

## Multifunctional rice cooker based on multistage temperature control

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**Keywords:** patented technical parameter measurement, intelligent health electric cooker, multistage automatic temperature control, automatic water boiling time control, automatic

### Abstract:

a multifunctional rice cooker with multi-stage temperature control is introduced. Patent number: 200920052311.7(multistage temperature control electric rice cooker) Patent technical parameters measurement method.It has become China's strategic state policy to build an innovation-oriented country. Therefore, how to enhance the ability of independent innovation has become a major issue that has attracted high attention from all walks of life. In this paper, we discuss with readers the measurement method of the patent technical parameters of "a multifunctional rice cooker with multi-stage temperature control"patent number: ZL20052311.7. Through research and measurement and verification, product technical standards have been developed and applied to enhance independent innovation capabilities, thereby saving energy, reducing emissions of waste gas and improving the environment. Enhancing the core competitiveness of countries and enterprises to cope with the intense competition of globalization.

### preface

Under the trend of globalization, developed countries such as the United States, Britain and Japan have long made scientific and technological innovation a national strategic policy, and have invested enormous financial, material and human resources to this end. This has greatly enhanced the international competitiveness and market position of these

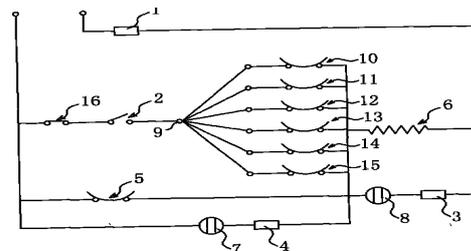
countries. Our country has also made it a national strategic and national policy to enhance its core competitiveness. Therefore, how to enhance our country's independent innovation ability, vigorously promote the application of our original independent intellectual property rights projects, improve the success rate of the transformation of scientific and technological

achievements into productive forces, thus improving the country's core competitiveness, occupy an important position in the international market, increase the voice and pricing power. It has become a very important topic that deserves the high attention and exploration of all parties at present. The following is a new patent technology(Multi-segment temperature sensor automatic control) of the utility model "a multifunctional rice cooker with multi-stage temperature control" that I invented. It is an example to discuss with experts and readers the measurement method of its technical parameters. I would also like to ask you for your valuable comments. We will work together to establish and improve the technical standard system for this original and independent intellectual property project, and transform it into a productive force with strong competitive capabilities as soon as possible, thus benefiting the human society and the people.

The measurement method was developed for the application of patented technology(Patent No. 200920052311.7) and was designed specifically for the measurement of the main technical wood parameters of the patented product of multi-temperature controlled multifunctional rice cooker. It is suitable for the measurement of the technical parameters of the multi-section temperature controlled rice cooker temperature controller when working.

**I. Technical principles:**

**1. Key Core Technology:** It is a multi-stage temperature information sensing automatic control circuit. See Figure(1). Multifunctional cooking is realized by installing multistage temperature controller under the electric heating plate.



(Fig. 1 Temperature controlled circuit diagram)

Note: Temperature fuse 1, magnetic steel button switch 2, first current limiting resistor 3, second current limiting resistor 4, thermal insulation temperature switch 5, electric heat plate 6, thermal insulation indicator 7, heating indicator 8, selection switch 9, first temperature switch 10, second temperature switch 11, Third Temperature Switch 12, Fourth Temperature Switch 13, Fifth Temperature Switch 14, Sixth Temperature Switch 15, Timer 16,

**2. Implementation process:**

Its core technology is a multi-stage temperature information sensor automatic control circuit of (1) multiple temperature control switches, (2) electric heating plates, (3) magnetic steel button switches, (4) heating, heat insulation indicator lights, (5) Multiple selection switches and other components. The heating temperature of (2) is controlled by the temperature control switch when (5) the corresponding temperature control switch is turned on. When the temperature of (2) is higher than the disconnection temperature of the temperature control switch, the temperature control switch will automatically Disconnect and stop heating.

Then(2) the temperature is lower than the disconnection temperature of the temperature switch, the temperature switch will automatically turn on and start heating, so that repeated until the food is cooked to lift the magnetic steel switch. When the operator forgets to lift the magnetic steel switch, the magnetic steel switch will automatically jump off when the water in the cooker is boiled, and it will enter the automatic insulation state to ensure safety. It can provide families with a variety of cooking methods such as cooking, porridge, soup, and meat, which greatly facilitates consumers. At present, many kinds of small samples have been tested in a small range of markets.

## II. Main characteristics and functions of patent

It has the following characteristics:

1. Use multi-stage temperature information sensing automatic control technology to adjust the automatic temperature control heating of the electric heating body.
2. Realize the continuous loop process in which the hot water is boiling when the power is added, and the water is slightly boiling or stops boiling when the power is stopped, so that the boiling time of the water can be flexibly controlled and the boiling time and water temperature can be stopped.
3. Since the electric heating board is not continuously energized and heated during the cooking process, it is automatically energized and heated according to the set temperature, and the power is cut off and kept warm, and the purpose of intelligent cooking is realized, thus saving a large amount of electric heat and water resources. Its standby power consumption is almost zero(only one heat insulation indicator power consumption).
4. At the same time, it has a variety of cooking functions of traditional Chinese cooking techniques(free choice of large, medium, and small fires). When boiled, it can automatically enter a low-temperature insulation state, ensuring safe use and easy cleaning.

## III. Selection of the main technical parameters and measurement methods for switching on and off temperature controllers

### 3.1 Key technical parameters

3.1.1 T When working for the thermostat, the cyclic time value of a conduction → disconnection → reconnection.

3.3.2 When TC works for a thermostat, the water temperature reaches 100 °C -90 °C and begins to boil → the temperature is below 100 °C -90 °C and stops boiling → rises to 100 °C -90 °C and starts boiling again. Cycle time value.

3.1.3 T1 is the power time value of the temperature controller during the T cycle from the conduction to the moment of disconnection.

3.1.4 T2 is the time value of the power outage from the break to the moment of retransmission of the T cycle thermostat.

3.1.5 Ta is the time value of water boiling at a working temperature of 100 °C -90 °C in the TC cycle. (Figure 2)

3.1.6 Tb is the time when the water temperature in the TC cycle is less than 100 °C -90 °C.

3.1.7 C1 is the temperature of the temperature in the oven when the temperature controller is instantaneously turned on within the T cycle.

3.1.8 C2 is the water temperature in the oven when the temperature controller is instantly disconnected within the T cycle.

3.1.9 Ca is the water temperature at the beginning of boiling in the TC cycle.

3.1.10 Cb is the temperature of the water in the cooker during the TC cycle at the moment of cessation of boiling.

Among the above parameters, there are the following relations

$$T1 + T2 = T \quad Ta + Tb = TC$$

### 3.2.Measurement

#### Methods

The technical parameter measurement test method is shown(Figure 2). According to the "Standard for the Measurement of the Technical Parameters of the Thermostats of the Multisegment Temperature Control Multifunctional Rice Cooker"(Spike I) Copyright Registration Number: 2013-A-00083523. The enterprise standard document is executed.



(Figure 2 Temperature measurement :)

#### IV. Purpose of measuring the technical parameters of each thermostat when working

Since the technical parameters  $T_1$ ,  $T_2$ ,  $T_a$ ,  $T_b$ ,  $C_1$ ,  $C_2$ ,  $C_a$ ,  $C_b$  are different when each thermostat is working, This determines the cooking function of a temperature controller and the amount of electricity used per unit time and the evaporation of water. Therefore, the value of  $T_1$ ,  $T_2$ ,  $T_a$ ,  $T_b$ ,  $C_1$ ,  $C_2$ ,  $C_a$ , and  $C_b$  can be changed by using a temperature controller that is disconnected from the temperature, so as to change its cooking function and control the use of electricity and water. This is the purpose of designing the measurement method.

Through the analysis of  $T_1$  and  $T_2$  parameters in the T cycle, accurate scientific theoretical calculation results can be made for the power consumption per unit time of the temperature controlled rice cooker. Through the analysis of the values of  $T_a$  and  $T_b$  parameters in the TC cycle, the evaporation of water during the operation of the temperature control devices of multiple temperature controlled rice cookers can be scientifically quantified, and the theoretical basis for the realization of cooking function can be provided.

#### V. Initial self-measurement results

Take the product DCFXB-50A(volume 3L, power 500W) as an example, According to the "Standard for the Measurement of the Technical Parameters of the multi-stage Temperature Control Multifunctional Rice Cooker Temperature Controller of the" Sui Jie "Brand", the method introduced is self-measured several times at room temperature at a temperature of 30 °C. The range of results measured by the main technical parameters when the selected switch is connected to each thermostat is as follows.

##### 1. First thermostat:

$T_1 = 30 \pm 15$  s . $T_2 = 5 \pm 2$  min.  $C_1 = 75 \pm 3$  °C.  
 $C_2 = 77 \pm 3$  °C

##### 2. Second thermostat:

$T_1 = 3 \pm 1$  min.  $T_2 = 19 \pm 2$  min.  $C_1 = 90 \pm 2$  °C.  $C_2 = 94 \pm 2$  °C.  $T_a = 3 \pm 2$  min . $T_b = 19 \pm 2$  min . $C_a = 90 \pm 1$  °C . $C_b = 94 \pm 2$  °C

##### 3. Third thermostat:

$T_1 = 3 \pm 2$  min . $T_2 = 10 \pm 2$  min . $C_1 = 96 \pm 2$  °C.  $C_2 = 99 \pm 1$  °C.  $T_a = 5 \pm 1$  min . $T_b = 9 \pm 2$  min.  $C_a = 97 \pm 1$  °C. $C_b = 98 \pm 1$  °C

##### 4. Fourth thermostat:

$T_1 = 3$  min  $\pm 1$  . $T_2 = 6 \pm 2$  min.  $C_1 = 97 \pm 2$  °C.  $C_2 = 99 \pm 1$  °C.  $T_a = 6 \pm 2$  min.  $T_b = 6 \pm 2$  min.  $C_a = 98 \pm 1$  °C. $C_b = 99 \pm 1$  °C

##### 5. Fifth thermostat:

$T_1 = 6 \pm 2$  min . $T_2 = 6 \pm 2$  min.  $C_1 = 99 \pm 2$  °C.  $C_2 = 99 \pm 1$  °C . $T_a = 8 \pm 2$  min.  $T_b = 4 \pm 2$  min.  $C_a = 99 \pm 1$  °C. $C_b = 99 \pm 1$  °C

##### 6. Sixth thermostat:

Since the operating temperature of the thermostat is as high as 165 °C or more, it is basically in the state of conduction during operation, so it is not necessary to determine the values of  $T_1$ ,  $T_2$ ,  $C_1$ ,  $C_2$ ,  $T_a$ ,  $T_b$ ,  $C_a$ ,  $C_b$ . When the water continuously boils at 100 °C, as long as the water inside the stove is boiled, the magnetic steel key switch can automatically jump so that the rice cooker can enter the state of automatic low temperature insulation(50 °C -70 °C).

#### VI. Statistical Analysis of Measurement Data and Realizable Cooking Function for Each Thermostat

1. The water temperature automatically controlled by the first thermostat is in the range

of 72 °C -80 °C. The water will not boil. It can be used to cook rice porridge, heat milk, meals and other cooked foods. During a power outage cycle of about 5 minutes, the power consumption time is about 20 seconds and the power outage time is about 5 minutes. That is, when the rice cooker is controlled by the thermostat, there are 10 power and power cycle cycles in about 50 minutes. The temperature of the boiled food is kept within 72 °C -80 °C, and its power consumption time is only about 2 minutes.

2. The water temperature automatically controlled by the second thermostat is in the range of 88 °C -98 °C. During each cycle of about 22 minutes, the water does not boil for about 19 minutes and the boiling time is about 3 minutes(the water temperature is between 90 °C and 96 °C)., It can be used to automatically cook old fire soup for a long time. Instead of being looked after. During a power cycle of about 22 minutes, the power consumption time is about 3 minutes and the power consumption time is about 19 minutes. That is, when the rice cooker is controlled by the thermostat, there are 10 power and power cycle cycles every 220 minutes or so. The temperature of the boiled food is maintained within the range of 88 °C -98 °C, and its power consumption time is only about 30 minutes.. At the same time, the water in the tank will boil once every 23 minutes, for a total of 10 times, each time about 3 minutes, and the total boiling time will be 30 minutes.

3. The automatic controlled water temperature of the third thermostat is in the range of 94 °C -100 °C. During each cycle of about 14 minutes, the water does not boil for about 9 minutes and the boiling time is about 5 minutes(the water temperature is between 97 °C and 99 °C)., It can be used to slowly cook bone soup, stew meat and fried food. In a cycle of about 12 minutes of power and power, the power consumption time is about 3 minutes and the power is about 9 minutes. That is, when the rice cooker is controlled by the thermostat, there are 10 power and power cycle

cycles in about 120 minutes. The temperature of the boiled food is kept within the range of 90 °C -98 °C, and its power consumption time is only about 30 minutes.. At the same time, the water in the tank boils once every 14 minutes or so in about 140 minutes, a total of 10 times, each time about 5 minutes, a total boiling time of 50 minutes.

4. The automatic controlled water temperature of the fourth thermostat is in the range of 95 °C -100 °C. During the cycle of about 9 minutes, the water does not boil for about 3 minutes and the boiling time is about 6 minutes(the water temperature is between 99 °C and 100 °C)., It can be used to make soup, Cook, stew meat and stew food at a relatively short time. During a power outage cycle of about 9 minutes, the power consumption time is about 3 minutes and the power outage time is about 6 minutes. That is, when the rice cooker is controlled by the thermostat, there are 10 power and power cycle cycles per 90 minutes or so. The temperature of the boiled food is kept within 95 °C -100 °C, and its power consumption time is only about 30 minutes.. At the same time, the water in the tank boils once every about 9 minutes in about 90 minutes, a total of 10 times, each time about 3 minutes, a total boiling time of 30 minutes.

5. The automatic controlled water temperature of the fifth thermostat is in the range of 96 °C -100 °C. During the cycle of about 9 minutes, the water does not boil for about 5 minutes and the boiling time is about 4 minutes(the water temperature is between 99 °C and 100 °C)., It can be used to make soup, cooking, cooking meat and cooking food faster. The power consumption time is about 3 minutes and the power consumption time is about 3 minutes during a power connection loop cycle of about 6 minutes. That is, the rice cooker has 10 power and power cycle cycles every 60 minutes or so during the control of the thermostat. The temperature of the boiled food is kept within 96 °C -100 °C, and its power consumption time is only about 30 minutes. At the same time, in about 90 minutes, the water

in the tank boils 10 times every 9 minutes, each time about 5 minutes, and the total boiling time is 50 minutes.

6. Since the disconnection temperature is as high as 165 °C and it is basically in a continuous heating state, it is generally not necessary to determine the values of T1, T2, C1, C2, Ta, Tb, Ca, and Cb. The food can be heated and heated continuously. At this time, the water is always boiling. The water temperature reaches 100 °C. When the water is boiled and dried, the cooking button will automatically jump.

### Seven.

### Conclusion

The following results can be obtained by measuring the main technical parameters of each thermostat and making preliminary statistical analysis of the measured data:

1. When rice cookers choose different temperature controllers for cooking, they can obtain a stable cooking temperature within a certain range and the boiling of water and the cycle time cycle that stops boiling. It does not require manual intervention and saves people's energy and time., Saved electricity consumption.

2. Users can choose the corresponding thermostat to cook according to their own cooking requirements and time, and can also flexibly convert to other thermostats to continue cooking as needed.

3. When using thermostat with different movement temperature to control, the indexes of its main technical parameters are different, which provides a convenient and flexible choice for the change of cooking function. It can also make statistics and analysis of the data on the amount of electricity used per hour and the boiling time of water. To guide the functional design of the product.

4. Because the temperature information can be effectively transmitted to the thermostat by using different thermostats, the indicator of the technical parameters is automatically changed. The water is not continuously boiling during cooking, but is controlled by the set thermostat. The boiling time and water temperature. That is, when the power is heated up, boiling is reduced or stopped when the power is cut off and the boiling state of the water and the water temperature are automatically controlled. As a result, It reduces the emission of large amounts of hot water vapor exhaust gas. Thus, it saves the water consumption, reduces the emission of thermal exhaust gas, and achieves the purpose of energy conservation and environmental protection. Use a cooker to provide family with a variety of cooking options. It greatly facilitates consumers and has been used in products. Now it is implementing industrialization. It can also be widely used in other fields that require electrothermal automatic control.

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5. In the process of measuring the main technical parameters of each thermostat, two thermophysical phenomena of temperature change during boiling of water are found. The first is that when measuring the second thermostat, the water temperature is about 88 °C and is in a state of thermal equilibrium. When the thermostat conducts the heat plate to heat up, the water temperature rises to 90 °C and begins to boil slightly. The water temperature is rising and the boiling speed is accelerated. The water stops boiling until the water temperature reaches about 96 °C and the thermostat breaks off the heat plate to stop heating. Second, when measuring the working parameters of the fifth thermostat, it was found that the water temperature was 100 °C -99 °C

and was in a state of thermal equilibrium. When the thermostat was disconnected and the electric plate stopped heating, the boiling speed of the water began to slow down until it stopped boiling. At this time, the water temperature is still between 100 °C and 99 °C but it is not boiling. These two images seem to be inconsistent with the view that the boiling point of water at an atmospheric pressure is 100 °C. It needs to be verified and analyzed in the future. Due to the lack of equipment and the poor measurement environment, the measured data still needs to be tested and certified by the third party of the relevant national authority testing institution. When the financial conditions are ripe, the inspection and certification work in this area will be completed, and further improvements and modifications will be made to form a product technical standard for multi-section temperature control smart rice cookers, so as to guide the large-scale industrial production of future products.

#### **Eight. Research and development of "high precision Multi-segment temperature information sensor automatic controller"**

Temperature is one of the important parameters in thermodynamics and statistical physics. Therefore, the use of effective key technical means to accurately control the use of energy. The quantity used, so as to achieve the precise control of the changes in the temperature of the substances needed by people, has a very important scientific research significance and a wide range of practical applications. The purpose of the research item "High-precision multi-stage temperature sensor automatic controller" is to use the original patented new technology "multi-stage temperature information sensing automatic control technology" patent number: 200920052311.7 to achieve this goal., The technology has been successfully applied to rice cooker. "multi-stage temperature control patent intelligent rice cooker" is a successful application example. At present, multiple temperature controllers(six sections) have been used to control the temperature range of rice cookers from 70

degrees to 100 degrees(ie, the temperature range of 30 degrees is divided into six regions), and the average temperature control range is 5 degrees. About the technical index, If we want to improve the control precision of this range further, we must study the new control method to implement it. Therefore, the research goal of the project is to achieve a temperature range of about 15 temperature control areas within a range of 70 degrees to 100 degrees, with an average temperature control range of fine. At the same time, the second generation high-precision multi-section temperature controlled rice cooker was developed and put into the consumer home appliance market.

**Concluding remarks:**  
High-precision and accurate automatic control of the temperature of the object will have a great and extensive scientific research value and technology application scene and a wide market use space.

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30 April 2019