(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 4 393 334 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
03.07.2024 Bulletin 2024/27

(21) Application number: **22866289.6**

(22) Date of filing: **03.08.2022**

(51) International Patent Classification (IPC):
A24F 40/53 *(2020.01)* ***A24F 40/40*** *(2020.01)*
A24F 40/50 *(2020.01)* ***A24F 40/57*** *(2020.01)*
A24F 40/465 *(2020.01)*

(86) International application number:
PCT/CN2022/110052

(87) International publication number:
WO 2023/035815 (16.03.2023 Gazette 2023/11)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **07.09.2021 CN 202111044259**

(71) Applicant: **Shenzhen Merit Technology Co., Ltd.**
Shenzhen, Guangdong 518105 (CN)

(72) Inventors:
- **WANG, Liang**
  Shenzhen, Guangdong 518105 (CN)
- **DOU, Hengheng**
  Shenzhen, Guangdong 518105 (CN)

(74) Representative: **Westphal, Mussgnug & Partner, Patentanwälte mbB**
Werinherstraße 79
81541 München (DE)

(54) COMPUTER PROGRAM PRODUCT, STORAGE MEDIUM, CONTROL APPARATUS, AEROSOL GENERATING APPARATUS, AND CONTROL METHOD THEREFOR

(57) A computer program product, a storage medium, a control apparatus, an aerosol generating apparatus and a control method therefor. The aerosol generating apparatus comprises a resonance module, which comprises a detection coil, wherein the detection coil is at least partially located in a magnetic field of the heating element; a control module, which is used to control the resonance module to operate in the resonance state, determine the resonance frequency of the resonance module according to a voltage signal of the detection coil, and determine a corresponding detection result according to the resonance frequency. Since a corresponding detection function can be achieved without providing a temperature sensor, the problem of the structural design of the aerosol generating apparatus being limited can be solved. Moreover, since the detection coil does not need to be electrically connected to the heating element, the problem of cleaning difficulties caused by electrical connection is also solved.

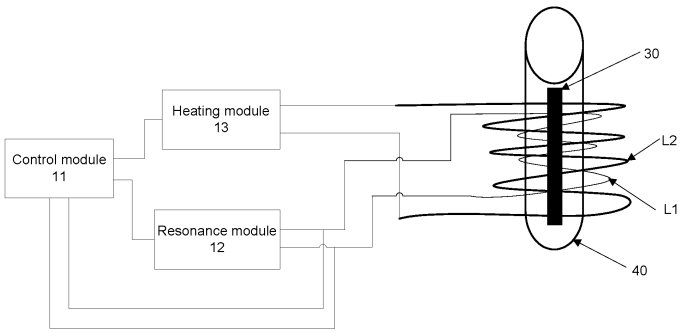

FIG1

EP 4 393 334 A1

Description

Technical Field

[0001] The invention relates to the field of atomizing equipment, in particular to a computer program product, a storage medium, a control apparatus, an aerosol generating apparatus and a control method therefor.

Description of Related Art

[0002] Aerosol generating apparatus is a kind of apparatus which can atomize aerosol generating matrix in atomizer. It has the advantages of safety, convenience, health and environmental protection and the like, so it is more and more concerned and favored by people.

[0003] In the existing aerosol generating apparatus, a temperature sensor is usually used to detect the temperature of the aerosol generating matrix. However, due to the need to reserve space for the temperature sensor in the structure, there is a problem of limited structural design, and because the electrical separation from the heating element cannot be realized, there is also a problem of difficult cleaning caused by electrical connection.

BRIEF SUMMARY OF THE INVENTION

Technical issues

[0004] The technical problem to be solved by the invention is that the structure design of the aerosol generating apparatus in the prior art is limited and the cleaning is difficult.

SOLUTIONS TO PROBLEMS

Technical solutions

[0005] The technical proposal adopted by the invention to solve the technical problem is that an aerosol generating apparatus is constructed, which comprises a containing cavity for containing an aerosol generating matrix and a heating element for heating the aerosol generating matrix, wherein the heating element is a heating element with magnetic temperature characteristics, and the aerosol generating apparatus comprises:

A resonance module, and the resonance module comprises a detection coil, and at least a part of the detection coil is in a magnetic field of the heating element;

A control module, which is used for controlling the resonance module to work in a resonant state, and determining the resonant frequency of the resonance module according to the voltage signal of the detection coil, and determining the corresponding detection result according to the resonant frequency.

[0006] Preferably, the corresponding detection results comprise the temperature of the heating element, whether a suction action occurs, or whether an insertion action of a aerosol generating matrix occurs.

[0007] Preferably, the detection coil is a spiral spring coil, and the spiral spring coil is sleeved on the containing cavity.

[0008] Preferably, the detection coil is a spiral flat coil, and the spiral flat coil is arranged at the periphery of the containing cavity.

[0009] Preferably, the heating element is a flat cuboid, the detection coil comprises a plurality of the spiral flat coils connected in series, and the plurality of the spiral flat coils are dispersed at the periphery of the containing cavity.

[0010] Preferably, the resonance module further comprises a first switch tube, a second switch tube, a fifth switch tube, a first diode, a second diode, a first capacitor, a first inductor and a second inductor, wherein the control end of the fifth switch tube is connected with the first output end of the control module, the first end of the fifth switch tube is connected with an output end of a power supply, the second end of the fifth switch tube is respectively connected with the control end of the first switch tube, the control end of the second switch tube, the anode of the first diode and the anode of the second diode; the first end of the first switch tube and the first end of the second switch tube are respectively grounded, the second end of the first switch tube is respectively connected with the cathode of the first diode, the first end of the detection coil, the first end of the first capacitor and the first end of the first inductor. The second end of the second switch tube is respectively connected with the cathode of the second diode, the second end of the detection coil, the second end of the first capacitor and the first end of the second inductor; and the second end of the first inductor and the second end of the second inductor are respectively connected with the second end of the fifth switch tube.

[0011] Preferably, the control module comprises:

A conversion unit, which is used for acquiring a voltage signal of the detection coil and converting the voltage signal into a pulse signal;

A main control unit, which is used for determining the resonant frequency of the resonance module according to the pulse signal and determining the corresponding detection result according to the resonant frequency.

[0012] Preferably, the conversion unit comprises an operational amplifier, a first resistor, a second resistor, a third resistor and a fourth resistor, wherein, the inverted input end of the operational amplifier is connected to one end of the detection coil through the second resistor, the non-inverted input end of the operational amplifier is connected to the other end of the detection coil through the third resistor, the first resistor is connected between the

inverted input end of the operational amplifier and ground, and the fourth resistor is connected between the non-inverted input end of the operational amplifier and ground.

[0013] Preferably, the invention also comprises a heating module, wherein the heating module comprises a heating coil sleeved on the containing cavity,

[0014] The control module is also used for controlling the heating module to generate alternating current on the heating coil, so as to carry out electromagnetic heating on the heating element in the containing cavity.

[0015] Preferably, the heating module also comprises a third switch tube, a fourth switch tube, a second capacitor and a third capacitor, wherein, the first end of the third switch tube is connected with the second end of the fourth switch tube, the second end of the third switch tube is connected with an output end of a power supply, the first end of the fourth switch tube is grounded, the control end of the third switch tube is connected with the second output end of the control module, the control end of the fourth switch tube is connected with the third output end of the control module, the second capacitor and the third capacitor are connected in series between the output end of the power supply and the ground, the first end of the heating coil is connected with the first end of the third switch tube, and the second end of the heating coil is connected with the connection point of the second capacitor and the third capacitor.

[0016] Preferably, the control module is used for controlling the heating module to generate alternating current according to the temperature of the heating element in a heating period of each cycle when the power control of the heating element is carried out; controlling the resonance module to operate in a resonant state in a non-heating period of each cycle, and determining the temperature of the heating element according to the resonant frequency of the resonance module.

[0017] Preferably, the control module is also used for controlling the resonance module to work in a resonant state by timing awakening in the standby state, and determining whether an insertion action of the aerosol generating matrix occurs according to the resonant frequency of the resonance module.

[0018] The invention also constructs a control method of an aerosol generating apparatus, which comprises the following steps:

Controlling a resonance module to work in a resonant state, wherein, the resonance module comprises a detection coil, and at least a part of the detection coil is in a magnetic field of a heating element, and the heating element is a heating element with magnetic temperature characteristics;

Determining the resonant frequency of the resonance module according to the voltage signal of the detection coil;

Determining a corresponding detection result according to the resonant frequency.

[0019] Preferably, determining the resonant frequency of the resonance module according to the voltage signal of the detection coil, comprising:

Converting the voltage signal of the detection coil into a pulse signal;

Determining the resonant frequency of the resonance module according to the pulse signal.

[0020] The invention also constructs a control apparatus, which comprises a memory and a processor, wherein the memory stores a computer program, and when the processor executes the computer program, the steps of the control method of an aerosol generating apparatus as described above are realized.

[0021] The invention also constructs a storage medium including computer instructions that, when run on a processor, cause the processor to execute a control method of an aerosol generating apparatus as described above.

[0022] The invention also constructs a computer program product that, when run on a computer, causes the computer to execute the control method of an aerosol generating apparatus as described above.

BENEFICIAL EFFECTS OF INVENTION

Beneficial effect

[0023] By implementing the technical proposal of the invention, the corresponding detection function can be realized without setting a temperature sensor, which solves the problem of limited structural design of an aerosol generating apparatus, and also solves the problem of difficult cleaning caused by electrical connection because the detection coil does not need to be electrically connected with a heating element.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Illustrated drawings

[0024]

Fig. 1 is a logic structure diagram of an embodiment of an aerosol generating apparatus according to the present invention;

Fig. 2 is a schematic structural diagram of a second embodiment of an aerosol generating apparatus according to the present invention;

Fig. 3 is a circuit diagram of a first embodiment of a resonance module and a conversion unit in an aerosol generating apparatus of the present invention;

Fig. 4 is a circuit diagram of a first embodiment of a heating module in an aerosol generating apparatus of the present invention;

Fig. 5 is a graph of resonance frequency versus time in one embodiment of the present invention;

Fig. 6 is a flowchart of an embodiment of the control method of the aerosol generating apparatus of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Embodiments of the invention

[0025] A clear and complete description of the technical aspects of the embodiments of the invention will be given below in conjunction with the accompanying drawings in which the embodiments of the invention are described, and it will be apparent that the described embodiments are only part of the embodiments of the invention, not all of them. Based on the embodiments in the present invention, all other embodiments obtained by those of ordinary skill in the art without making creative efforts are within the scope of protection of the present invention.

[0026] Fig. 1 is a logical structure diagram of an embodiment of an aerosol generating apparatus of the present invention. At first, the aerosol generating apparatus comprises a containing cavity (not shown) and a heating element 30, the containing cavity is used for containing an aerosol generating matrix 40, and the heating element 30 is used for heating the aerosol generating matrix 40. For example, the heating element 30 may be embedded in the aerosol generating matrix 40. Moreover, the heating element 30 is a heating element having magnetic temperature characteristics, that is, an alloy having a specific Curie temperature point, and the magnetic induction value of the alloy decreases with an increase in temperature at or below the specific Curie temperature point (for example, 420°C), and has an almost linear relationship. For example, an iron-nickel-chromium alloy can be selected as the material of the heating element 30.

[0027] Combined with Fig. 1, the aerosol generating apparatus of the embodiment further comprises a control module 11, a resonance module 12 and a heating module 13, and the heating module 13 comprises a heating coil L2, which is sleeved on the containing cavity; The Resonance Module 12 comprises a detection coil L1 at least a portion of which is within the magnetic field of the heating element 30. In this embodiment, both the detection coil L1 and the heating coil L2 are spiral spring coils, and both the detection coil L1 and the heating coil L2 are sleeved on the containing cavity, for example, they can be coaxially sleeved, and preferably, the heating coil L2 can be arranged outside the detection coil L1.

[0028] The control module 11 is respectively connected with the resonance module 12 and the heating module 13, and the control module 11 is used for controlling the heating module 12 to generate alternating current on the heating coil L2 ,so as to carry out electromagnetic heating the heating element 30 in the containing cavity; It is also used for controlling the resonance module 12 to operate in a resonant state, so that almost no induced heating is generated during detection and the current is very small during actual operation. At the same time, the resonant frequency of the resonance module 12 is determined according to the voltage signal of the detection coil L1, and corresponding detection results are determined according to the resonant frequency, for example, including the temperature of the heating element, whether a suction action occurs, or whether an insertion action of the aerosol generating matrix occurs.

[0029] In this embodiment, during a normal operation of the aerosol generating apparatus, the temperature of the heating element 30 will change, for example, the temperature of the heating period and the non-heating period in a control period are different; The temperature is different when suction action occurs and when no suction action occurs. and a change in the temperature of the heating element 30 causes a change in the magnetic induction value thereof. In the aerosol generating apparatus, the magnetic induction value of the heating element 30 is different in different cases where the aerosol generating matrix is inserted or not inserted. Thus, when the magnetic induction value of the heating element 30 is changed, since at least a part of the detection coil L1 is in a magnetic field of the heating element 30, the resonance frequency of the resonance module 12 is changed, that is, the frequency of the voltage on the detection coil L1 is changed, so that the frequency characteristic can be used as a characterization of the corresponding detection result of the aerosol generating apparatus, and therefore the control module 11 can determine the corresponding detection result according to the resonance frequency. This detection method solves the problem of limited structural design of aerosol generating apparatus because it does not need to set a temperature sensor, and also solves the problem of cleaning difficulty caused by electrical connection because the detection coil L1 does not need to be electrically connected with the heating element. In addition, by separating the resonance module from the heating module, the flexible design of the heating module can be realized.

[0030] In addition, it should be noted that in other embodiments, the heating element 30 can also be heated by other means, for example, direct heating.

[0031] Fig. 2 is a structural schematic diagram of the second embodiment of on aerosol generating apparatus of the present invention. Compared with the embodiment shown in Fig. 1, the only difference in this embodiment is that the heating element 30 is a flat cuboid, and the detection coil comprises four spiral flat coils L11, L12, L13 and L14 connected in series, and the four spiral flat coils L11, L12, L13 and L14 are dispersed around the heating element 30, that is, around the containing cavity, and the detection coil is arranged in a multi-sided induction arrangement. With respect to this embodiment, it should be noted that since the heating element 30 is a flat cuboid, the detection coil is also a spiral flat coil, and in practical application, after the aerosol generating matrix is inserted and removed, the heating element 30 may

rotate around its vertical axis, that is, the projected shape in the horizontal plane changes, and it may occur that the flat surface of the heating element 30 is just perpendicular to or nearly perpendicular to the flat surface of a spiral flat coil. In this case, the influence on the resonant frequency of the resonance module is small, so that the detection result may be inaccurate. In order to avoid the occurrence of this situation, a plurality of spiral flat coils connected in series are arranged on the periphery of the heating element 30 in this embodiment, and no matter how the heating element rotates around its vertical axis, enough parts of the spiral flat coils falling into the magnetic field of the heating element 30 can be ensured, thereby improving the detection accuracy. It should be understood that the present invention is not limited to the number of spiral flat coils and in other embodiments the number of spiral flat coils may be two, three or the like. Of course, in other embodiments, if the heating element is a cylinder or a cuboid with a square cross section, only one spiral flat coil may be provided.

[0032] Further, the control module 11 comprises a conversion unit and a main control unit, wherein, the conversion unit is used for acquiring a voltage signal of the detection coil and converting the voltage signal into a pulse signal; The main control unit is used for determining the resonant frequency of the resonance module according to the pulse signal and determining the corresponding detection result according to the resonant frequency.

[0033] Fig. 3 is a circuit diagram of a first embodiment of a resonance module and a conversion unit in the aerosol generating apparatus of the present invention. In the embodiment, the resonance module comprises a first switch tube Q1, a second switch tube Q2, a fifth switch tube Q5, a first diode D1, a second diode D2, a first capacitor C1, a first inductor L3 and a second inductor L4, in addition to a detection coil L1. Moreover, the first switch tube Q1, the second switch tube Q2 and the fifth switch tube Q5 are all MOS tubes. In addition, it also comprises resistors R1, R2, R3, R4, R11 and capacitor C4. The gate of the fifth switch tube Q5 is connected to the first output end of the main control unit (VCC2_EN), the source of the fifth switch tube Q5 is connected to an output end of a power supply (VCC), the resistor R11 is connected between the gate and the source of the fifth switch tube Q5, and the capacitor C4 is connected between the drain of the fifth switch tube Q5 and ground. The gate of the first switch tube Q1 is connected to the drain (VCC2) of the fifth switch tube Q5 through a resistor R1, the gate of the second switch tube Q2 is connected to the drain (VCC2) of the fifth switch tube Q5 through a resistor R2, the source of the first switch tube Q1 and the source of the second switch tube Q2 are respectively grounded, the resistor R3 is connected between the gate and the source of the first switch tube Q1, and the resistor R4 is connected between the gate and the source of the second switch tube Q2. The drain of the first switch tube Q1 is respectively connected to the cathode of the first diode D1, the first end of the detection coil L1, the first end of the first capacitor C1 and the first end of the first inductor L3. The drain of the second switch tube Q2 is respectively connected to the cathode of the second diode D2, the second end of the detection coil L1, the second end of the first capacitor C1 and the first end of the second inductor L4, and the second end of the first inductor L3 and the second end of the second inductor L4 are respectively connected to the drain of the fifth switch tube Q5. The anode of the first diode D1 is connected to the gate of the second switch tube Q2, and the anode of the second diode D1 is connected to the gate of the first switch tube Q2. It should be understood that resistors R1 and R2 serve as current limiting, resistors R3, R4 and R11 serve as isolation, and capacitor C4 serves as voltage stabilizing, which may be omitted in other embodiments.

[0034] In this embodiment, the conversion unit comprises an operational amplifier U1B, a first resistor R5, a second resistor R6, a third resistor R8, a fourth resistor R10, and also comprises resistors R7 and R9. The inverting input end of the operational amplifier U1B is connected to one end of the detection coil L1 through the second resistor R6, the non-inverting input end of the operational amplifier U1B is connected to the other end of the detection coil L1 through the third resistor R8, the first resistor R5 is connected between the inverting input end of the operational amplifier U1B and ground, the fourth resistor R10 is connected between the non-inverting input end of the operational amplifier U1B and ground, the resistors R7 and R9 are connected in series between the output end of the operational amplifier U1B and ground, and the connection point of the resistors R7 and R9 is the output end of the conversion unit.

[0035] Fig. 4 is a circuit diagram of a first embodiment of a heating module in an aerosol generating apparatus of the present invention. The heating module of the embodiment comprises a third switch tube Q3, a fourth switch tube Q4, a second capacitor C2 and a third capacitor C3, and in the embodiment, the third switch tube Q3 and the fourth switch tube Q4 are all MOS tubes. The source of the third switch tube Q3 is connected to the drain of the fourth switch tube Q4, the drain of the third switch tube Q3 is respectively connected to an output of a power supply (VCC1), the source of the fourth switch tube Q4 is grounded, the gate of the third switch tube Q3 is connected to the second output of the control module (PWM-H), the gate of the fourth switch tube Q4 is connected to the third output of the control module (PWM-L), the second capacitor C2 and the third capacitor C3 are connected in series between the output of the power supply and the ground, the first end of the heating coil L2 is connected to the source of the third switch tube Q3, and the second end of the heating coil L2 is connected to the connection point between the second capacitor C2 and the third capacitor C3.

[0036] Combined with figs. 3 and 4, the third switch tube Q3, the fourth switch tube Q4, the heating coil L2, the second capacitor C2 and the third capacitor C3 con-

stitute a controllable heating module. When heating control of the heating element is needed, the main control unit in the control module controls the alternating conduction of the third switch tube Q3 and the fourth switch tube Q4 through PWM-H and PWM-L to generate alternating current on the heating coil L2, thus realizing controllable heating of the heating element.

[0037] The detection coil L1, the first capacitor C1 and an auxiliary circuit constitute a resonance module, and the operational amplifier U1B and an auxiliary circuit constitute a conversion unit. When the corresponding detection is needed, the main control unit in the control module controls the fifth switch tube Q5 to conduct through VCC2_EN. then, VCC2 is at a high level, the detection coil L1 resonates with the first capacitor C1, and a voltage signal with waveform oscillation is generated on the detection coil L1, which is sent to the operational amplifier U1B. The operational amplifier U1B converts the voltage signal with waveform oscillation into a pulse signal capable of frequency measurement, and at the same time, realizes level matching through resistors R7 and R9, and then transmits the output signal Fre to the main control unit of the control module. The main control unit obtains the characteristics of the current resonant frequency of the resonance module through frequency measurement, and then carries out corresponding detection through the characteristic change of the resonant frequency. Moreover, various detections can be realized by using the characteristic change of the resonant frequency.

[0038] In an optional embodiment, the temperature of the heating element is detected by utilizing the characteristic change of the resonant frequency, in particular, the control module is used for controlling the heating module to generate an alternating current according to the temperature of the heating element in a heating period of each cycle when the power control of the heating element is carried out; In a non-heating period of each cycle, the resonance module is controlled to operate in a resonant state, and the temperature of the heating element is determined according to the resonant frequency of the resonance module. In this embodiment, under the control of the control module, an alternating current of a specific time period (Tm) is loaded on the heating coil, and the heating element performs induction heating. However, the heating element has obvious magnetic temperature characteristics under specific temperature conditions (for example, between 150 °C and 420 °C). Then, the control module controls the resonance module to work in another specific time period (Tn), Tm and Tn are two time periods that do not coincide. Because the change of frequency characteristics of the resonance module can feedback the change of the temperature of the heating element, the control module can obtain the peak frequency characteristics of the resonance module by detecting the voltage on the detection coil, and then determine the change of the temperature of the heating element according to the change of the frequency characteristics, and adjust the interaction current on the heating coil according to the change of the temperature of the heating element. Moreover, the heating method is an induction heating method, so it has a larger conversion power. At the same time, the resonance module works in a resonant state, which hardly produces obvious induction heating, and the working current is very small in actual work.

[0039] In an alternative embodiment, the detection of the suction action is realized by using the characteristic change of the resonant frequency. In particular, the detection of the suction action can be realized by the obvious jump of the resonant frequency characteristic because the heating experience has obvious temperature change when a suction air flow flows through the aerosol generating matrix, and then the number of suction actions can be measured.

[0040] In an alternative embodiment, the insertion detection of the aerosol generating matrix is realized by utilizing the characteristic change of the resonant frequency. In particular, the working current of the resonance module is very small, and when the aerosol generating apparatus is in the standby state, the control module can detect the change of the working frequency of the resonance module by timing wake-up through the "VCC2_EN" signal, thereby realizing the insertion detection of the aerosol generating matrix.

[0041] To sum up, combined with fig. 5, in the period of 0 ~ 11, when no aerosol generating matrix is inserted, the detected resonance frequency is f0; At time t1, aerosol forming matrix is inserted, and the detected resonance frequency decreases to f1; During a period from t1 to t2, since the start of preheating, the detected resonant frequency is gradually raised to f2, wherein f2 is a frequency corresponding to a preset temperature point, and the detected resonant frequency is maintained at this frequency point by controlling heating; During the period t3 to t4, when the user performs a single suction, the temperature of the heating element drops, the detected resonant frequency drops from f2 to f3, and then the resonant frequency rises to f2 by heating control. Likewise, during the period t5 to t6, the detected resonant frequency decreases from f2 to f4 due to another suction by the user, and then the resonant frequency increases to f2 by heating control. Moreover, when the suction depth is different, the frequency drop range will be different. For example, because f4 is lower than f3, the suction depth of the second suction is greater than that of the first suction.

[0042] Fig. 6 is a flowchart of the first embodiment of the control method of an aerosol generating apparatus of the present invention. The control method of the embodiment is applied to a control module. Furthermore, combined with Fig. 1, the control method comprises:

Step S10. Controlling a resonance module to work in a resonant state, wherein, the resonance module comprises a detection coil, and at least a part of the detection coil is in the magnetic field of a heating

element, and the heating element is a heating element with magnetic temperature characteristics;
S20. Determining the resonant frequency of the resonance module according to the voltage signal of the detection coil;
Step S30. Determining the corresponding detection result according to the resonant frequency, and the detection result comprises, for example, the temperature of the heating element, whether a suction action occurs, or whether an insertion action of the aerosol generating matrix occurs.

[0043] Further, the step S20 comprises:

Converting the voltage signal of the detection coil into a pulse signal;
Determining the resonant frequency of the resonance module according to the pulse signal.

[0044] The invention also constructs a control apparatus, which comprises a memory and a processor, wherein the memory stores a computer program, and when the processor executes the computer program, the steps of the control method of an aerosol generating apparatus as described above are realized.
[0045] The invention also constructs a storage medium including computer instructions that, when run on a processor, cause the processor to execute the control method of an aerosol generating apparatus as described above.
[0046] The invention also constructs a computer program product that, when run on a computer, causes the computer to execute the control method of an aerosol generating apparatus as described above.
[0047] The foregoing is merely a preferred embodiment of the invention and is not intended to limit the invention which may be subject to various modifications and variations to those skilled in the art. Any modifications, equivalents, modifications, etc. made within the spirit and principles of the present invention shall be comprised within the scope of the claims of the present invention.

Claims

1. An aerosol generating apparatus comprising a containing cavity for containing an aerosol generating matrix and a heating element for heating the aerosol generating matrix, wherein, the heating element is a heating element with magnetic temperature characteristics, and the aerosol generating apparatus comprises:

   a resonance module, and the resonance module comprises a detection coil, and at least a part of the detection coil is in a magnetic field of the heating element;
   a control module, which is used for controlling the resonance module to work in a resonant state, and determining the resonant frequency of the resonance module according to the voltage signal of the detection coil, and determining the corresponding detection result according to the resonant frequency.

2. The aerosol generating apparatus according to Claim 1, wherein, the corresponding detection results comprise the temperature of the heating element, whether a suction action occurs, or whether an insertion action of a aerosol generating matrix occurs.

3. The aerosol generating apparatus according to Claim 1, wherein, the detection coil is a spiral spring coil and the spiral spring coil is sleeved on the containing cavity.

4. The aerosol generating apparatus according to Claim 1, wherein, the detection coil is a spiral flat coil, and the spiral flat coil is arranged at the periphery of the containing cavity.

5. The aerosol generating apparatus according to Claim 4, wherein, the heating element is a flat cuboid, the detection coil comprises a plurality of the spiral flat coils connected in series, and the plurality of the spiral flat coils are dispersed at the periphery of the containing cavity.

6. The aerosol generating apparatus according to Claim 1, wherein, the resonance module further comprises a first switch tube (Q1), a second switch tube (Q2), a fifth switch tube (Q5), a first diode (D1), a second diode (D2), a first capacitor (C1), a first inductor (L3) and a second inductor (L4), wherein , the control end of the fifth switch tube (Q5) is connected with the first output end of the control module, the first end of the fifth switch tube (Q5) is connected with an output end of a power supply, the second end of the fifth switch tube (Q5) is respectively connected with the control end of the first switch tube (Q1), the control end of the second switch tube (Q2), the anode of the first diode (D1) and the anode of the second diode (D2); the first end of the first switch tube (Q1) and the first end of the second switch tube (Q2) are respectively grounded , the second end of the first switch tube (Q1) is respectively connected with the cathode of the first diode (D1), the first end of the detection coil (L1), the first end of the first capacitor (C1) and the first end of the first inductor (L3); the second end of the second switch tube (Q2) is respectively connected to the cathode of the second diode (D2), the second end of the detection coil (L1), the second end of the first capacitor (C 1) and the first end of the second inductor (L4); and the second end of the first inductor (L3) and the second end of

the second inductor (L4) are respectively connected to the second end of the fifth switch tube (Q5).

7. The aerosol generating apparatus according to Claim 1, wherein, the control module comprises:

a conversion unit, which is used for acquiring a voltage signal of the detection coil and converting the voltage signal into a pulse signal;
a main control unit, which is used for determining the resonant frequency of the resonance module according to the pulse signal and determining the corresponding detection result according to the resonant frequency.

8. The aerosol generating apparatus according to Claim 7, wherein, the conversion unit comprises an operational amplifier (U1B), a first resistor (R5), a second resistor (R6), a third resistor (R8) and a fourth resistor (R10), wherein the inverting input of the operational amplifier (U1B) is connected to one end of the detection coil (L1) through the second resistor (R6), the non-inverting input of the operational amplifier (U1B) is connected to the other end of the detection coil (L1) through the third resistor (R8), the first resistor (R5) is connected between the inverting input of the operational amplifier (U1B) and ground, and the fourth resistor (R10) is connected between the non-inverting input of the operational amplifier (U1B) and ground.

9. The aerosol generating apparatus according to Claim 1, wherein, further comprising a heating module, he heating module comprises a heating coil sleeved on the containing cavity, and the control module is also used for controlling the heating module to generate alternating current on the heating coil , so as to carry out electromagnetic heating on the heating element in the containing cavity.

10. The aerosol generating apparatus according to Claim 9, wherein, the heating module further comprises a third switch tube (Q3), a fourth switch tube (Q4), a second capacitor (C2) and a third capacitor (C3), wherein the first end of the third switch tube (Q3) is connected to the second end of the fourth switch tube (Q4), the second end of the third switch tube (Q3) is connected to an output end of a power supply, the first end of the fourth switch tube (Q4) is grounded, the control end of the third switch tube (Q3) is connected to the second output end of the control module, the control end of the fourth switch tube (Q4) is connected to the third output end of the control module, the second capacitor (C2) and the third capacitor (C3) are connected in series between the output end of the power supply and the ground, the first end of the heating coil is connected with the first end of the third switch tube (Q3) and the second end of the heating coil are connected to the connection point between the second capacitor (C2) and the third capacitor (C3).

11. The aerosol generating apparatus according to Claim 9, wherein,
the control module is used for controlling the heating module to generate alternating current according to the temperature of the heating element in a heating period of each cycle when the power control of the heating element is carried out; controlling the resonance module to operate in a resonant state in a non-heating period of each cycle, and determining the temperature of the heating element according to the resonant frequency of the resonance module.

12. The aerosol generating apparatus according to Claim 1, wherein,
the control module is also used for controlling the resonance module to work in a resonant state by timing awakening in the standby state, and determining whether an insertion action of the aerosol generating matrix occurs according to the resonant frequency of the resonance module.

13. A control method of an aerosol generating apparatus, wherein comprises:

controlling a resonance module to work in a resonant state, wherein, the resonance module comprises a detection coil, and at least a part of the detection coil is in a magnetic field of a heating element, and the heating element is a heating element with magnetic temperature characteristics;
determining the resonant frequency of the resonance module according to the voltage signal of the detection coil;
determining a corresponding detection result according to the resonant frequency.

14. The control method of the aerosol generating apparatus according to Claim 13, wherein, determining the resonant frequency of the resonance module according to a voltage signal of the detection coil comprises:

converting the voltage signal of the detection coil into a pulse signal;
determining the resonant frequency of the resonance module according to the pulse signal.

15. A control apparatus comprising a memory and a processor, the memory having a computer program stored therein, wherein the processor performs the steps of the control method of an aerosol generating apparatus according to claim 13 or 14 when executing the computer program.

16. A storage medium, wherein the storage medium comprising computer instructions that, when run on a processor, cause the processor to execute the control method of an aerosol generating apparatus according to claim 13 or 14.

17. A computer program product, wherein when the computer program product is run on a computer, the computer is caused to perform the control method of the aerosol generating apparatus according to claim 13 or 14.

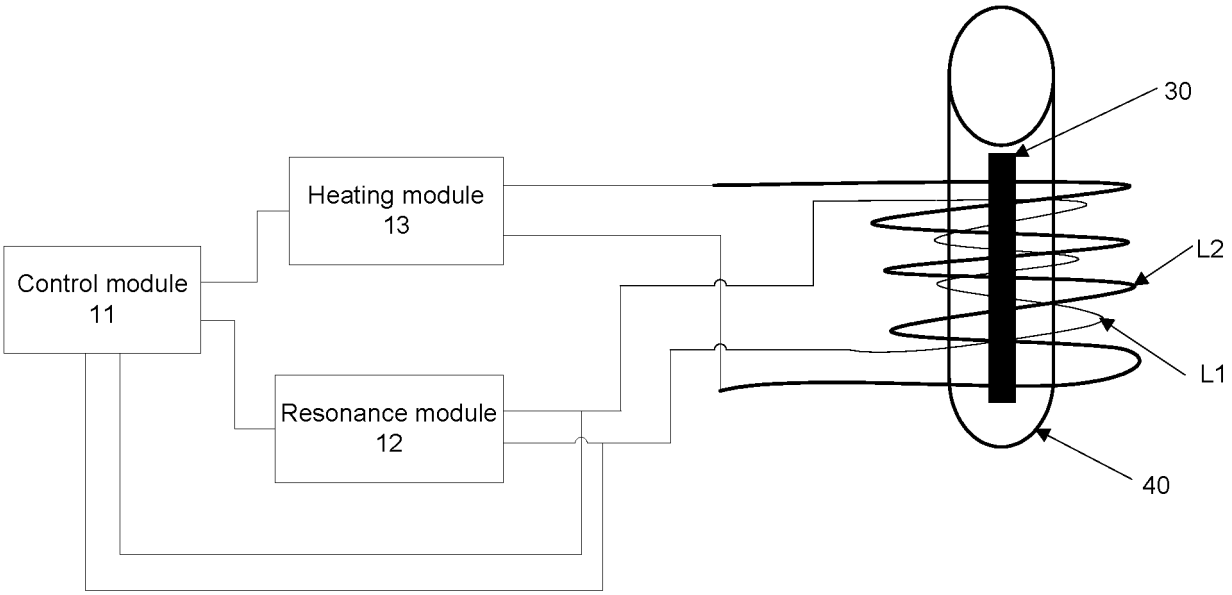
Heating module
13
Control module
11
Resonance module
12
30
L2
L1
40

FIG1

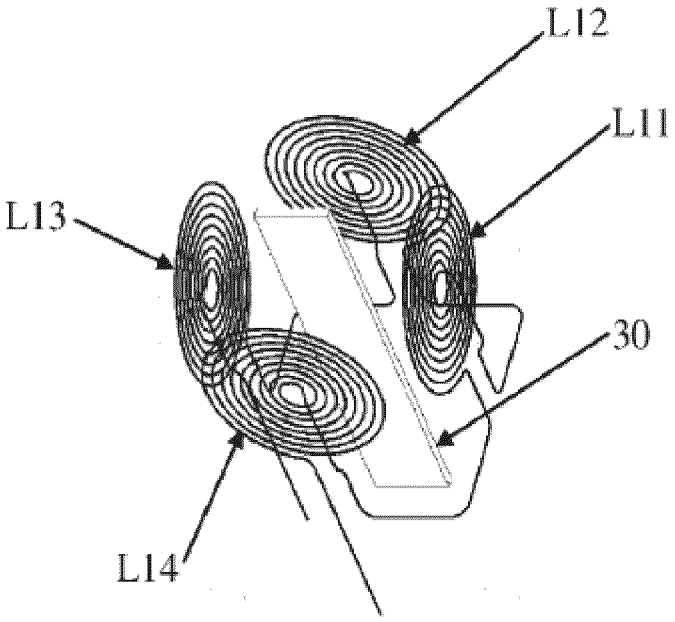
L12
L11
L13
30
L14

FIG2

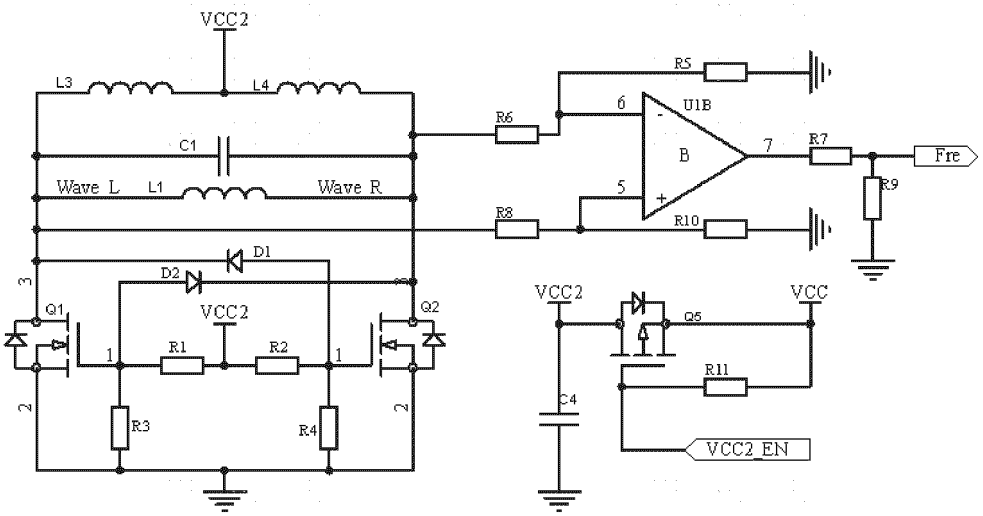
VCC2
L3
L4
C1
Wave L
L1
Wave R
D1
D2
Q1
Q2
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
U1B
B
Fre
VCC2
VCC
Q5
R11
C4
VCC2_EN

FIG3

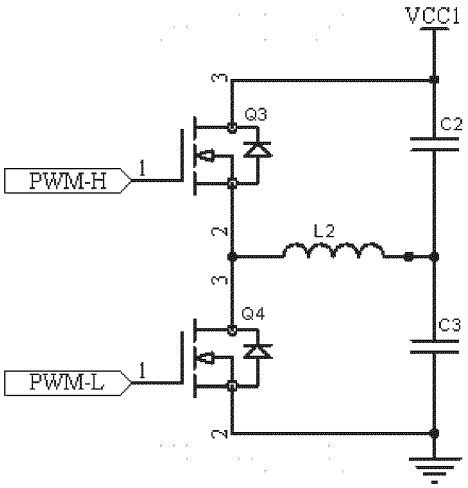
VCC1
Q3
C2
PWM-H
L2
Q4
C3
PWM-L

FIG4

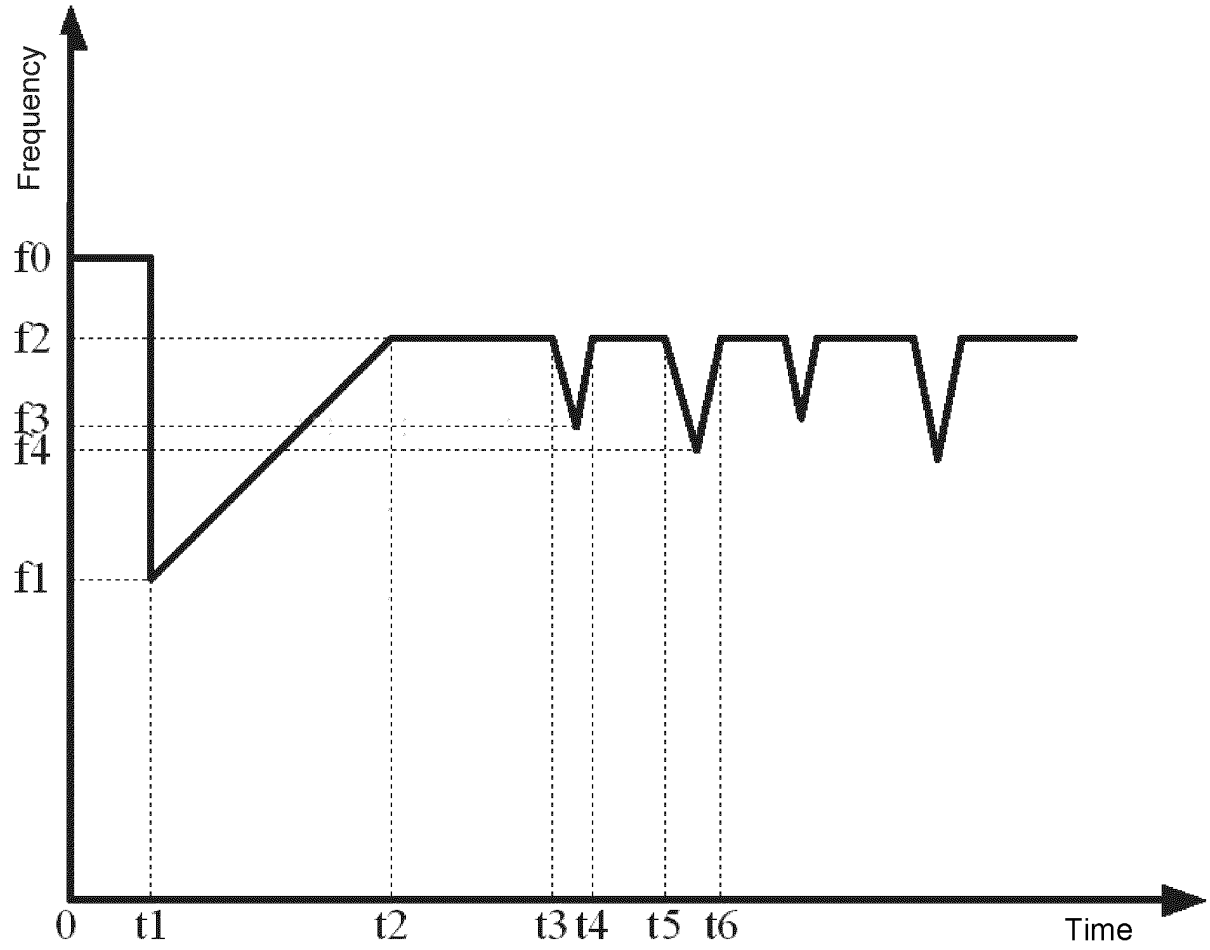
Frequency
f0
f2
f3
f4
f1
0
t1
t2
t3
t4
t5
t6
Time

FIG5

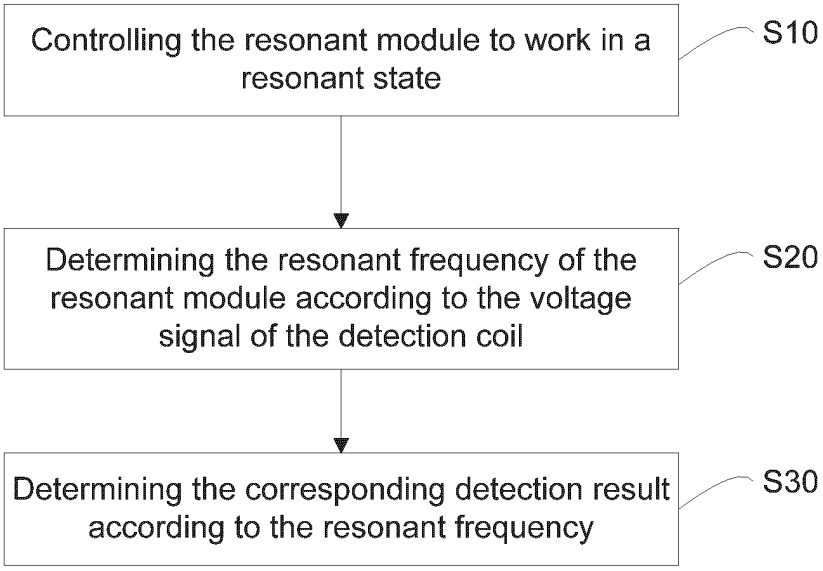
Controlling the resonant module to work in a resonant state
S10
Determining the resonant frequency of the resonant module according to the voltage signal of the detection coil
S20
Determining the corresponding detection result according to the resonant frequency
S30

FIG6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/110052

A. CLASSIFICATION OF SUBJECT MATTER

A24F 40/53(2020.01)i; A24F 40/40(2020.01)i; A24F 40/50(2020.01)i; A24F 40/57(2020.01)i; A24F 40/465(2020.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A24F40/-

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, WPI, EPODOC, CNKI: 谐振, 谐振频率, 温度, 检测, 感测, 感知, 监测, 抽吸, 插入; resonance, resonant frequency, temperature, detect+, determin+, sens+, suct+, insert+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 113907424 A (SHENZHEN MAISHI TECHNOLOGY CO., LTD.) 11 January 2022 (2022-01-11) claims 1-17	1-17
X	CN 112702929 A (BRITISH AMERICAN TOBACCO INVESTMENTS LTD.) 23 April 2021 (2021-04-23) description, paragraphs [0041]-[0151], and figures 1-5	1-17
X	CN 112469294 A (JT INTERNATIONAL SA) 09 March 2021 (2021-03-09) description, paragraphs [0061]-[0090], and figures 1-6	1-17
X	CN 111150114 A (HUIZHOU PEIGESI TECHNOLOGY CO., LTD.) 15 May 2020 (2020-05-15) description, paragraphs [0035]-[0061], and figures 1-7	1-17
A	CN 112741375 A (SHENZHEN FIRST UNION TECHNOLOGY CO., LTD.) 04 May 2021 (2021-05-04) entire document	1-17
A	US 2021127738 A1 (JT INTERNATIONAL S.A.) 06 May 2021 (2021-05-06) entire document	1-17

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 October 2022	**01 November 2022**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2022/110052

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 113907424 A	11 January 2022	None	
CN 112702929 A	23 April 2021	KR 20210044877 A	23 April 2021
		GB 201814199 D0	17 October 2018
		CA 3110943 A1	05 March 2020
		JP 2021534772 A	16 December 2021
		US 2021204612 A1	08 July 2021
		BR 112021003927 A2	18 May 2021
		IL 281036 A	29 April 2021
		AU 2019328516 A1	18 March 2021
		WO 2020043900 A1	05 March 2020
		EP 3843568 A1	07 July 2021
CN 112469294 A	09 March 2021	None	
CN 111150114 A	15 May 2020	None	
CN 112741375 A	04 May 2021	None	
US 2021127738 A1	06 May 2021	JP 2021522830 A	02 September 2021
		EP 3793380 A1	24 March 2021
		EA 202092788 A1	11 February 2021
		CN 112188841 A	05 January 2021
		CA 3098268 A1	21 November 2019
		TW 202002816 A	16 January 2020
		WO 2019219740 A1	21 November 2019
		KR 20210020917 A	24 February 2021

Form PCT/ISA/210 (patent family annex) (January 2015)