating chamber (9) for measuring a distance to said object (7) or said table means (8); and
 - control means (5) coupled to said second sensor means (6) to be responsive to a detection signal indicative of the distance to said object (7) or said table means (8) to determine a position of said table means (8) within said heating chamber (9) and further coupled to said first sensor means (32) to be responsive to a detection signal indicative of an amount of the vapor and/or gas generated from said object (7), said control means (5) determining the kind of said object (7) on the basis of detection signals from said first and second sensor means (32, 6) in accordance with a curve formed by the plotting of the outputs of said first sensor means (32) so as to control a feed



to said heating means (16) in accordance with the determined kind of said object (7).

2. A heating appliance as claimed in claim 1, **characterized in that** said second sensor means (6) comprises an ultrasonic sensor for transmitting an ultrasonic wave toward said table means (8) or said object (7) and receiving an echo signal returning therefrom.
3. A heating appliance as claimed in claim 1, **characterized in that** said first sensor means (32) comprises a humidity sensor for measuring a humidity within said heating chamber (9).
4. A heating appliance as claimed in claim 1, **characterized in that** said heating means (16) comprises upper and lower heaters provided at upper and lower portions of said heating chamber (9) and said control means (5) controls the distribution of power supply to said upper and lower heaters (16) in accordance with the measured distance to said table means (8) or said object (7).
5. A heating appliance as claimed in claim 2, **characterized in that** said ultrasonic sensor (6) has a circuit (18) for comparing the echo signal with a reference and supplies to said control means (5) the echo signal exceeding said reference in level.

Patentansprüche

1. Wärmegerät mit einer Wärmekammer (9), die ein zu erwärmendes Objekts (7) einschließt, mit:
 - einer zum Erwärmen des Objekts (7) geschaffenen Heizeinrichtung (16);
 - einer innerhalb der Wärmekammer (9) in einer festgelegten Höhenposition angebrachten Tischeinrichtung (8); und
 - einer ersten Sensoreinrichtung (32) zum Wahrnehmen einer Menge von dem Objekt (7) erzeugten Dampfes und/oder Gases; wobei das Wärmegerät **gekennzeichnet ist durch**
 - eine an einem oberen Abschnitt der Wärmekammer (9) geschaffene zweite Sensoreinrichtung (6) zum Messen eines Abstandes zu dem Objekt (7) oder der Tischeinrichtung (8); und
 - eine Regeleinrichtung (5), die zum Ansprechen auf ein den Abstand des Objekts (7) oder der Tischeinrichtung (8) anzeigendes Erfassungssignal an die zweite Sensoreinrichtung gekoppelt ist, um eine Position der Tischeinrichtung (8) innerhalb der Wärmekammer (9) zu bestimmen, und ferner an die erste Sensor-

einrichtung (32) gekoppelt ist, um auf ein die Menge des von dem Objekt (7) erzeugten Dampfes und/oder des Gases anzeigendes Erfassungssignal anzusprechen, wobei die Regeleinrichtung (5) die Art des Objekts (7) auf der Basis der Erfassungssignale von der ersten und der zweiten Sensoreinrichtung (32, 6) in Übereinstimmung mit einer durch die Auswertung der Ausgangssignale der ersten Sensoreinrichtung (32) ausgebildeten Kurve bestimmt, um in Übereinstimmung mit der bestimmten Art des Objekts (7) eine Stromzuführung zu der Heizeinrichtung zu regeln.

2. Wärmegerät nach Anspruch 1, **dadurch gekennzeichnet, daß** die zweite Sensoreinrichtung (6) einen Ultraschallsensor aufweist, um eine Ultraschallwelle auf die Tischeinrichtung (8) oder das Objekt (7) zu übertragen und ein davon zurückkehrendes Echosignal zu empfangen.
3. Wärmegerät nach Anspruch 1, **dadurch gekennzeichnet, daß** die erste Sensoreinrichtung (32) einen Feuchtigkeitssensor zum Messen einer Feuchtigkeit innerhalb der Wärmekammer (9) aufweist.
4. Wärmegerät nach Anspruch 1, **dadurch gekennzeichnet, daß** die Heizeinrichtung (16) an oberen und unteren Abschnitten der Wärmekammer (9) angebrachte obere und untere Heizelemente aufweist und die Regeleinrichtung (5) die Verteilung der Stromversorgung zu den oberen und unteren Heizelementen (16) in Übereinstimmung mit dem gemessenen Abstand zu der Tischeinrichtung (8) oder dem Objekt (7) regelt.
5. Wärmegerät nach Anspruch 2, **dadurch gekennzeichnet, daß** der Ultraschallsensor (6) eine Schaltung (18) zum Vergleichen des Echosignals mit einem Bezugswert hat und der Regeleinrichtung (5) das den Bezugswert im Pegel übersteigende Echosignal zuführt.

Revendications

1. Appareil de chauffage avec une chambre de chauffage (9) pour enfermer un objet (7) à chauffer, comprenant:
 - un moyen de chauffage (16) prévu pour chauffer ledit objet (7),
 - un moyen formant plateau (8) placé en une position de hauteur prédéterminée à l'intérieur de ladite chambre de chauffage (9), et



- un premier moyen formant capteur (32) pour détecter une quantité de vapeur et/ou de gaz produite par ledit objet (7), ledit appareil de chauffage étant caractérisé par: 5
 - un second moyen formant capteur (6) placé au niveau d'une partie supérieure de ladite chambre de chauffage (9) pour mesurer une distance audit objet (7) ou audit moyen formant plateau (8), et 10
 - un moyen de commande (5) couplé audit second moyen formant capteur (6) pour être sensible à un signal de détection indiquant la distance audit objet (7) ou audit moyen formant plateau (8) afin de déterminer la position dudit moyen formant plateau (8) à l'intérieur de ladite chambre de chauffage (9), et couplé en outre audit premier moyen formant capteur (32) pour être sensible à un signal de détection indiquant la quantité de vapeur et/ou de gaz produite par ledit objet (7), ledit moyen de commande (5) déterminant la nature dudit objet (7) sur la base des signaux de détection provenant desdits premier et second moyens formant capteur (32, 6) d'après une courbe formée en traçant les signaux de sortie dudit premier moyen formant capteur (32), de façon à commander l'alimentation dudit moyen de chauffage (16) en fonction de la nature déterminée dudit objet (7). 25
2. Appareil de chauffage selon la revendication 1, caractérisé en ce que ledit second moyen formant capteur (6) comprend un capteur à ultrasons pour envoyer une onde ultrasonore vers ledit moyen formant plateau (8) ou ledit objet (7) et recevoir un signal d'écho qui en revient. 35
3. Appareil de chauffage selon la revendication 1, caractérisé en ce que ledit premier moyen formant capteur (32) comprend un capteur d'humidité pour mesurer l'humidité à l'intérieur de ladite chambre de chauffage (9). 40
4. Appareil de chauffage selon la revendication 1, caractérisé en ce que ledit moyen de chauffage (16) comprend des dispositifs chauffants supérieur et inférieur placés au niveau des parties supérieure et inférieure de ladite chambre de chauffage (9), et ledit moyen de commande (5) commande la répartition de l'alimentation en puissance desdits dispositifs chauffants supérieur et inférieur (16) d'après la distance mesurée audit moyen formant plateau (8) ou audit objet (7). 50
5. Appareil de chauffage selon la revendication 2, caractérisé en ce que ledit capteur à ultrasons (6) comprend un circuit (18) pour comparer le signal d'écho avec une référence et envoyer audit moyen de commande (5) le signal d'écho dont le niveau dépasse ladite référence. 55