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(54) AEROSOL GENERATING DEVICE, CONTROL METHOD, CONTROL DEVICE AND READABLE STORAGE MEDIUM

(57) The present disclosure relates to an aerosol-generating apparatus, a control method, a control device and a readable storage medium. The aerosol-generating apparatus includes an atomization cavity configured to accommodate an aerosol-forming substrate and a microwave assembly configured to feed microwaves into the atomization cavity. The control method includes: controlling the microwave assembly to sweep in a microwave frequency range and search for a target microwave frequency in the microwave frequency range; determining a presence state of the aerosol-forming substrate in the atomization cavity according to a numerical relationship between the target microwave frequency and a set frequency range; and controlling a running state of the microwave assembly according to the presence state of the aerosol-forming substrate. In the present disclosure, the target microwave frequency in the current state of the atomization cavity is determined through the sweep operation of the microwave assembly, so as to detect whether the aerosol-forming substrate is present in the atomization cavity, thereby avoiding feeding the microwave into the atomization cavity in the empty state, and thus prolonging the service life of the aerosol-generating apparatus.

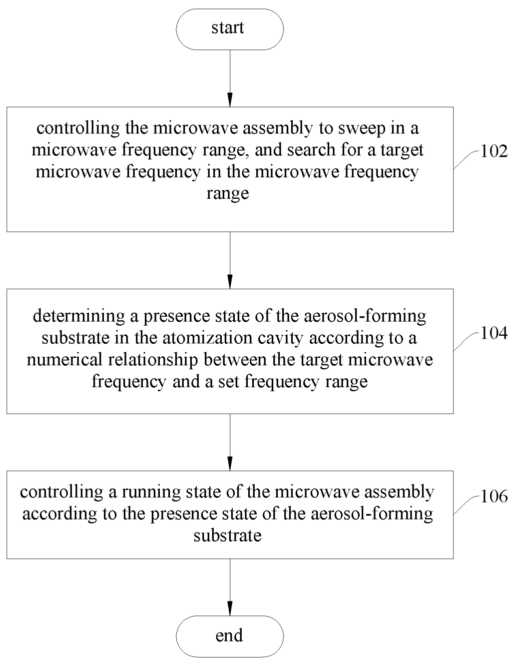

FIG. 1

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Description

FIELD

[0001] The present disclosure relates to the field of electronic atomization technology, and more specifically, to a control method for an aerosol-generating apparatus, a control device for the aerosol-generating apparatus, the aerosol-generating apparatus, and a readable storage medium.

BACKGROUND

[0002] A heat-not-burn (HNB) apparatus is an electronic apparatus that heats an aerosol-forming substrate (a processed plant leaf product) in a heat-not-burn manner. The heating apparatus can heat the aerosol-forming substrate to a high temperature at which the aerosol-forming substrate can generate an aerosol but does not burn, so that the aerosol-forming substrate can generate the aerosol required by a user on the premise of not burning.

[0003] Currently, the heat-not-burn apparatus in the market mainly adopt a resistance heating mode, which uses a central heating sheet or a central heating needle or the like to insert from the center of the aerosol-forming substrate into the aerosol-forming substrate for heating. This apparatus needs a long preheating waiting time before use, and cannot be smoked and stopped freely. The carbonization of the aerosol-forming substrate is uneven, resulting in insufficient baking and a low utilization rate of the aerosol-forming substrate. Secondly, the heating sheet of the HNB apparatus is prone to generating dirt in the aerosol-forming substrate extractor and the heating sheet base, making it difficult to clean. Besides, the local aerosol-forming substrate in contact with the heating sheet is too high in temperature, leading to a partial cracking to produce harmful substances to the human body. Therefore, the microwave heating technology gradually replaces the resistance heating mode to become a new heating mode. The microwave heating technology has the characteristics of high efficiency, timeliness, selectivity, and no delay in heating, and only has a heating effect on substances having specific dielectric properties. The advantages of using the microwave heating for atomization are as follows: a, the microwave heating is radiation heating and non-heat conduction, and instant smoking and stopping can be achieved; b, no heating sheet exists, so that the problems of sheet breaking and heating sheet cleaning do not exist; c, the aerosol-forming substrate is high in utilization rate, high in taste consistency, and closer to a cigarette in taste.

[0004] However, the existing HNB apparatus using the microwave heating has a risk of cavity dry burning, resulting in a decrease in the service life of the apparatus.

SUMMARY

[0005] The present disclosure aims to solve one of the technical problems existing in the prior art or related technologies.

[0006] In view of this, in a first aspect, a control method for an aerosol-generating apparatus is provided in an embodiment of the present disclosure, wherein the aerosol-generating apparatus includes an atomization cavity and a microwave assembly, the atomization cavity is configured to accommodate an aerosol-forming substrate, the microwave assembly is configured to feed microwaves into the atomization cavity, and the control method includes: controlling the microwave assembly to sweep in a microwave frequency range, and search for a target microwave frequency in the microwave frequency range; determining a presence state of the aerosol-forming substrate in the atomization cavity according to a numerical relationship between the target microwave frequency and a set frequency range; and controlling a running state of the microwave assembly according to the presence state of the aerosol-forming substrate.

[0007] The control method provided in the present disclosure is used for controlling the aerosol-generating apparatus, and the aerosol-generating apparatus is used to heat the aerosol-forming substrate, wherein the aerosol-forming substrate may be a solid aerosol-forming substrate or a liquid aerosol-forming substrate. The aerosol-generating apparatus is provided therein with the atomization cavity for accommodating the aerosol-forming substrate. The microwave assembly can feed the microwaves into the atomization cavity, and the aerosol-forming substrate is heated and atomized under the action of the microwave.

[0008] When the aerosol-generating apparatus receives a start atomization command, the microwave assembly is controlled to sweep in the microwave frequency range. Specifically, the microwave assembly is controlled to feed microwaves into the atomization cavity sequentially according to each microwave frequency in the microwave frequency range. The target microwave frequency in the microwave frequency range is determined according to the change of the parameters in the atomization cavity. The target microwave frequency is the optimal frequency point of the operation of the microwave assembly in the current state of the atomization cavity, that is, the microwave frequency with the maximum microwave absorption in the atomization cavity. According to the numerical relationship between the target microwave frequency and the set frequency range, the presence state of the aerosol-forming substrate in the atomization cavity can be determined, that is, whether the aerosol-forming substrate is accommodated in the atomization cavity. Then, the operation of the microwave assembly is controlled according to the presence state of the aerosol-forming substrate in the atomization cavity. If it is detected that the aerosol-forming substrate is accommodated in the atomization cavity, the microwave assembly is controlled to operate normally to heat and atomize the aerosol-forming substrate. If it is detected that the atomization cavity is in an empty state, the microwave assembly is controlled to stop running in order to avoid feeding the microwave into the empty cavity to shorten the service life of the aerosol-generating apparatus. In the present disclosure, the target microwave frequency in the current state of the atomization cavity is determined through the frequency sweep operation of the microwave assembly, so as to detect whether the aerosol-forming substrate is present in the atomization cavity, thereby avoiding feeding the microwave into the atomization cavity in the empty state, and thus prolonging the service life of the aerosol-generating apparatus.

[0009] It can be understood that, the difference between the target microwave frequencies determined through the frequency sweep is large in the state that the atomization cavity is empty and in the state that the aerosol-forming substrate is present in the atomization cavity. Therefore, the numerical relationship between the target microwave frequency obtained by frequency sweeping and the set frequency range can accurately determine whether the aerosol-forming substrate is accommodated in the atomization cavity.

[0010] Further, the control method for the aerosol-generating apparatus in the above technical solution provided in the present disclosure may have the following additional feathers:

[0011] In a possible design, the step of determining the presence state of the aerosol-forming substrate in the atomization cavity according to the numerical relationship between the target microwave frequency and the set frequency range includes: determining that the aerosol-forming substrate is not present in the atomization cavity if the target microwave frequency is less than the minimum value in the set frequency range; determining that the aerosol-forming substrate is present in the atomization cavity if the target microwave frequency is larger than the maximum value in the set frequency range; and determining the presence state of the aerosol-forming substrate in the atomization cavity according to a numerical relationship between an average frequency value of the set microwave frequency range and the target microwave frequency if the target microwave frequency is within the set microwave frequency range.

[0012] In this design, the maximum value in the set frequency range is the optimal frequency point when the aerosol-forming substrate is present in the atomization cavity, while the minimum value in the set frequency range is the optimal frequency point when the atomization cavity is in the empty state, that is, when the aerosol-forming substrate is not present in the atomization cavity.

[0013] If the target microwave frequency is detected to be less than the minimum value in the set frequency range, it is determined that the atomization cavity is in the empty state, that is, the aerosol-forming substrate is not present in the atomization cavity.

[0014] If the target microwave frequency is detected to be larger than the maximum value in the set frequency range, it is determined that the aerosol-forming substrate is present in the atomization cavity, that is, the aerosol-forming substrate is present in the atomization cavity.

[0015] If the target microwave frequency is detected to be within the microwave frequency range, the state of the aerosol-forming substrate in the atomization cavity is further detected according to the numerical relationship between the average value of the microwave frequency range and the target microwave frequency.

[0016] By comparing the target microwave frequency with the value in the set frequency range, the accuracy of judging whether the aerosol-forming substrate is accommodated in the atomization cavity is improved. By means of the above detection method, whether the aerosol-forming substrate is accommodated in the atomization cavity can be accurately detected, and the situation of microwave heating of the empty atomization cavity caused by misjudgment is avoided.

[0017] It should be noted that, since the optimal frequency point when the atomization cavity is in the empty state is different from the optimal frequency point when the atomization cavity contains the aerosol-forming substrate, where the optimal frequency point when the atomization cavity is in the empty state is a, the optimal frequency point when the atomization cavity contains the aerosol-forming substrate is b, and the difference between a and b is 25 MHz to 35 MHz, while the target microwave frequency obtained through frequency sweeping is usually a $\pm$ 2 MHz or b $\pm$ 2 MHz. Therefore, the set frequency range is set as a to b, and the presence state of the aerosol-forming substrate in the atomization cavity can be accurately determined according to the numerical relationship between the target microwave frequency and the a and the b.

[0018] In a possible design, the step of determining the presence state of the aerosol-forming substrate in the atomization cavity according to the numerical relationship between the average frequency value of the set microwave frequency range and the target microwave frequency includes: determining that the aerosol-forming substrate is present in the atomization cavity if the target microwave frequency is larger than the average frequency value; and determining that the aerosol-forming substrate is not present in the atomization cavity if the target microwave frequency is less than or equal to the average frequency value.

[0019] In this design, when the target microwave frequency is detected to be within the microwave frequency range, the numerical relationship between the target microwave frequency and the average frequency value of the set frequency range is determined, and according to the numerical relationship, the presence state of the aerosol-forming substrate in the atomization cavity is further determined.

[0020] When the target microwave frequency is detected to be larger than the average frequency value, it is determined that the aerosol-forming substrate is in the present state in the atomization cavity, that is, the aerosol-forming substrate is present in the atomization cavity.

[0021] When the target microwave frequency is detected to be less than or equal to the average frequency value, it is determined that the atomization cavity is in the empty state, that is, the aerosol-forming substrate is not present in the atomization cavity.

[0022] When the target microwave frequency is within the microwave frequency range, the presence state of the aerosol-forming substrate in the atomization cavity can be accurately determined by comparing the numerical values of the target microwave frequency and the average frequency value. By means of the above detection method, whether the aerosol-forming substrate is accommodated in the atomization cavity can be accurately detected, and the situation of microwave heating of the empty atomization cavity caused by misjudgment is avoided.

[0023] In a possible design, the step of controlling the running state of the microwave assembly according to the presence state of the aerosol-forming substrate includes: controlling the microwave assembly to feed the microwaves into the atomization cavity according to the target microwave frequency if the aerosol-forming substrate is present in the atomization cavity; and controlling the microwave assembly to stop running and output a prompt information if the aerosol-forming substrate is not present in the atomization cavity.

[0024] In this design, when it is detected that the aerosol-forming substrate is in the presence state, that is, when the aerosol-forming substrate is accommodated in the atomization cavity, it is determined that the microwave heating and atomization on the aerosol-forming substrate can be performed normally, and the microwave assembly is controlled to feed the microwaves into the atomization cavity at the target microwave frequency, where the target microwave frequency is determined by the microwave assembly through frequency sweeping. By feeding the microwaves of the target microwave frequency into the atomization cavity, the optimal atomization state of the aerosol-forming substrate in the atomization cavity can be achieved, that is, the aerosol-forming substrate can have the best absorption effect on the microwave of the target microwave frequency, so that the energy consumption of the aerosol-generating apparatus is reduced, the atomization efficiency of the aerosol-forming substrate is improved, and harmful substances generated by uneven heating of the aerosol-forming substrate are reduced.

[0025] When it is detected that the aerosol-forming substrate is in the non-presence state, that is, the atomization cavity is in the empty state, the microwave assembly is controlled to stop running, so that the situation that the service life of the aerosol-generating apparatus is shortened due to the fact that the microwave assembly continues to feed the microwaves into the atomization cavity in the empty state is avoid. In addition, when it is detected that the atomization cavity is in the empty state, the prompt information is output to remind the user to place the aerosol-forming substrate into the atomization cavity, thereby improving the use experience of the user.

[0026] In a possible design, the microwave assembly includes a microwave generation device and a microwave antenna, the microwave antenna is connected to the microwave generation device and configured to emit the microwaves generated by the microwave generation device into the atomization cavity and to receive feedback signals, the step of controlling the microwave assembly to sweep in the microwave frequency range, and search for the target microwave frequency in the microwave frequency range includes: controlling the microwave assembly to emit the microwaves into the atomization cavity according to each microwave frequency in the microwave frequency range; detecting feedback power values of the feedback signals corresponding to each microwave frequency; and screening the target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency.

[0027] In this design, the microwave assembly includes the microwave generation device and the microwave antenna. The microwave generation device is configured to generate the microwave of corresponding frequency, and the microwave antenna is configured to feed the microwave of the corresponding frequency into the atomization cavity. After the microwave enters the atomization cavity, the microwave antenna can receive the feedback signal corresponding to the microwave. The microwave assembly further includes a first power detection device and a second power detection device, wherein the first power detection device is connected to the microwave generation device and can collect the operating power value of the microwave generation device during operation. The second power detection device is connected to the microwave antenna and can detect the feedback power value of the feedback signal received by the microwave antenna.

[0028] The microwave assembly is controlled to feed the microwaves into the atomization cavity according to each microwave frequency in the microwave frequency range, that is, the microwave assembly is controlled to sequentially emit the microwaves with different microwave frequencies into the atomization cavity. During the emission process of the microwave assembly, the feedback signal corresponding to each microwave frequency is received simultaneously, and the feedback power value of each feedback signal is determined by the second power detection device. The target microwave frequency in the microwave frequency range is screened according to the detected feedback power value, so as to determine the target microwave frequency with the best absorption effect in the atomization cavity. By means of frequency sweeping, the microwaves in the microwave frequency range can be screened, so as to determine the target microwave frequency with the best absorption effect in the current atomization cavity, thereby achieving feeding the microwave with the target microwave frequency into the atomization cavity when the aerosol-forming substrate is accommodated in the atomization cavity, and improving the atomization effect of the aerosol-forming substrate.

[0029] In a possible design, the step of screening the target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency includes: detecting operating power values corresponding to the microwave of each microwave frequency output by the microwave assembly; calculating the ratios between the feedback power values and the operating power values corresponding to each microwave frequency to obtain power ratios; and selecting the target microwave frequency in the microwave frequency range according to the power ratios corresponding to each microwave frequency.

[0030] In this design, the first power detection device is configured to monitor the operating power value corresponding to each microwave frequency. By calculating the ratio between the operating power value and the corresponding feedback power value, the power ratio can be obtained. The formula for calculating the power ratio is as follows:

$$N=P_1 / P_2$$

[0031] Wherein, Pi is the feedback power value, P_2 is the operating power value, and N is the power ratio.

[0032] The smaller the value of the N, the better the coupling effect of the microwave in the atomization cavity, that is, the better the absorption effect of the microwave in the atomization cavity. The larger the value of the N, the worse the coupling effect of the microwave in the atomization cavity, that is, the worse the absorption effect of the microwave in the atomization cavity.

[0033] In a possible design, the step of selecting the target microwave frequency in the microwave frequency range according to the power ratios corresponding to each microwave frequency includes: determining the minimum power ratio among the power ratios corresponding to each microwave frequency; and searching for the microwave frequency corresponding to the minimum power ratio to determine the target microwave frequency.

[0034] In this design, the power ratios corresponding to each microwave frequency are sorted according to the numerical values, and the operating frequency corresponding to the power ratio with the smallest numerical value is used as the target microwave frequency. By calculating the frequency ratio, the error part in the frequency sweeping stage can be filtered, thereby improving the screening accuracy of the target microwave frequency and avoiding misjudgment of the target microwave frequency.

[0035] In a possible design, the step of screening the target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency includes: determining the minimum feedback power value among the feedback power values corresponding to each microwave frequency; and searching for the microwave frequency corresponding to the minimum feedback power value to determine the target microwave frequency.

[0036] In this design, the feedback power values are directly sorted according to the numerical values, so as to determine the minimum feedback power value. The microwave frequency corresponding to the minimum feedback power value is taken as the target microwave frequency.

[0037] It can be understood that the operating powers of the microwave generation device varies small when outputting the microwaves of different frequencies. Therefore, the microwave frequency corresponding to the minimum feedback power value is directly selected as the target microwave frequency, which can reduce the data processing amount while ensuring the accuracy of the target microwave frequency selection.

[0038] In a second aspect, a control device for an aerosol-generating apparatus is provided in an embodiment of the present disclosure, wherein the aerosol-generating apparatus includes an atomization cavity and a microwave assembly, the atomization cavity is configured to accommodate an aerosol-forming substrate, the microwave assembly is configured to feed microwaves into the atomization cavity, and the control device includes: a search unit, configured to control the microwave assembly to sweep in a microwave frequency range, and to search for a target microwave frequency in the microwave frequency range; a detection unit, configured to determine a presence state of the aerosol-forming substrate in the atomization cavity according to a numerical relationship between the target microwave frequency and a set frequency range; and a control unit, configured to control a running state of the microwave assembly according to the presence state of the aerosol-forming substrate.

[0039] The control device provided in the present disclosure is used to control the aerosol-generating apparatus, and the aerosol-generating apparatus is used to heat the aerosol-forming substrate. The aerosol-forming substrate may be a solid aerosol-forming substrate or a liquid aerosol-forming substrate. The aerosol-generating apparatus is provided therein with an atomization cavity for accommodating the aerosol-forming substrate. The microwave assembly can feed microwaves into the atomization cavity, and the aerosol-forming substrate is heated and atomized under the action of the microwaves.

[0040] When the search unit receives the start atomization command, the microwave assembly is controlled to perform frequency sweep operation in the microwave frequency range. Specifically, the microwave assembly is controlled to feed the microwaves into the atomization cavity sequentially according to each microwave frequency in the microwave frequency range. The target microwave frequency in the microwave frequency range is determined according to the changes of the parameters in the atomization cavity. The target microwave frequency is the optimal frequency point of the operation of the microwave assembly in the current atomization state, which is the microwave frequency with the maximum microwave absorption amount in the atomization cavity. According to the numerical relationship between the target microwave frequency and the set frequency range, the detection unit can determine the presence state of the aerosol-forming substrate in the atomization cavity, that is, whether the aerosol-forming substrate is accommodated in the atomization cavity. The control unit controls the operation of the microwave assembly according to the presence state of the aerosol-forming substrate in the atomization cavity. If it is detected that the aerosol-forming substrate is accommodated in the atomization cavity, the microwave assembly is controlled to operate normally to heat and atomize the aerosol-forming substrate. If it is detected that the atomization cavity is in the empty state, the microwave assembly is controlled to stop running in order to avoid feeding the microwave into the empty cavity to shorten the service life of the aerosol-generating apparatus. In the present disclosure, the target microwave frequency in the current state of the atomization cavity is determined through the frequency sweep operation of the microwave assembly, so as to detect whether the aerosol-forming substrate is present in the atomization cavity, thereby avoiding feeding the microwave into the atomization cavity in the empty state, and thus prolonging the service life of the aerosol-generating apparatus.

[0041] It can be understood that the difference between the target microwave frequencies determined through the frequency sweep is large in the state that the atomization cavity is empty and in the state that the aerosol-forming substrate is present in the atomization cavity. Therefore, the numerical relationship between the target microwave frequency obtained by frequency sweeping and the set frequency range can accurately determine whether the aerosol-forming substrate is accommodated in the atomization cavity.

[0042] Further, the control device for the aerosol-generating apparatus in the above technical solution provided in the present disclosure may have the following additional feathers:

[0043] In a possible design, the detection unit is further configured to determine that the aerosol-forming substrate is not present in the atomization cavity if the target microwave frequency is less than the minimum value in the set frequency range; the detection unit is further configured to determine that the aerosol-forming substrate is present in the atomization cavity if the target microwave frequency is larger than the maximum value in the set frequency range; and the detection unit is further configured to determine the presence state of the aerosol-forming substrate in the atomization cavity according to a numerical relationship between an average frequency value of the set microwave frequency range and the target microwave frequency if the target microwave frequency is within the set microwave frequency range.

[0044] In this design, the maximum value in the set frequency range is the optimal frequency point when the aerosol-forming substrate is present in the atomization cavity, while the minimum value in the set frequency range is the optimal frequency point when the atomization cavity is in the empty state, that is, when the aerosol-forming substrate is not present in the atomization cavity.

[0045] If the target microwave frequency is detected to be less than the minimum value in the set frequency range, it is determined that the atomization cavity is in the empty state, that is, the aerosol-forming substrate is not present in the atomization cavity.

[0046] If the target microwave frequency is detected to be larger than the maximum value in the set frequency range, it is determined that the aerosol-forming substrate is in the present state in the atomization cavity, that is, the aerosol-forming substrate is present in the atomization cavity.

[0047] When the target microwave frequency is detected to be within the microwave frequency range, the state of the aerosol-forming substrate in the atomization cavity is further detected according to the numerical relationship between the average value of the microwave frequency range and the target microwave frequency.

[0048] By comparing the target microwave frequency with the value in the set frequency range, the accuracy of judging whether the aerosol-forming substrate is accommodated in the atomization cavity is improved. By means of the above detection method, whether the aerosol-forming substrate is accommodated in the atomization cavity can be accurately detected, and the situation of microwave heating of the empty atomization cavity caused by misjudgment is avoided.

[0049] It should be noted that, since the optimal frequency point when the atomization cavity is in the empty state is different from the optimal frequency point when the atomization cavity contains the aerosol-forming substrate, where the optimal frequency point when the atomization cavity is in the empty state is a, the optimal frequency point when the atomization cavity contains the aerosol-forming substrate is b, and the difference between a and b is 25 MHz to 35 MHz, while the target microwave frequency obtained through frequency sweeping is usually a $\pm$ 2 MHz or b $\pm$ 2 MHz. Therefore, the set frequency range is set as a to b, and the presence state of the aerosol-forming substrate in the atomization cavity can be accurately determined according to the numerical relationship between the target microwave frequency and the a and the b.

[0050] In a possible design, the detection unit is further configured to determine that the aerosol-forming substrate is present in the atomization cavity if the target microwave frequency is larger than the average frequency value; and the detection unit is further configured to determine that the aerosol-forming substrate is not present in the atomization cavity if the target microwave frequency is less than or equal to the average frequency value.

[0051] In this design, when the target microwave frequency is detected to be within the microwave frequency range, the numerical relationship between the target microwave frequency and the average frequency value of the set frequency range is determined, and the presence state of the aerosol-forming substrate in the atomization cavity is further determined according to the numerical relationship.

[0052] When the target microwave frequency is detected to be larger than the average frequency value, it is determined that the aerosol-forming substrate is in the present state in the atomization cavity, that is, the aerosol-forming substrate is present in the atomization cavity.

[0053] When the target microwave frequency is detected to be less than or equal to the average frequency value, it is determined that the atomization cavity is in the empty state, that is, the aerosol-forming substrate is not located in the atomization cavity.

[0054] When the target microwave frequency is within the microwave frequency range, the presence state of the aerosol-forming substrate in the atomization cavity can be accurately determined by comparing the numerical values of the target microwave frequency and the average frequency value. By means of the above detection method, whether the aerosol-forming substrate is accommodated in the atomization cavity can be accurately detected, and the situation of microwave heating of the empty atomization cavity caused by misjudgment is avoided.

[0055] In a possible design, the control unit is further configured to control the microwave assembly to feed the microwaves into the atomization cavity according to the target microwave frequency if the aerosol-forming substrate is present in the atomization cavity; and the control unit is further configured to control the microwave assembly to stop running and output a prompt information if the aerosol-forming substrate is not present in the atomization cavity.

[0056] In this design, when it is detected that the aerosol-forming substrate is in the presence state, that is, when the aerosol-forming substrate is accommodated in the atomization cavity, it is determined that the microwave heating and atomization on the aerosol-forming substrate can be performed normally, and the microwave assembly is controlled to feed the microwaves into the atomization cavity at the target microwave frequency, where the target microwave frequency is determined by the microwave assembly through frequency sweeping. By feeding the microwaves of the target microwave frequency into the atomization cavity, the optimal atomization state of the aerosol-forming substrate in the atomization cavity can be achieved, that is, the aerosol-forming substrate can have the best absorption effect on the microwave of the target microwave frequency, so that the energy consumption of the aerosol-generating apparatus is reduced, the atomization efficiency of the aerosol-forming substrate is improved, and harmful substances generated by uneven heating of the aerosol-forming substrate are reduced.

[0057] When it is detected that the aerosol-forming substrate is in a non-presence state, that is, the atomization cavity is in the empty state, the microwave assembly is controlled to stop running, so that the situation that the service life of the aerosol-generating apparatus is shortened due to the fact that the microwave assembly continues to feed the microwaves into the atomization cavity in the empty state is avoid. In addition, when it is detected that the atomization cavity is in the empty state, the prompt information is output to remind the user to place the aerosol-forming substrate into the atomization cavity, thereby improving the use experience of the user.

[0058] In a possible design, the control unit is further configured to control the microwave assembly to emit the microwaves into the atomization cavity according to each microwave frequency in the microwave frequency range; the detection unit is further configured to detect feedback power values of the feedback signals corresponding to each microwave frequency; and the search unit is further configured to screen the target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency.

[0059] In this design, the microwave assembly includes a microwave generation device and a microwave antenna. The microwave generation device is configured to generate the microwave of corresponding frequency, and the microwave antenna is configured to feed the microwave of the corresponding frequency into the atomization cavity. After the microwave enters the atomization cavity, the microwave antenna can receive the feedback signal corresponding to the microwave. The microwave assembly further includes a first power detection device and a second power detection device, where the first power detection device is connected to the microwave generation device and can collect the operating power value of the microwave generation device during operation. The second power detection device is connected to the microwave antenna and can detect the feedback power value of the feedback signal received by the microwave antenna.

[0060] The microwave assembly is controlled to feed the microwaves into the atomization cavity according to each microwave frequency in the microwave frequency range, that is, the microwave assembly is controlled to sequentially emit the microwaves with different microwave frequencies into the atomization cavity. During the emission process of the microwave assembly, the feedback signal corresponding to each microwave frequency is received, and the feedback power value of each feedback signal is determined by the second power detection device. The target microwave frequency in the microwave frequency range is screened according to the detected feedback power value, so as to determine the target microwave frequency with the best absorption effect in the atomization cavity. By means of frequency sweeping, the microwaves in the microwave frequency range can be screened, so as to determine the target microwave frequency with the best absorption effect in the current atomization cavity, thereby achieving feeding the microwave with the target microwave frequency into the atomization cavity when the aerosol-forming substrate is accommodated in the atomization cavity, and improving the atomization effect of the aerosol-forming substrate.

[0061] In a possible design, the detection unit is further configured to detect operating power values corresponding to the microwave of each microwave frequency output by the microwave assembly; the control device includes: a calculation unit, configured to calculate the ratio between the feedback power values and the operating power values corresponding to each microwave frequency to obtain power ratios; the search unit is further configured to select the target microwave frequency in the microwave frequency range according to the power ratios corresponding to each microwave frequency.

[0062] In this design, the operating power value corresponding to each microwave frequency is monitored by the first power detection device. By calculating the ratio between the operating power value and the corresponding feedback power value, the power ratio can be obtained. The formula for calculating the power ratio is as follows:

$$N=P_1 / P_2$$

[0063] Wherein, Pi is the feedback power value, P_2 is the operating power value, and N is the power ratio.

[0064] The smaller the value of the N, the better the microwave coupling effect in the atomization cavity, that is, the better the microwave absorption effect in the atomization cavity. The larger the value of the N, the worse the microwave coupling effect in the atomization cavity, that is, the worse the microwave absorption effect in the atomization cavity.

[0065] In a possible design, the search unit is further configured to determine the minimum power ratio among the power ratios corresponding to each microwave frequency; and the search unit is further configured to search for the microwave frequency corresponding to the minimum power ratio to determine the target microwave frequency.

[0066] In this design, the power ratios corresponding to each microwave frequency are sorted according to the numerical values, and the operating frequency corresponding to the power ratio with the smallest numerical value is taken as the target microwave frequency. By calculating the frequency ratio, the error part in the frequency sweeping stage can be filtered, thereby improving the screening accuracy of the target microwave frequency and avoiding misjudgment of the target microwave frequency.

[0067] In a possible design, the search unit is further configured to determine the minimum feedback power value among the feedback power values corresponding to each microwave frequency; and the search unit is further configured to search for the microwave frequency corresponding to the minimum feedback power value to determine the target microwave frequency. In this design, the feedback power values are directly sorted according to the numerical values, so as to determine the minimum feedback power value. The microwave frequency corresponding to the minimum feedback power value is taken as the target microwave frequency.

[0068] It is understandable that the operating powers of the microwave generation device varies small when outputting the microwaves of different frequencies. Therefore, the microwave frequency corresponding to the minimum feedback power value is directly selected as the target microwave frequency, which can reduce the data processing amount while ensuring the accuracy of the target microwave frequency selection.

[0069] In a third aspect, an aerosol-generating apparatus is provided in an embodiment of the present disclosure, including: an atomization cavity, configured to accommodate an aerosol-forming substrate; a microwave assembly, configured to feed microwaves into the atomization cavity; and the control device for the aerosol-generating apparatus in any of the above possible designs in the second aspect, wherein the control device is connected to the microwave assembly.

[0070] The aerosol-generating apparatus provided in the present disclosure includes the atomization cavity, the microwave assembly, and the control device of the aerosol-generating apparatus. The aerosol-generating apparatus is used to heat the aerosol-forming substrate, wherein the aerosol-forming substrate may be a solid aerosol-forming substrate or a liquid aerosol-forming substrate. The aerosol-generating apparatus is provided therein with the atomization cavity configured for accommodating the aerosol-forming substrate. The microwave assembly can feed microwaves into the atomization cavity, and the aerosol-forming substrate is heated and atomized under the action of the microwaves.

[0071] The control device of the aerosol-generating apparatus is connected to the microwave assembly, to control the operation of the microwave assembly. The control device of the aerosol-generating apparatus may be selected as the control device of the aerosol-generating apparatus in any of the above possible designs in the second aspect, and thus, it has all of the beneficial technical effects of the control device of the aerosol-generating apparatus in any of the above possible designs in the second aspect, which will not be repeated herein.

[0072] In a fourth aspect, an aerosol-generating apparatus is provided in an embodiment of the present disclosure, including: a memory, a program or an instruction being stored in the memory; a processor, configured to execute the program or the instruction stored in the memory to implement the steps of the control method for the aerosol-generating apparatus in any of the above possible designs in the first aspect. Therefore, it has all of the beneficial technical effects of the control method for the aerosol-generating apparatus in any one of the above possible designs, which will not be repeated here.

[0073] The aerosol-generating apparatus provided in the present disclosure further includes an atomization cavity and a microwave assembly. The atomization cavity is configured to accommodate the aerosol-forming substrate, and the microwave assembly is configured to feed microwaves into the atomization cavity. The microwaves act on the aerosol-forming substrate, causing the aerosol-forming substrate to be heated and atomized. The microwave assembly is connected to the processor, and the processor executes the control method of the aerosol-generating apparatus to control the microwave assembly in the aerosol-generating apparatus.

[0074] In a fifth aspect, an aerosol-generating apparatus is provided in an embodiment of the present disclosure, including: a shell; an atomization cavity, configured to accommodate an aerosol-forming substrate; a microwave assembly, configured to feed microwaves into the atomization cavity; and a control device, wherein the control device is configured to control the microwave assembly to sweep in a microwave frequency range, and to search for a target microwave frequency in the microwave frequency range; to determine a presence state of the aerosol-forming substrate in the atomization cavity according to a numerical relationship between the target microwave frequency and the set frequency range; and to control a running state of the microwave assembly according to the presence state of the aerosol-forming substrate.

[0075] The aerosol-generating apparatus provided in the present disclosure includes the shell, the atomization cavity, the microwave assembly, and the control device. The shell is provided therein with the atomization cavity, which is used to accommodate the aerosol-forming substrate. The output end of the microwave assembly is communicated to the atomization cavity. The microwave assembly feeds the microwaves into the atomization cavity when electrified, and the aerosol-forming substrate is heated and atomized under the action of the microwaves.

[0076] When the control device receives a start atomization command, the microwave assembly is controlled to sweep in the microwave frequency range. Specifically, the microwave assembly is controlled to feed the microwaves into the atomization cavity sequentially according to each microwave frequency in the microwave frequency range. The target microwave frequency in the microwave frequency range is determined according to the change of the parameters in the atomization cavity. The target microwave frequency is the optimal frequency point of the operation of the microwave assembly in the current state of the atomization cavity, that is, the microwave frequency with the maximum microwave absorption in the atomization cavity. According to the numerical relationship between the target microwave frequency and the set frequency range, the presence state of the aerosol-forming substrate in the atomization cavity can be determined, that is, whether the aerosol-forming substrate is accommodated in the atomization cavity. Then, the operation of the microwave assembly is controlled according to the presence state of the aerosol-forming substrate in the atomization cavity. If it is detected that the aerosol-forming substrate is accommodated in the atomization cavity, the microwave assembly is controlled to operate normally to heat and atomize the aerosol-forming substrate. If it is detected that the atomization cavity is in an empty state, the microwave assembly is controlled to stop running in order to avoid feeding the microwave into the empty cavity to shorten the service life of the aerosol-generating apparatus. In the present disclosure, the target microwave frequency in the current state of the atomization cavity is determined through the frequency sweep operation of the microwave assembly, so as to detect whether the aerosol-forming substrate is present in the atomization cavity, thereby avoiding feeding the microwave into the atomization cavity in the empty state, and thus prolonging the service life of the aerosol-generating apparatus.

[0077] It can be understood that the difference between the target microwave frequencies determined through the frequency sweep is large in the state that the atomization cavity is empty and in the state that the aerosol-forming substrate is present in the atomization cavity. Therefore, the numerical relationship between the target microwave frequency obtained by frequency sweeping and the set frequency range can accurately determine whether the aerosol-forming substrate 108 is accommodated in the atomization cavity.

[0078] Further, the aerosol-generating apparatus in the above technical solution provided in the present disclosure may have the following additional feathers:

[0079] In a possible design, the microwave assembly includes: a microwave generation device, connected to the control device; a microwave antenna, connected to a microwave generation circuit, and configured to emit the microwaves generated by the microwave generation device to the atomization cavity and receive feedback signals; a first power detection device, connected to the control device, and the acquisition end of the first power detection device being connected to the microwave generation device to collect the operating power value of the microwave generation device; and a second power detection device, connected to the control device, and the acquisition end of the second power detection device being connected to the microwave antenna for detecting the feedback power value of the feedback signal received by the microwave antenna.

[0080] In this embodiment, the microwave assembly includes the microwave generation device, the microwave antenna, the first power detection device, and the second power detection device. The microwave assembly includes the microwave generation device and the microwave antenna, wherein the microwave generation device can generate microwaves of corresponding frequencies, and the microwave antenna can feed the microwaves of corresponding frequencies into the atomization cavity. After the microwaves enter the atomization cavity, the microwave antenna can receive the corresponding feedback signals of the microwaves. The microwave assembly further includes the first power detection device and the second power detection device, wherein the first power detection device is connected to the microwave generation device and can collect the operating power values of the microwave generation device during its operation, and the second power detection device is connected to the microwave antenna and can detect the feedback power values of the feedback signals received by the microwave antenna.

[0081] In a possible design, the microwave assembly further includes a directional coupler, wherein the directional coupler includes a first end, a second end, a third end, and a fourth end, the first end is connected to the microwave generation device, the second end is connected to the microwave antenna, the third end is connected to the first power detection device, and the fourth end is connected to the second power detection device.

[0082] In this design, the microwave assembly further includes the directional coupler. The first end, the second end, the third end, and the fourth end of the directional coupler are respectively connected to the microwave generation device, the microwave antenna, the first power detection device, and the second power detection device.

[0083] The first power detection device can detect the operating power value of the microwave generation device through the directional coupler, and the second power detection device can detect the feedback power value of the feedback signal detected by the microwave antenna through the directional coupler. The microwave signal generated by the microwave generation device is transmitted to the microwave antenna through the directional coupler, and the microwave antenna feeds the microwave into the atomization cavity.

[0084] The microwave generation device, the microwave antenna, the first power detection device, and the second power detection device are connected through the directional coupler, thereby reducing the power connection lines in the microwave assembly 104 and thus reducing the space occupied by the microwave assembly. Therefore, the volume of the aerosol-generating apparatus can be reduced, which meets the requirements of product miniaturization.

[0085] In a possible design, the microwave generation device includes: a microwave generator, connected to the control device; and a power amplifier, connected to the control device, the input end of the power amplifier being connected to the microwave generator, and the output end of the power amplifier being connected to the first end of the directional coupler.

[0086] In this design, the microwave generation device includes the microwave generator and the power amplifier. The microwave generator can generate a microwave signal and is connected to the control device, and the control device can control the operation of the microwave generator. The output end of the microwave generator is connected to the input end of the power amplifier, and the output end of the power amplifier is connected to the directional coupler. The control device can not only control the operating power of the microwave generator, but also control the amplification factor of the power amplifier.

[0087] In a possible design, the microwave generation device further includes a power regulator. A first end of the power regulator is connected to the control device, and a second end of the power regulator is connected to the power amplifier.

[0088] In this design, the electronic atomization device further includes the power regulator, which is connected to the power amplifier. The control device can control the power regulator, thereby adjusting the power of the output microwave and increasing the adjustment range of the power of the emitted microwave.

[0089] In a possible design, the power regulator is integrated with the power amplifier.

[0090] In this design, the power regulator is integrated with the power amplifier, that is, the power regulator and the power amplifier are an integrated electronic component, and the integrated electronic component has two functions of power regulation and amplification. By integrating the power regulator with the power amplifier, the space occupied by the microwave assembly in the aerosol-generating apparatus can be further reduced.

[0091] In a possible design, the aerosol-generating apparatus further includes: an isolating member, disposed in the atomization cavity, and dividing the atomization cavity into an accommodating cavity and a resonant cavity, the accommodating cavity being configured to accommodate the aerosol-forming substrate; and a resonant column, disposed on the bottom wall of the resonant cavity.

[0092] In this design, the aerosol-generating apparatus further includes the isolating member disposed in the atomization cavity, and the isolating member divides the atomization cavity into the accommodating cavity and the resonant cavity. The accommodating cavity is configured to accommodate the aerosol-forming substrate, the microwave assembly feeds microwaves into the resonant cavity, and the microwaves can be transmitted through the resonant cavity to the accommodating cavity for microwave heating of the aerosol-forming substrate in the accommodating cavity.

[0093] The accommodating cavity and the resonant cavity are isolated from each other through the isolating member, which can prevent the liquid waste or the solid waste generated after the aerosol-forming substrate in the accommodating cavity is atomized from entering the resonant cavity, thereby avoiding the occurrence of a failure of the microwave assembly caused by the waste entering the resonant cavity.

[0094] Optionally, the isolating member is detachably connected to the shell, and the accommodating cavity is provided in the isolating member. By disassembling the isolating member, the accommodating cavity can be individually disassembled and cleaned, thereby improving the user experience.

[0095] It can be understood that the isolating member may be made of a material such as a ceramic or a glass, so that the microwave in the resonant cavity can be transmitted to the accommodating cavity to heat the aerosol-forming substrate in the accommodating cavity.

[0096] In a possible design, the resonant column is connected to the microwave antenna.

[0097] In this design, the microwave is fed into the resonant cavity through the resonant column. The first end of the resonant column is connected to the bottom wall of the resonant cavity, and the second end of the resonant column is arranged corresponding to the accommodating cavity. The microwave is transmitted along the direction from the first end to the second end of the resonant column to heat the aerosol-forming substrate in the accommodating cavity.

[0098] In a sixth aspect, a readable storage medium is provided in an embodiment of the present disclosure, wherein a program or an instruction is stored on the readable storage medium, and when the program or the instruction is executed by a processor, the steps of the control method for the aerosol-generating apparatus in any of the above possible designs are implemented, thus having all the beneficial technical effects of the control method for the aerosol-generating apparatus in any of the above possible designs.

[0099] The additional aspects and advantages of the present disclosure will become apparent in the description below, or will be understood through the practice of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0100] The above and/or additional aspects and advantages of the present disclosure will become apparent and easy to be understood from the following description of embodiments in conjunction with the accompanying drawings. In the accompanying drawings:

FIG. 1 is a first flow diagram of a control method for an aerosol-generating apparatus in a first embodiment of the present disclosure;

FIG. 2 is a second flow diagram of a control method for the aerosol-generating apparatus in the first embodiment of the present disclosure;

FIG. 3 is a third flow diagram of a control method for the aerosol-generating apparatus in the first embodiment of the present disclosure;

FIG. 4 is a fourth flow diagram of a control method for the aerosol-generating apparatus in the first embodiment of the present disclosure;

FIG. 5 is a fifth flow diagram of a control method for the aerosol-generating apparatus in the first embodiment of the present disclosure;

FIG. 6 is a sixth flow diagram of a control method for the aerosol-generating apparatus in the first embodiment of the present disclosure;

FIG. 7 is a flow diagram of a control method for an aerosol-generating apparatus in a second embodiment of the present disclosure;

FIG. 8 is a schematic block diagram of a control device for an aerosol-generating apparatus in a third embodiment of the present disclosure;

FIG. 9 is a schematic block diagram of an aerosol-generating apparatus in a fourth embodiment of the present disclosure;

FIG. 10 is a schematic block diagram of an aerosol-generating apparatus in a fifth embodiment of the present disclosure;

FIG. 11 is a first schematic structural diagram of an aerosol-generating apparatus in a sixth embodiment of the present disclosure;

FIG. 12 is a second schematic structural diagram of the aerosol-generating apparatus in the sixth embodiment of the present disclosure; and

FIG. 13 is a third schematic structural diagram of the aerosol-generating apparatus in the sixth embodiment of the present disclosure.

[0101] Wherein, the correspondence between the reference numerals and the component names in FIG. 11 to FIG. 13 is:

[0102] 100 aerosol-generating apparatus, 102 shell, 103 atomization cavity, 1032 accommodating cavity, 1034 resonant cavity, 104 microwave assembly, 1041 microwave generation device, 10412 microwave generator, 10414 power amplifier, 10416 power regulator, 1042 microwave antenna, 1043 first power detection device, 1044 second power detection device, 1048 directional coupler, 105 control device, 106 isolating member, 107 resonant column, 108 aerosol-forming substrate.

DETAILED DESCRIPTION

[0103] To have a clearer understanding of the above-mentioned objectives, features, and advantages of the present disclosure, the present disclosure will be further described in detail below with reference to the accompanying drawings and specific embodiments. It should be noted that, in the case of no conflict, the embodiments of the present disclosure and the features in the embodiments may be combined with each other.

[0104] Many specific details are elaborated in the following description to facilitate a thorough understanding of the present disclosure. However, the present disclosure may also be implemented in other manners different from those described herein. Therefore, the scope of protection of the present disclosure is not limited by the specific embodiments disclosed below.

[0105] A control method for an aerosol-generating apparatus, a control device for the aerosol-generating apparatus, the aerosol-generating apparatus, and a readable storage medium in some embodiments of the present disclosure will be described below with reference to FIG. 1 to FIG. 13.

Embodiment One:

[0106] As shown in FIG. 1, a control method for an aerosol-generating apparatus is provided in a first embodiment of the present disclosure. The aerosol-generating apparatus includes an atomization cavity and a microwave assembly. The atomization cavity is configured to accommodate the aerosol-forming substrate, and the microwave assembly is configured to feed a microwave into the atomization cavity.

[0107] The control method for the aerosol-generating apparatus includes:

step 102, controlling the microwave assembly to sweep in a microwave frequency range, and search for a target microwave frequency in the microwave frequency range;

step 104, determining a presence state of the aerosol-forming substrate in the atomization cavity according to a numerical relationship between the target microwave frequency and a set frequency range;

step 106, controlling a running state of the microwave assembly according to the presence state of the aerosol-forming substrate.

[0108] This control method provided in the embodiment is used for controlling the aerosol-generating apparatus, and the aerosol-generating apparatus is used to heat the aerosol-forming substrate, wherein the aerosol-forming substrate may be a solid aerosol-forming substrate or a liquid aerosol-forming substrate. The aerosol-generating apparatus is provided therein with the atomization cavity for accommodating the aerosol-forming substrate. The microwave assembly can feed the microwaves into the atomization cavity, and the aerosol-forming substrate is heated and atomized under the action of the microwave.

[0109] When a start atomization command is received, the microwave assembly is controlled to sweep in the microwave frequency range. Specifically, the microwave assembly is controlled to feed microwaves into the atomization cavity sequentially according to each microwave frequency in the microwave frequency range. The target microwave frequency in the microwave frequency range is determined according to the change of the parameters in the atomization cavity. The target microwave frequency is the optimal frequency point of the operation of the microwave assembly in the current state of the atomization cavity, that is, the microwave frequency with the maximum microwave absorption in the atomization cavity. According to the numerical relationship between the target microwave frequency and the set frequency range, the presence state of the aerosol-forming substrate in the atomization cavity can be determined, that is, whether the aerosol-forming substrate is accommodated in the atomization cavity. Then, the operation of the microwave assembly is controlled according to the presence state of the aerosol-forming substrate in the atomization cavity. If it is detected that the aerosol-forming substrate is accommodated in the atomization cavity, the microwave assembly is controlled to operate normally to heat and atomize the aerosol-forming substrate. If it is detected that the atomization cavity is in an empty state, the microwave assembly is controlled to stop running in order to avoid feeding the microwave into the empty cavity to shorten the service life of the aerosol-generating apparatus. In the present disclosure, the target microwave frequency in the current state of the atomization cavity is determined through the frequency sweep operation of the microwave assembly, so as to detect whether the aerosol-forming substrate is present in the atomization cavity, thereby avoiding feeding the microwave into the atomization cavity in the empty state, and thus prolonging the service life of the aerosol-generating apparatus.

[0110] It can be understood that, the difference between the target microwave frequencies determined through the frequency sweep is large in the state that the atomization cavity is empty and in the state that the aerosol-forming substrate is present in the atomization cavity. Therefore, the numerical relationship between the target microwave frequency obtained by frequency sweeping and the set frequency range can accurately determine whether the aerosol-forming substrate is accommodated in the atomization cavity.

[0111] As shown in FIG. 2, in any of the above embodiments, the step of determining the presence state of the aerosol-forming substrate in the atomization cavity according to the numerical relationship between the target microwave frequency and the set frequency range includes:

step 202, obtaining the set frequency range;

step 204, determining whether the target microwave frequency is less than the minimum value in the set frequency range, executing step 206 if the determining result is no, and executing step 212 if the determining result is yes;

step 206, determining whether the target microwave frequency is larger than the maximum value in the set frequency range, executing step 208 if the determining result is no, and executing step 214 if the determining result is yes;

step 208, obtaining an average frequency value in the set frequency range;

step 210, determining whether the target microwave frequency is larger than the average frequency value, executing step 214 if the determining result is yes, and executing step 212 if the determining result is no;

step 212, determining that the aerosol-forming substrate is not present in the atomization cavity, and controlling the microwave assembly to stop running;

step 214, determining that the aerosol-forming substrate is present in the atomization cavity, and controlling the microwave assembly to feed microwaves into the atomization cavity according to the target microwave frequency.

[0112] In this embodiment, based on the target microwave frequency being less than the minimum value in the set frequency range, it is determined that the aerosol-forming substrate is not present in the atomization cavity;

based on the target microwave frequency being larger than the maximum value in the set frequency range, it is determined that the aerosol-forming substrate is present in the atomization cavity; and

based on the target microwave frequency being within the set frequency range, the presence state of the aerosol-forming substrate in the atomization cavity is determined according to the numerical relationship between the target microwave frequency and the average frequency value of the set frequency range.

[0113] The maximum value in the set frequency range is the optimal frequency point when the aerosol-forming substrate is present in the atomization cavity, while the minimum value in the set frequency range is the optimal frequency point when the atomization cavity is in the empty state, that is, when the aerosol-forming substrate is not present in the atomization cavity.

[0114] If the target microwave frequency is detected to be less than the minimum value in the set frequency range, it is determined that the atomization cavity is in the empty state, that is, the aerosol-forming substrate is not present in the atomization cavity.

[0115] If the target microwave frequency is detected to be larger than the maximum value in the set frequency range, it is determined that the aerosol-forming substrate is present in the atomization cavity, that is, the aerosol-forming substrate is present in the atomization cavity.

[0116] If the target microwave frequency is detected to be within the microwave frequency range, the state of the aerosol-forming substrate in the atomization cavity is further detected according to the numerical relationship between the average value of the microwave frequency range and the target microwave frequency.

[0117] By comparing the target microwave frequency with the value in the set frequency range, the accuracy of judging whether the aerosol-forming substrate is accommodated in the atomization cavity is improved. By means of the above detection method, whether the aerosol-forming substrate is accommodated in the atomization cavity can be accurately detected, and the situation of microwave heating of the empty atomization cavity caused by misjudgment is avoided.

[0118] It should be noted that, since the optimal frequency point when the atomization cavity is in the empty state is different from the optimal frequency point when the atomization cavity contains the aerosol-forming substrate, where the optimal frequency point when the atomization cavity is in the empty state is a, the optimal frequency point when the atomization cavity contains the aerosol-forming substrate is b, and the difference between a and b is 25 MHz to 35 MHz, while the target microwave frequency obtained through frequency sweeping is usually a $\pm$ 2 MHz or b $\pm$ 2 MHz. Therefore, the set frequency range is set as a to b, and the presence state of the aerosol-forming substrate in the atomization cavity can be accurately determined according to the numerical relationship between the target microwave frequency and the a and the b.

[0119] The step of determining the presence state of the aerosol-forming substrate in the atomization cavity according to the numerical relationship between the target microwave frequency and the average frequency value of the set frequency range includes:

determining that the aerosol-forming substrate is present in the atomization cavity if the target microwave frequency is larger than the average frequency value;

determining that the aerosol-forming substrate is not present in the atomization cavity if the target microwave frequency is less than or equal to the average frequency value.

[0120] When the target microwave frequency is detected to be within the microwave frequency range, the numerical relationship between the target microwave frequency and the average frequency value of the set frequency range is determined, and according to the numerical relationship, the presence state of the aerosol-forming substrate in the atomization cavity is further determined.

[0121] When the target microwave frequency is detected to be larger than the average frequency value, it is determined that the aerosol-forming substrate is in the present state in the atomization cavity, that is, the aerosol-forming substrate is present in the atomization cavity.

[0122] When the target microwave frequency is detected to be less than or equal to the average frequency value, it is determined that the atomization cavity is in the empty state, that is, the aerosol-forming substrate is not present in the atomization cavity.

[0123] When the target microwave frequency is within the microwave frequency range, the presence state of the aerosol-forming substrate in the atomization cavity can be accurately determined by comparing the numerical values of the target microwave frequency and the average frequency value. By means of the above detection method, whether the aerosol-forming substrate is accommodated in the atomization cavity can be accurately detected, and the situation of microwave heating of the empty atomization cavity caused by misjudgment is avoided.

[0124] It can be understood that, the frequencies in the set frequency range should be set before the aerosol-generating apparatus leaves the factory. Wherein, the maximum value in the set frequency range is the optimal frequency value for the microwave assembly to feed the microwaves into the atomization cavity when the aerosol-forming substrate is accommodated in the atomization cavity. The minimum value in the set frequency range is the optimal frequency value for the microwave assembly to feed the microwaves into the atomization cavity when the atomization cavity is in the empty state.

[0125] In some embodiments, the set frequency range includes a plurality of set frequency values, which are arranged in a descending order of Fi, F_2, ... F_n. The average value of the set frequency range is calculated according to the following formula:

$$F_{AVG} = (F_1+F_2...+F_n) / n;$$

[0126] Wherein, F_{AVG} is the average frequency value, Fi, F_2, ... F_n is each frequency value in the set frequency range, and n is the number of set frequency values in the set frequency range.

[0127] In some other embodiments, the set frequency range includes a plurality of set frequency values, the minimum frequency value and the maximum frequency value are extracted from the set frequency range, and the average frequency value in the set frequency range is calculated according to the maximum frequency value and the minimum frequency value. The average value of the set frequency range is calculated according to the following formula:

$$F_{AVG} = (F_{min}+F_{max}) / 2$$

[0128] Wherein, F_{AVG} is the average frequency value, F_{min} is the minimum frequency value, and Fmax is the maximum frequency value.

[0129] The steps of controlling the running state of the microwave assembly according to the presence state of the aerosol-forming substrate includes:

controlling the microwave assembly to feed the microwaves into the atomization cavity at the target microwave frequency when the aerosol-forming substrate is in the presence state;

controlling the microwave assembly to stop running and output a prompt information when the aerosol-forming substrate is in the non-presence state.

[0130] When it is detected that the aerosol-forming substrate is in the presence state, that is, when the aerosol-forming substrate is accommodated in the atomization cavity, it is determined that the microwave heating and atomization on the aerosol-forming substrate can be performed normally, and the microwave assembly is controlled to feed the microwaves into the atomization cavity at the target microwave frequency, where the target microwave frequency is determined by the microwave assembly through frequency sweeping. By feeding the microwaves of the target microwave frequency into the atomization cavity, the optimal atomization state of the aerosol-forming substrate in the atomization cavity can be achieved, that is, the aerosol-forming substrate can have the best absorption effect on the microwave of the target microwave frequency, so that the energy consumption of the aerosol-generating apparatus is reduced, the atomization efficiency of the aerosol-forming substrate is improved, and harmful substances generated by uneven heating of the aerosol-forming substrate are reduced.

[0131] When it is detected that the aerosol-forming substrate is in a non-presence state, that is, the atomization cavity is in the empty state and is not provided therein with the aerosol-forming substrate, the microwave assembly is controlled to stop running, so that the situation that the service life of the aerosol-generating apparatus is shortened due to the fact that the microwave assembly continues to feed the microwaves into the atomization cavity in the empty state is avoid. In addition, when it is detected that the atomization cavity is in the empty state, the prompt information is output to remind the user to place the aerosol-forming substrate into the atomization cavity, thereby improving the use experience of the user.

[0132] As shown in FIG. 3, in any of the above embodiments, the microwave assembly includes a microwave generation device and a microwave antenna.

[0133] The microwave antenna is connected to the microwave generation device, and is configured to emit the microwave generated by the microwave generation device into the atomization cavity and receive a feedback signal.

[0134] The step of controlling the microwave assembly to sweep in the microwave frequency range, and search for the target microwave frequency in the microwave frequency range includes:

step 302, controlling the microwave assembly to emit the microwaves into the atomization cavity according to each microwave frequency in the microwave frequency range;

step 304, detecting feedback power values of feedback signals corresponding to each microwave frequency;

step 306, screening the target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency.

[0135] In this embodiment, the microwave assembly includes the microwave generation device and the microwave antenna. The microwave generation device is configured to generate the microwave of corresponding frequency, and the microwave antenna is configured to feed the microwave of the corresponding frequency into the atomization cavity. After the microwave enters the atomization cavity, the microwave antenna can receive the feedback signal corresponding to the microwave. The microwave assembly further includes a first power detection device and a second power detection device, wherein the first power detection device is connected to the microwave generation device and can collect the operating power value of the microwave generation device during operation. The second power detection device is connected to the microwave antenna and can detect the feedback power value of the feedback signal received by the microwave antenna.

[0136] The microwave assembly is controlled to feed the microwaves into the atomization cavity according to each microwave frequency in the microwave frequency range, that is, the microwave assembly is controlled to sequentially emit the microwaves with different microwave frequencies into the atomization cavity. During the emission process of the microwave assembly, the feedback signal corresponding to each microwave frequency is received simultaneously, and the feedback power value of each feedback signal is determined by the second power detection device. The target microwave frequency in the microwave frequency range is screened according to the detected feedback power value, so as to determine the target microwave frequency with the best absorption effect in the atomization cavity. By means of frequency sweeping, the microwaves in the microwave frequency range can be screened, so as to determine the target microwave frequency with the best absorption effect in the current atomization cavity, thereby achieving feeding the microwave with the target microwave frequency into the atomization cavity when the aerosol-forming substrate is accommodated in the atomization cavity, and improving the atomization effect of the aerosol-forming substrate.

[0137] It should be noted that the target microwave frequency is the optimal frequency point for the microwave assembly to feed the microwave into the current atomization cavity. When the atomization cavity is in the empty state, the detected target microwave frequency is the optimal frequency point of the microwave output by the microwave assembly when the microwave is fed into the empty atomization cavity. When the atomization cavity is in the state of containing the aerosol-forming substrate, the detected target microwave frequency is the optimal frequency point of the microwave output by the microwave assembly when the microwave is fed into the atomization cavity containing the aerosol-forming substrate.

[0138] As shown in FIG. 4, in any of the above embodiments, the step of screening the target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency includes:

step 402, detecting the operating power values corresponding to the microwave of each microwave frequency output by the microwave assembly;

step 404, calculating the ratios between the feedback power values and the operating power values corresponding to each microwave frequency to obtain a power ratio;

step 406, selecting the target microwave frequency in the microwave frequency range according to the power ratios corresponding to each microwave frequency.

[0139] In this design, the first power detection device is configured to monitor the operating power value corresponding to each microwave frequency. By calculating the ratio between the operating power value and the corresponding feedback power value, the power ratio can be obtained. The formula for calculating the power ratio is as follows:

$$N=P_1 / P_2$$

[0140] Wherein, Pi is the feedback power value, P_2 is the operating power value, and N is the power ratio.

[0141] The smaller the value of the N, the better the coupling effect of the microwave in the atomization cavity, that is, the better the absorption effect of the microwave in the atomization cavity. The larger the value of the N, the worse the coupling effect of the microwave in the atomization cavity, that is, the worse the absorption effect of the microwave in the atomization cavity.

[0142] It can be understood that the numerical range of the N is less than 1.

[0143] In some embodiments, three microwave frequencies are provided, which are F_a, F_b, and F_c, respectively. After calculation, the power ratio N_a corresponding to the F_a is 0.1, the power ratio N_b corresponding to the F_b is 0.5, and the power ratio N_c corresponding to the F_c is 0.3. N_a, N_b, and N_c are arranged according to numerical values, that is, $N_a < N_c < N_b$. Since the smaller the numerical value of the power ratio, the higher the microwave absorption rate, it is determined that the microwave assembly is controlled to feed the microwave into the atomization cavity according to the microwave frequency F_a corresponding to the power ratio N_a, so that the best heating effect can be achieved, and therefore, F_a is the target microwave frequency.

[0144] As shown in FIG. 5, in any of the above embodiments, the step of selecting the target microwave frequency in the microwave frequency range according to the power ratios corresponding to each microwave frequency includes:

step 502, determining the minimum power ratio among the power ratios corresponding to each microwave frequency;

step 504, searching for the microwave frequency corresponding to the minimum power ratio to determine the target microwave frequency.

[0145] In this design, the power ratios corresponding to each microwave frequency are sorted according to the numerical values, and the operating frequency corresponding to the power ratio with the smallest numerical value is used as the target microwave frequency. By calculating the frequency ratio, the error part in the frequency sweeping stage can be filtered, thereby improving the screening accuracy of the target microwave frequency and avoiding misjudgment of the target microwave frequency.

[0146] As shown in FIG. 6, in any of the above embodiments, the step of selecting the target microwave frequency in the microwave frequency range according to the power ratios corresponding to each microwave frequency includes:

step 602, determining the minimum feedback power value among the feedback power values corresponding to each microwave frequency;

step 604, searching for the microwave frequency corresponding to the minimum feedback power value to determine the target microwave frequency.

[0147] In this design, the feedback power values are directly sorted according to the numerical values, so as to determine the minimum feedback power value. The microwave frequency corresponding to the minimum feedback power value is taken as the target microwave frequency.

[0148] It can be understood that the operating powers of the microwave generation device varies small when outputting the microwaves of different frequencies. Therefore, the microwave frequency corresponding to the minimum feedback power value is directly selected as the target microwave frequency, which can reduce the data processing amount while ensuring the accuracy of the target microwave frequency selection.

Embodiment Two:

[0149] As shown in FIG. 7, a control method for an aerosol-generating apparatus is provided in a first embodiment of the present disclosure. The aerosol-generating apparatus includes an atomization cavity and a microwave assembly. The atomization cavity is configured to accommodate the aerosol-forming substrate, and the microwave assembly is configured to feed a microwave into the atomization cavity.

[0150] The control method for the aerosol-generating apparatus includes:

step 702, controlling the microwave assembly to sweep at each microwave frequency in response to a start operation command;

step 704, detecting feedback power values of feedback signals corresponding to each microwave frequency during the sweep operation;

step 706, screening a target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency;

step 708, obtaining a set frequency range;

step 710, determining whether the target microwave frequency is less than the minimum value in the set frequency range, executing step 718 if the determining result is yes, and executing step 712 if the determining result is no;

step 712, determining whether the target microwave frequency is larger than the maximum value in the set frequency range, executing step 720 if the determining result is yes, and executing step 714 if the determining result is no;

step 714, obtaining an average frequency value in the set frequency range;

step 716, determining whether the target microwave frequency is larger than the average frequency value in the set frequency range, executing step 720 if the determining result is yes, and executing step 718 if the determining result is no;

step 718, determining that the atomization cavity is in an empty state, and controlling the microwave assembly to stop running;

step 720, determining that the aerosol-forming substrate is present in the atomization cavity, and controlling the microwave assembly to feed microwaves into the atomization cavity according to the target microwave frequency.

[0151] In this embodiment, when the aerosol-generating apparatus receives the start operation command, the microwave assembly is controlled to perform frequency sweep detection to the atomization cavity, so as to determine the target microwave frequency for the microwave assembly to operate, that is, the optimal frequency point for the microwave assembly to feed the microwaves into the atomization cavity in the current state. During the sweep operation, the microwave assembly is controlled to sequentially feed the microwaves into the atomization cavity according to each microwave frequency, receive the corresponding feedback signals, and determine the feedback power values of each of the feedback signals.

[0152] The feedback power value can reflect the microwave absorption effect of the atomization cavity. It can be understood that the smaller the feedback power value, the stronger the microwave absorption effect of the atomization cavity, while the larger the feedback power value, the worse the microwave absorption effect of the atomization cavity. The microwave frequency corresponding to the feedback power value with the strongest microwave absorption effect is selected as the target microwave frequency.

[0153] The frequencies in the set frequency range should be set before the aerosol-generating apparatus leaves the factory. Wherein, the maximum value in the set frequency range is the optimal frequency value of the microwave output by the microwave assembly into the atomization cavity when the aerosol-forming substrate is accommodated in the atomization cavity. The minimum value in the set frequency range is the optimal frequency value of the microwave output by the microwave assembly when the atomization cavity is in the empty state.

[0154] When the target microwave frequency is detected to be less than the minimum value in the set frequency range, it is determined that the atomization cavity is currently in the empty state, that is, the aerosol-forming substrate is not accommodated in the atomization cavity. Then the microwave assembly is controlled to stop running to avoid dry burning of the atomization cavity.

[0155] When the target microwave frequency is detected to be larger than the maximum value in the set frequency range, it is determined that the aerosol-forming substrate is accommodated in the atomization cavity. At this time, the microwave assembly is controlled to feed the microwaves into the atomization cavity according to the target microwave frequency obtained through frequency sweep screening, so that the microwave absorption efficiency of the aerosol-forming substrate is improved, and the atomization effect of the aerosol-forming substrate is improved.

[0156] When the target microwave frequency is detected to be smaller than the average frequency value of the set frequency range, it is determined that the atomization cavity is currently in the empty state, that is, the aerosol-forming substrate is not accommodated in the atomization cavity. Then, the microwave assembly is controlled to stop running to avoid dry burning of the atomization cavity.

[0157] When the target microwave frequency is detected to be larger than the average frequency value in the set frequency range, it is determined that the aerosol-forming substrate is accommodated in the atomization cavity. At this time, the microwave assembly is controlled to feed the microwaves into the atomization cavity according to the target microwave frequency obtained through frequency sweep screening, so that the microwave absorption efficiency of the aerosol-forming substrate is improved, and the atomization effect of the aerosol-forming substrate is improved.

[0158] When the target microwave frequency is detected to be within the microwave frequency range, the state of the aerosol-forming substrate in the atomization cavity is further detected according to the numerical relationship between the average value of the microwave frequency range and the target microwave frequency. Therefore, misjudgment caused by detection errors is avoided, the accuracy of determining whether the aerosol-forming substrate is accommodated in the atomization cavity is further improved, the situation of microwave heating of the empty atomization cavity caused by misjudgment is avoided toensure that the aerosol-generating apparatus does not perform microwave heating on the atomization cavity in the empty state, and the use experience of the user is improved.

Embodiment Three:

[0159] As shown in FIG. 8, a control device 800 for an aerosol-generating apparatus is provided in a third embodiment of the present disclosure. The aerosol-generating apparatus includes an atomization cavity and a microwave assembly, wherein the atomization cavity is configured to accommodate the aerosol-forming substrate, and the microwave assembly is configured to feed microwaves into the atomization cavity.

[0160] The control device 800 for the aerosol-generating apparatus includes:

a search unit 802, configured to control the microwave assembly to sweep in the microwave frequency range, and to search for the target microwave frequency in the microwave frequency range;

a detection unit 804, configured to determine the presence state of the aerosol-forming substrate in the atomization cavity according to the numerical relationship between the target microwave frequency and the set frequency range;

a control unit 806, configured to control the running state of the microwave assembly according to the presence state of the aerosol-forming substrate.

[0161] The control device provided in this embodiment is used to control the aerosol-generating apparatus, and the aerosol-generating apparatus is used to heat the aerosol-forming substrate. The aerosol-forming substrate may be a solid aerosol-forming substrate or a liquid aerosol-forming substrate. The aerosol-generating apparatus is provided therein with an atomization cavity for accommodating the aerosol-forming substrate. The microwave assembly can feed microwaves into the atomization cavity, and the aerosol-forming substrate is heated and atomized under the action of the microwaves.

[0162] When the search unit 802 receives the start atomization command, the microwave assembly is controlled to perform frequency sweep operation in the microwave frequency range. Specifically, the microwave assembly is controlled to feed the microwaves into the atomization cavity sequentially according to each microwave frequency in the microwave frequency range. The target microwave frequency in the microwave frequency range is determined according to the changes of the parameters in the atomization cavity. The target microwave frequency is the optimal frequency point of the operation of the microwave assembly in the current atomization state, which is the microwave frequency with the maximum microwave absorption amount in the atomization cavity. According to the numerical relationship between the target microwave frequency and the set frequency range, the detection unit 804 can determine the presence state of the aerosol-forming substrate in the atomization cavity, that is, whether the aerosol-forming substrate is accommodated in the atomization cavity. The control unit 806 controls the operation of the microwave assembly according to the presence state of the aerosol-forming substrate in the atomization cavity. If it is detected that the aerosol-forming substrate is accommodated in the atomization cavity, the microwave assembly is controlled to operate normally to heat and atomize the aerosol-forming substrate. If it is detected that the atomization cavity is in the empty state, the microwave assembly is controlled to stop running in order to avoid feeding the microwave into the empty cavity to shorten the service life of the aerosol-generating apparatus. In the present disclosure, the target microwave frequency in the current state of the atomization cavity is determined through the frequency sweep operation of the microwave assembly, so as to detect whether the aerosol-forming substrate is present in the atomization cavity, thereby avoiding feeding the microwave into the atomization cavity in the empty state, and thus prolonging the service life of the aerosol-generating apparatus.

[0163] It can be understood that the difference between the target microwave frequencies determined through the frequency sweep is large in the state that the atomization cavity is empty and in the state that the aerosol-forming substrate is present in the atomization cavity. Therefore, the numerical relationship between the target microwave frequency obtained by frequency sweeping and the set frequency range can accurately determine whether the aerosol-forming substrate is accommodated in the atomization cavity.

[0164] In the above embodiments, the detection unit is further configured to determine that the aerosol-forming substrate is not present in the atomization cavity based on that the target microwave frequency is less than the minimum value in the set frequency range;

the detection unit is further configured to determine that the aerosol-forming substrate is present in the atomization cavity based on that the target microwave frequency is larger than the maximum value in the set frequency range;

the detection unit is further configured to determine the presence state of the aerosol-forming substrate in the atomization cavity according to the numerical relationship between the target microwave frequency and the average frequency value of the set frequency range when the target microwave frequency is within the set frequency range.

[0165] In this embodiment, the maximum value in the set frequency range is the optimal frequency point when the aerosol-forming substrate is present in the atomization cavity, while the minimum value in the set frequency range is the optimal frequency point when the atomization cavity is in the empty state, that is, when the aerosol-forming substrate is not present in the atomization cavity.

[0166] If the target microwave frequency is detected to be less than the minimum value in the set frequency range, it is determined that the atomization cavity is in the empty state, that is, the aerosol-forming substrate is not present in the atomization cavity.

[0167] If the target microwave frequency is detected to be larger than the maximum value in the set frequency range, it is determined that the aerosol-forming substrate is in the present state in the atomization cavity, that is, the aerosol-forming substrate is present in the atomization cavity.

[0168] When the target microwave frequency is detected to be within the microwave frequency range, the state of the aerosol-forming substrate in the atomization cavity is further detected according to the numerical relationship between the average value of the microwave frequency range and the target microwave frequency.

[0169] By comparing the target microwave frequency with the value in the set frequency range, the accuracy of judging whether the aerosol-forming substrate is accommodated in the atomization cavity is improved. By means of the above detection method, whether the aerosol-forming substrate is accommodated in the atomization cavity can be accurately detected, and the situation of microwave heating of the empty atomization cavity caused by misjudgment is avoided.

[0170] It should be noted that, since the optimal frequency point when the atomization cavity is in the empty state is different from the optimal frequency point when the atomization cavity contains the aerosol-forming substrate, where the optimal frequency point when the atomization cavity is in the empty state is a, the optimal frequency point when the atomization cavity contains the aerosol-forming substrate is b, and the difference between a and b is 25 MHz to 35 MHz, while the target microwave frequency obtained through frequency sweeping is usually a $\pm$ 2 MHz or b $\pm$ 2 MHz. Therefore, the set frequency range is set as a to b, and the presence state of the aerosol-forming substrate in the atomization cavity can be accurately determined according to the numerical relationship between the target microwave frequency and the a and the b.

[0171] In any of the above embodiments, the detection unit is further configured to determine that the aerosol-forming substrate is present in the atomization cavity according to that the target microwave frequency is larger than the average frequency value;

the detection unit is further configured to determine that the aerosol-forming substrate is not present in the atomization cavity according to that the target microwave frequency is less than or equal to the average frequency value.

[0172] In this embodiment, when the target microwave frequency is detected to be within the microwave frequency range, the numerical relationship between the target microwave frequency and the average frequency value of the set frequency range is determined, and the presence state of the aerosol-forming substrate in the atomization cavity is further determined according to the numerical relationship.

[0173] When the target microwave frequency is detected to be larger than the average frequency value, it is determined that the aerosol-forming substrate is in the present state in the atomization cavity, that is, the aerosol-forming substrate is present in the atomization cavity.

[0174] When the target microwave frequency is detected to be less than or equal to the average frequency value, it is determined that the atomization cavity is in the empty state, that is, the aerosol-forming substrate is not located in the atomization cavity.

[0175] When the target microwave frequency is within the microwave frequency range, the presence state of the aerosol-forming substrate in the atomization cavity can be accurately determined by comparing the numerical values of the target microwave frequency and the average frequency value. By means of the above detection method, whether the aerosol-forming substrate is accommodated in the atomization cavity can be accurately detected, and the situation of microwave heating of the empty atomization cavity caused by misjudgment is avoided.

[0176] In any of the above embodiments, the control unit is further configured to control the microwave assembly to feed the microwaves into the atomization cavity at the target microwave frequency the aerosol-forming substrate is present in the atomization cavity;

the control unit is further configured to control the microwave assembly to stop running and output a prompt information when the aerosol-forming substrate is in the non-presence state.

[0177] In this embodiment, when it is detected that the aerosol-forming substrate is in the presence state, that is, when the aerosol-forming substrate is accommodated in the atomization cavity, it is determined that the microwave heating and atomization on the aerosol-forming substrate can be performed normally, and the microwave assembly is controlled to feed the microwaves into the atomization cavity at the target microwave frequency, where the target microwave frequency is determined by the microwave assembly through frequency sweeping. By feeding the microwaves of the target microwave frequency into the atomization cavity, the optimal atomization state of the aerosol-forming substrate in the atomization cavity can be achieved, that is, the aerosol-forming substrate can have the best absorption effect on the microwave of the target microwave frequency, so that the energy consumption of the aerosol-generating apparatus is reduced, the atomization efficiency of the aerosol-forming substrate is improved, and harmful substances generated by uneven heating of the aerosol-forming substrate are reduced.

[0178] When it is detected that the aerosol-forming substrate is in a non-presence state, that is, the atomization cavity is in the empty state, the microwave assembly is controlled to stop running, so that the situation that the service life of the aerosol-generating apparatus is shortened due to the fact that the microwave assembly continues to feed the microwaves into the atomization cavity in the empty state is avoid. In addition, when it is detected that the atomization cavity is in the empty state, the prompt information is output to remind the user to place the aerosol-forming substrate into the atomization cavity, thereby improving the use experience of the user.

[0179] In any of the above embodiments, the control unit is further configured to control the microwave assembly to emit the microwaves into the atomization cavity according to each microwave frequency in the microwave frequency range;

the detection unit is further configured to detect the feedback power values of the feedback signals corresponding to each microwave frequency;

the search unit is further configured to screen the target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency.

[0180] In this embodiment, the microwave assembly includes a microwave generation device and a microwave antenna. The microwave generation device is configured to generate the microwave of corresponding frequency, and the microwave antenna is configured to feed the microwave of the corresponding frequency into the atomization cavity. After the microwave enters the atomization cavity, the microwave antenna can receive the feedback signal corresponding to the microwave. The microwave assembly further includes a first power detection device and a second power detection device, where the first power detection device is connected to the microwave generation device and can collect the operating power value of the microwave generation device during operation. The second power detection device is connected to the microwave antenna and can detect the feedback power value of the feedback signal received by the microwave antenna.

[0181] The microwave assembly is controlled to feed the microwaves into the atomization cavity according to each microwave frequency in the microwave frequency range, that is, the microwave assembly is controlled to sequentially emit the microwaves with different microwave frequencies into the atomization cavity. During the emission process of the microwave assembly, the feedback signal corresponding to each microwave frequency is received, and the feedback power value of each feedback signal is determined by the second power detection device. The target microwave frequency in the microwave frequency range is screened according to the detected feedback power value, so as to determine the target microwave frequency with the best absorption effect in the atomization cavity. By means of frequency sweeping, the microwaves in the microwave frequency range can be screened, so as to determine the target microwave frequency with the best absorption effect in the current atomization cavity, thereby achieving feeding the microwave with the target microwave frequency into the atomization cavity when the aerosol-forming substrate is accommodated in the atomization cavity, and improving the atomization effect of the aerosol-forming substrate.

[0182] In any of the above embodiments, the detection unit is further configured to detect the operating power value corresponding to the microwave of each microwave frequency output by the microwave assembly;

the control device further includes:

a calculation unit, configured to calculate the ratio between the feedback power value and the operating power value corresponding to each microwave frequency, in order to obtain the power ratio;

the search unit is further configured to select the target microwave frequency in the microwave frequency range according to the power ratios corresponding to each microwave frequency.

[0183] In this embodiment, the operating power value corresponding to each microwave frequency is monitored by the first power detection device. By calculating the ratio between the operating power value and the corresponding feedback power value, the power ratio can be obtained. The formula for calculating the power ratio is as follows:

$$N=P_1 / P_2$$

[0184] Wherein, Pi is the feedback power value, P_2 is the operating power value, and N is the power ratio.

[0185] The smaller the value of the N, the better the microwave coupling effect in the atomization cavity, that is, the better the microwave absorption effect in the atomization cavity. The larger the value of the N, the worse the microwave coupling effect in the atomization cavity, that is, the worse the microwave absorption effect in the atomization cavity.

[0186] In any of the above embodiments, the search unit is further configured to determine the minimum power ratio among the power ratios corresponding to each microwave frequency. The search unit is further configured to search the microwave frequency corresponding to the minimum power ratio to determine the target microwave frequency.

[0187] In this embodiment, the power ratios corresponding to each microwave frequency are sorted according to the numerical values, and the operating frequency corresponding to the power ratio with the smallest numerical value is taken as the target microwave frequency. By calculating the frequency ratio, the error part in the frequency sweeping stage can be filtered, thereby improving the screening accuracy of the target microwave frequency and avoiding misjudgment of the target microwave frequency.

[0188] In any of the above embodiments, the search unit is further configured to determine the the minimum feedback power value among the feedback power values corresponding to each microwave frequency. The search unit is further configured to the microwave frequency corresponding to the minimum feedback power value to determine the target microwave frequency. In this embodiment, the feedback power values are directly sorted according to the numerical values, so as to determine the minimum feedback power value. The microwave frequency corresponding to the minimum feedback power value is taken as the target microwave frequency.

[0189] It is understandable that the operating powers of the microwave generation device varies small when outputting the microwaves of different frequencies. Therefore, the microwave frequency corresponding to the minimum feedback power value is directly selected as the target microwave frequency, which can reduce the data processing amount while ensuring the accuracy of the target microwave frequency selection.

Embodiment Four:

[0190] As shown in Fig. 9, an aerosol-generating apparatus 900 is provided in a fourth embodiment of the present disclosure, including: an atomization cavity configured to accommodate an aerosol-forming substrate; a microwave assembly 902 configured to feed a microwave into the atomization cavity; and the control device 800 for the aerosol-generating apparatus in any of the above possible designs which is connected to the microwave assembly 902.

[0191] The aerosol-generating apparatus provided in this embodiment includes the atomization cavity, the microwave assembly 902, and the control device 800 of the aerosol-generating apparatus. The aerosol-generating apparatus is used to heat the aerosol-forming substrate, wherein the aerosol-forming substrate may be a solid aerosol-forming substrate or a liquid aerosol-forming substrate. The aerosol-generating apparatus is provided therein with the atomization cavity configured for accommodating the aerosol-forming substrate. The microwave assembly 902 can feed microwaves into the atomization cavity, and the aerosol-forming substrate is heated and atomized under the action of the microwaves.

[0192] The control device 800 of the aerosol-generating apparatus is connected to the microwave assembly 902, to control the operation of the microwave assembly 902. The control device 800 of the aerosol-generating apparatus may be selected as the control device 800 of the aerosol-generating apparatus in any of the above Embodiment Two, and thus, it has all of the beneficial technical effects of the control device 800 of the aerosol-generating apparatus in any of the above embodiments, which will not be repeated herein.

Embodiment Five:

[0193] As shown in FIG. 10, an aerosol-generating apparatus 1000 is provided in a fifth embodiment of the present disclosure, including: a memory 1002, in which a program or an instruction is stored; a processor 1004 configured to execute the program or the instruction stored in the memory 1002 to implement the steps of the control method for the aerosol-generating apparatus in any one of the above embodiments. Therefore, it has all of the beneficial technical effects of the control method for the aerosol-generating apparatus in any one of the above embodiments, which will not be repeated here.

[0194] The aerosol-generating apparatus 1000 provided in this embodiment further includes an atomization cavity and a microwave assembly. The atomization cavity is configured to accommodate the aerosol-forming substrate, and the microwave assembly is configured to feed microwaves into the atomization cavity. The microwaves act on the aerosol-forming substrate, causing the aerosol-forming substrate to be heated and atomized. The microwave assembly is connected to the processor 1004, and the processor 1004 executes the control method of the aerosol-generating apparatus to control the microwave assembly in the aerosol-generating apparatus 1000.

Embodiment Six:

[0195] As shown in FIG. 11, an aerosol-generating apparatus 100 is provided in a sixth embodiment of the present disclosure, including a shell 102, an atomization cavity 103, a microwave assembly 104, and a control device 105;

the atomization cavity 103 is disposed in the shell 102, and is configured to accommodate the aerosol-forming substrate 108;

the microwave assembly 104 is configured to feed microwaves into the atomization cavity 103; and

the control device 105 is configured to control the microwave assembly 104 to sweep in a microwave frequency range, and to search for a target microwave frequency in the microwave frequency range; to determine a presence state of the aerosol-forming substrate 108 in the atomization cavity 103 according to a numerical relationship between the target microwave frequency and the set frequency range; and to control a running state of the microwave assembly 104 according to the presence state of the aerosol-forming substrate 108.

[0196] The aerosol-generating apparatus 100 in this embodiment includes the shell 102, the atomization cavity 103, the microwave assembly 104, and the control device 105. The shell 102 is provided therein with the atomization cavity 103, which is used to accommodate the aerosol-forming substrate 108. The output end of the microwave assembly 104 is communicated to the atomization cavity 103. The microwave assembly 104 feeds the microwaves into the atomization cavity 103 when electrified, and the aerosol-forming substrate 108 is heated and atomized under the action of the microwaves.

[0197] When the control device 105 receives a start atomization command, the microwave assembly 104 is controlled to sweep in the microwave frequency range. Specifically, the microwave assembly 104 is controlled to feed the microwaves into the atomization cavity 103 sequentially according to each microwave frequency in the microwave frequency range. The target microwave frequency in the microwave frequency range is determined according to the change of the parameters in the atomization cavity 103. The target microwave frequency is the optimal frequency point of the operation of the microwave assembly 104 in the current state of the atomization cavity 103, that is, the microwave frequency with the maximum microwave absorption in the atomization cavity 103. According to the numerical relationship between the target microwave frequency and the set frequency range, the presence state of the aerosol-forming substrate 108 in the atomization cavity 103 can be determined, that is, whether the aerosol-forming substrate 108 is accommodated in the atomization cavity 103. Then, the operation of the microwave assembly 104 is controlled according to the presence state of the aerosol-forming substrate 108 in the atomization cavity 103. If it is detected that the aerosol-forming substrate 108 is accommodated in the atomization cavity 103, the microwave assembly 104 is controlled to operate normally to heat and atomize the aerosol-forming substrate 108. If it is detected that the atomization cavity 103 is in an empty state, the microwave assembly 104 is controlled to stop running in order to avoid feeding the microwave into the empty cavity to shorten the service life of the aerosol-generating apparatus. In the present disclosure, the target microwave frequency in the current state of the atomization cavity 103 is determined through the frequency sweep operation of the microwave assembly 104, so as to detect whether the aerosol-forming substrate 108 is present in the atomization cavity 103, thereby avoiding feeding the microwave into the atomization cavity 103 in the empty state, and thus prolonging the service life of the aerosol-generating apparatus 100.

[0198] It can be understood that the difference between the target microwave frequencies determined through the frequency sweep is large in the state that the atomization cavity 103 is empty and in the state that the aerosol-forming substrate 108 is present in the atomization cavity 103. Therefore, the numerical relationship between the target microwave frequency obtained by frequency sweeping and the set frequency range can accurately determine whether the aerosol-forming substrate 108 is accommodated in the atomization cavity 103.

[0199] As shown in FIG. 12, in any of the above embodiments, the microwave assembly 104 includes: a microwave generation device 1041, a microwave antenna 1042, a first power detection device 1043, and a second power detection device 1044.

[0200] The microwave generation device 1041 is connected to the control device 105;

the microwave antenna 1042 is connected to a microwave generation circuit, and is configured to emit the microwaves generated by the microwave generation device 1041 to the atomization cavity 103 and receive feedback signals;

the first power detection device 1043 is connected to the control device 105, and the acquisition end of the first power detection device 1043 is connected to the microwave generation device 1041 to collect the operating power value of the microwave generation device 1041; and

the second power detection device 1044 is connected to the control device 105, and the acquisition end of the second power detection device 1044 is connected to the microwave antenna 1042 for detecting the feedback power value of the feedback signal received by the microwave antenna 1042.

[0201] In this embodiment, the microwave assembly 104 includes the microwave generation device 1041, the microwave antenna 1042, the first power detection device 1043, and the second power detection device 1044. The microwave assembly 104 includes the microwave generation device 1041 and the microwave antenna 1042, wherein the microwave generation device 1041 can generate microwaves of corresponding frequencies, and the microwave antenna 1042 can feed the microwaves of corresponding frequencies into the atomization cavity 103. After the microwaves enter the atomization cavity 103, the microwave antenna 1042 can receive the corresponding feedback signals of the microwaves. The microwave assembly 104 further includes the first power detection device 1043 and the second power detection device 1044, wherein the first power detection device 1043 is connected to the microwave generation device 1041 and can collect the operating power values of the microwave generation device 1041 during its operation, and the second power detection device 1044 is connected to the microwave antenna 1042 and can detect the feedback power values of the feedback signals received by the microwave antenna 1042.

[0202] In any of the above embodiments, the microwave assembly 104 further includes a directional coupler 1048, wherein the directional coupler 1048 includes a first end, a second end, a third end, and a fourth end, the first end is connected to the microwave generation device 1041, the second end is connected to the microwave antenna 1042, the third end is connected to the first power detection device 1043, and the fourth end is connected to the second power detection device 1044.

[0203] In this embodiment, the microwave assembly 104 further includes the directional coupler 1048. The first end, the second end, the third end, and the fourth end of the directional coupler 1048 are respectively connected to the microwave generation device 1041, the microwave antenna 1042, the first power detection device 1043, and the second power detection device 1044.

[0204] The first power detection device 1043 can detect the operating power value of the microwave generation device 1041 through the directional coupler 1048, and the second power detection device 1044 can detect the feedback power value of the feedback signal detected by the microwave antenna 1042 through the directional coupler 1048. The microwave signal generated by the microwave generation device 1041 is transmitted to the microwave antenna 1042 through the directional coupler 1048, and the microwave antenna 1042 feeds the microwave into the atomization cavity 103.

[0205] The microwave generation device 1041, the microwave antenna 1042, the first power detection device 1043, and the second power detection device 1044 are connected through the directional coupler 1048, thereby reducing the power connection lines in the microwave assembly 104 and thus reducing the space occupied by the microwave assembly 104. Therefore, the volume of the aerosol-generating apparatus 100 can be reduced, which meets the requirements of product miniaturization.

[0206] As shown in FIG. 13, in any of the above embodiments, the microwave generation device 1041 includes a microwave generator 10412 and a power amplifier 10414.

[0207] The microwave generator 10412 is connected to the control device 105; and

the power amplifier 10414 is connected to the control device 105, the input end of the power amplifier 10414 is connected to the microwave generator 10412, and the output end of the power amplifier 10414 is connected to the first end of the directional coupler 1048.

[0208] In this embodiment, the microwave generation device 1041 includes the microwave generator 10412 and the power amplifier 10414. The microwave generator 10412 can generate a microwave signal and is connected to the control device 105, and the control device 105 can control the operation of the microwave generator 10412. The output end of the microwave generator 10412 is connected to the input end of the power amplifier 10414, and the output end of the power amplifier 10414 is connected to the directional coupler 1048. The control device 105 can not only control the operating power of the microwave generator 10412, but also control the amplification factor of the power amplifier 10414.

[0209] As shown in FIG. 13, in any of the above embodiments, the microwave generation device 1041 further includes a power regulator 10416. A first end of the power regulator 10416 is connected to the control device 105, and a second end of the power regulator 10416 is connected to the power amplifier 10414.

[0210] In this embodiment, the electronic atomization device further includes the power regulator 10416, which is connected to the power amplifier 10414. The control device 105 can control the power regulator 10416, thereby adjusting the power of the output microwave and increasing the adjustment range of the power of the emitted microwave.

[0211] In any of the above embodiments, the power regulator 10416 is integrated with the power amplifier 10414.

[0212] In this embodiment, the power regulator 10416 is integrated with the power amplifier 10414, that is, the power regulator 10416 and the power amplifier 10414 are an integrated electronic component, and the integrated electronic component has two functions of power regulation and amplification. By integrating the power regulator 10416 with the power amplifier 10414, the space occupied by the microwave assembly 104 in the aerosol-generating apparatus 100 can be further reduced.

[0213] As shown in FIG. 11, in any of the above embodiments, the aerosol-generating apparatus 100 further includes an isolating member 106. The isolating member 106 is disposed in the atomization cavity 103, and divides the atomization cavity 103 into an accommodating cavity 1032 and a resonant cavity 1034. The accommodating cavity 1032 is configured to accommodate the aerosol-forming substrate 108. A resonant column 107 is disposed on the bottom wall of the resonant cavity 1034.

[0214] In this embodiment, the aerosol-generating apparatus 100 further includes the isolating member 106 disposed in the atomization cavity 103, and the isolating member 106 divides the atomization cavity 103 into the accommodating cavity 1032 and the resonant cavity 1034. The accommodating cavity 1032 is configured to accommodate the aerosol-forming substrate 108, the microwave assembly 104 feeds microwaves into the resonant cavity 1034, and the microwaves can be transmitted through the resonant cavity 1034 to the accommodating cavity 1032 for microwave heating of the aerosol-forming substrate 108 in the accommodating cavity 1032.

[0215] The accommodating cavity 1032 and the resonant cavity 1034 are isolated from each other through the isolating member 106, which can prevent the liquid waste or the solid waste generated after the aerosol-forming substrate 108 in the accommodating cavity 1032 is atomized from entering the resonant cavity 1034, thereby avoiding the occurrence of a failure of the microwave assembly 104 caused by the waste entering the resonant cavity 1034.

[0216] In some embodiments, the isolating member 106 is detachably connected to the shell 102, and the accommodating cavity 1032 is provided in the isolating member 106. By disassembling the isolating member 106, the accommodating cavity 1032 can be individually disassembled and cleaned, thereby improving the user experience.

[0217] It can be understood that the isolating member 106 may be made of a material such as a ceramic or a glass, so that the microwave in the resonant cavity 1034 can be transmitted to the accommodating cavity 1032 to heat the aerosol-forming substrate 108 in the accommodating cavity 1032.

[0218] In any of the above embodiments, the resonant column 107 is connected to the microwave antenna 1042.

[0219] In this embodiment, the microwave is fed into the resonant cavity 1034 through the resonant column 107. The first end of the resonant column 107 is connected to the bottom wall of the resonant cavity 1034, and the second end of the resonant column 107 is arranged corresponding to the accommodating cavity 1032. The microwave is transmitted along the direction from the first end to the second end of the resonant column 107 to heat the aerosol-forming substrate 108 in the accommodating cavity 1032.

Embodiment Seven:

[0220] A readable storage medium is provided in a seventh embodiment of the present disclosure, on which a program is stored. When the program is executed by the processor, the control method for the aerosol-generating apparatus in any of the above embodiments is implemented, thus having all the beneficial technical effects of the control method for the aerosol-generating apparatus in any of the above embodiments.

[0221] The readable storage media may be, for example, a Read-Only Memory (ROM), a Random Access Memory (RAM), a magnetic disk, or an optical disc, etc.

[0222] It should be noted that, unless otherwise explicitly specified and defined, in the claims, the specification, and the accompanying drawings of the present disclosure, the term "a plurality of refers to two or more. The orientation or positional relationships indicated by terms " upper", " lower", etc. are orientation or position relationships shown based on the accompanying drawings, and are merely used for more conveniently describing the present disclosure and simplifying the description, rather than indicating or implying that the device or component referred to should have a particular orientation or be constructed and operated in a particular orientation, and therefore, should not be understood as a limitation to the present disclosure. The terms "connection", "mounted", "fixation", etc. should be understood in a broad sense. For example, the "connection" may be a fixed connection between multiple objects, a detachable connection between multiple objects, or an integral connection; or may be a direct connection between multiple objects, or an indirect connection between multiple objects through an intermediate medium. For ordinary technical personnel in this field, the specific meanings of the above terms in the present disclosure can be understood based on specific circumstances of the above data.

[0223] In the claims, the specification, and the accompanying drawings of the present disclosure, the terms "one embodiment", "some embodiments", "specific embodiments", etc. mean that the specific features, structures, materials, or characteristics described in conjunction with the embodiments or examples are included in at least one embodiment or example of the present disclosure. In the claims, the specification, and the accompanying drawings of the present disclosure, the illustrative expressions of the above terms may not necessarily refer to the same embodiment or example. Moreover, the particular features, structures, materials, or characteristics described may be combined in an appropriate manner in any one or more embodiments or examples.

[0224] The above are only preferred embodiments of the present disclosure and are not intended to limit the present disclosure. For a person of ordinary skill in the art, the present disclosure may have various modifications and variations. Any modifications, equivalent replacements, improvements, etc. made within the spirit and principles of the present disclosure shall fall within the protection scope of the present disclosure.

Claims

1. A control method for an aerosol-generating apparatus, wherein the aerosol-generating apparatus comprises an atomization cavity and a microwave assembly, the atomization cavity is configured to accommodate an aerosol-forming substrate, the microwave assembly is configured to feed microwaves into the atomization cavity, and the control method comprises:

   controlling the microwave assembly to sweep in a microwave frequency range, and search for a target microwave frequency in the microwave frequency range;
   determining a presence state of the aerosol-forming substrate in the atomization cavity according to a numerical relationship between the target microwave frequency and a set frequency range; and
   controlling a running state of the microwave assembly according to the presence state of the aerosol-forming substrate.

2. The control method for the aerosol-generating apparatus of claim 1, wherein the step of determining the presence state of the aerosol-forming substrate in the atomization cavity according to the numerical relationship between the target microwave frequency and the set frequency range comprises:

   determining that the aerosol-forming substrate is not present in the atomization cavity if the target microwave frequency is less than the minimum value in the set frequency range;
   determining that the aerosol-forming substrate is present in the atomization cavity if the target microwave frequency is larger than the maximum value in the set frequency range; and
   determining the presence state of the aerosol-forming substrate in the atomization cavity according to a numerical relationship between an average frequency value of the set microwave frequency range and the target microwave frequency if the target microwave frequency is within the set microwave frequency range.

3. The control method for the aerosol-generating apparatus of claim 2, wherein the step of determining the presence state of the aerosol-forming substrate in the atomization cavity according to the numerical

relationship between the average frequency value of the set microwave frequency range and the target microwave frequency comprises:

determining that the aerosol-forming substrate is present in the atomization cavity if the target microwave frequency is larger than the average frequency value; and
determining that the aerosol-forming substrate is not present in the atomization cavity if the target microwave frequency is less than or equal to the average frequency value.

4. The control method for the aerosol-generating apparatus of any one of claims 1 to 3, wherein the step of controlling the running state of the microwave assembly according to the presence state of the aerosol-forming substrate comprises:

controlling the microwave assembly to feed the microwaves into the atomization cavity according to the target microwave frequency if the aerosol-forming substrate is present in the atomization cavity; and
controlling the microwave assembly to stop running and output a prompt information if the aerosol-forming substrate is not present in the atomization cavity.

5. The control method for the aerosol-generating apparatus of any one of claims 1 to 3, wherein the microwave assembly comprises a microwave generation device and a microwave antenna, the microwave antenna is connected to the microwave generation device and configured to emit the microwaves generated by the microwave generation device into the atomization cavity and to receive feedback signals, the step of controlling the microwave assembly to sweep in the microwave frequency range, and search for the target microwave frequency in the microwave frequency range comprises:

controlling the microwave assembly to emit the microwaves into the atomization cavity according to each microwave frequency in the microwave frequency range;
detecting feedback power values of the feedback signals corresponding to each microwave frequency; and
screening the target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency.

6. The control method for the aerosol-generating apparatus of claim 5, wherein the step of screening the target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency comprises:

detecting operating power values corresponding to the microwave of each microwave frequency output by the microwave assembly;
calculating the ratios between the feedback power values and the operating power values corresponding to each microwave frequency to obtain power ratios; and
selecting the target microwave frequency in the microwave frequency range according to the power ratios corresponding to each microwave frequency.

7. The control method for the aerosol-generating apparatus of claim 6, wherein the step of selecting the target microwave frequency in the microwave frequency range according to the power ratios corresponding to each microwave frequency comprises:

determining the minimum power ratio among the power ratios corresponding to each microwave frequency; and
searching for the microwave frequency corresponding to the minimum power ratio to determine the target microwave frequency.

8. The control method for the aerosol-generating apparatus of claim 5, wherein the step of screening the target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency comprises:

determining the minimum feedback power value among the feedback power values corresponding to each microwave frequency; and
searching for the microwave frequency corresponding to the minimum feedback power value to determine the target microwave frequency.

9. A control device for an aerosol-generating apparatus, wherein the aerosol-generating apparatus comprises an atomization cavity and a microwave assembly, the atomization cavity is configured to accommodate an aerosol-forming substrate, the microwave assembly is configured to feed microwaves into the atomization cavity, and the control device comprises:

a search unit, configured to control the microwave assembly to sweep in a microwave frequency range, and to search for a target microwave frequency in the microwave frequency range;
a detection unit, configured to determine a presence state of the aerosol-forming substrate in

the atomization cavity according to a numerical relationship between the target microwave frequency and a set frequency range; and
a control unit, configured to control a running state of the microwave assembly according to the presence state of the aerosol-forming substrate.

10. The control device for the aerosol-generating apparatus of claim 9, wherein,

the detection unit is configured to determine that the aerosol-forming substrate is not present in the atomization cavity if the target microwave frequency is less than the minimum value in the set frequency range;
the detection unit is configured to determine that the aerosol-forming substrate is present in the atomization cavity if the target microwave frequency is larger than the maximum value in the set frequency range; and
the detection unit is configured to determine the presence state of the aerosol-forming substrate in the atomization cavity according to a numerical relationship between an average frequency value of the set microwave frequency range and the target microwave frequency if the target microwave frequency is within the set microwave frequency range.

11. The control device for the aerosol-generating apparatus of claim 10, wherein,

the detection unit is configured to determine that the aerosol-forming substrate is present in the atomization cavity if the target microwave frequency is larger than the average frequency value; and
the detection unit is configured to determine that the aerosol-forming substrate is not present in the atomization cavity if the target microwave frequency is less than or equal to the average frequency value.

12. The control device for the aerosol-generating apparatus of any one of claims 9 to 11, wherein,

the control unit is configured to control the microwave assembly to feed the microwaves into the atomization cavity according to the target microwave frequency if the aerosol-forming substrate is present in the atomization cavity; and
the control unit is configured to control the microwave assembly to stop running and output a prompt information if the aerosol-forming substrate is not present in the atomization cavity.

13. The control device for the aerosol-generating apparatus of any one of claims 9 to 11, wherein the microwave assembly comprises a microwave generation device and a microwave antenna, the microwave antenna is connected to the microwave generation device and configured to emit the microwaves generated by the microwave generation device into the atomization cavity and to receive feedback signals,

the control unit is configured to control the microwave assembly to emit the microwaves into the atomization cavity according to each microwave frequency in the microwave frequency range;
the detection unit is configured to detect feedback power values of the feedback signals corresponding to each microwave frequency; and
the search unit is configured to screen the target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency.

14. The control device for the aerosol-generating apparatus of claim 13, wherein,

the detection unit is configured to detect operating power values corresponding to the microwave of each microwave frequency output by the microwave assembly;
the control device comprises:

a calculation unit, configured to calculate the ratio between the feedback power values and the operating power values corresponding to each microwave frequency to obtain power ratios;
the search unit is configured to select the target microwave frequency in the microwave frequency range according to the power ratios corresponding to each microwave frequency.

15. The control device for the aerosol-generating apparatus of claim 14, wherein,

the search unit is configured to determine the minimum power ratio among the power ratios corresponding to each microwave frequency; and
the search unit is configured to search for the microwave frequency corresponding to the minimum power ratio to determine the target microwave frequency.

16. The control device for the aerosol-generating apparatus of claim 13, wherein,

the search unit is configured to determine the

minimum feedback power value among the feedback power values corresponding to each microwave frequency; and
the search unit is configured to search for the microwave frequency corresponding to the minimum feedback power value to determine the target microwave frequency.

17. An aerosol-generating apparatus, comprising:

an atomization cavity, configured to accommodate an aerosol-forming substrate;
a microwave assembly, configured to feed microwaves into the atomization cavity; and
the control device for the aerosol-generating apparatus of any one of claims 9 to 16, the control device being connected to the microwave assembly.

18. An aerosol-generating apparatus, comprising:

a memory, a program or an instruction being stored in the memory;
a processor, configured to execute the program or the instruction stored in the memory to implement the steps of the control method for the aerosol-generating apparatus of any one of claims 1 to 8.

19. A readable storage medium, wherein a program or an instruction is stored on the readable storage medium, and when the program or the instruction is executed by a processor, the steps of the control method for the aerosol-generating apparatus of any one of claims 1 to 8 are implemented.

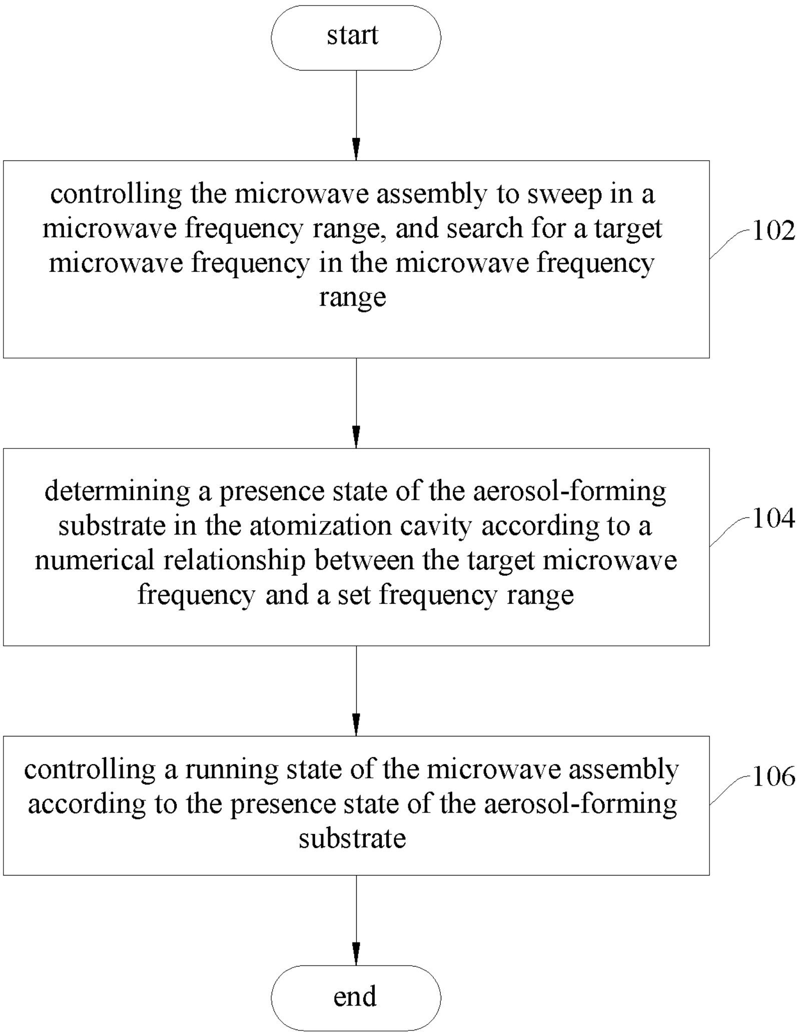
start
controlling the microwave assembly to sweep in a microwave frequency range, and search for a target microwave frequency in the microwave frequency range
102
determining a presence state of the aerosol-forming substrate in the atomization cavity according to a numerical relationship between the target microwave frequency and a set frequency range
104
controlling a running state of the microwave assembly according to the presence state of the aerosol-forming substrate
106
end

FIG. 1

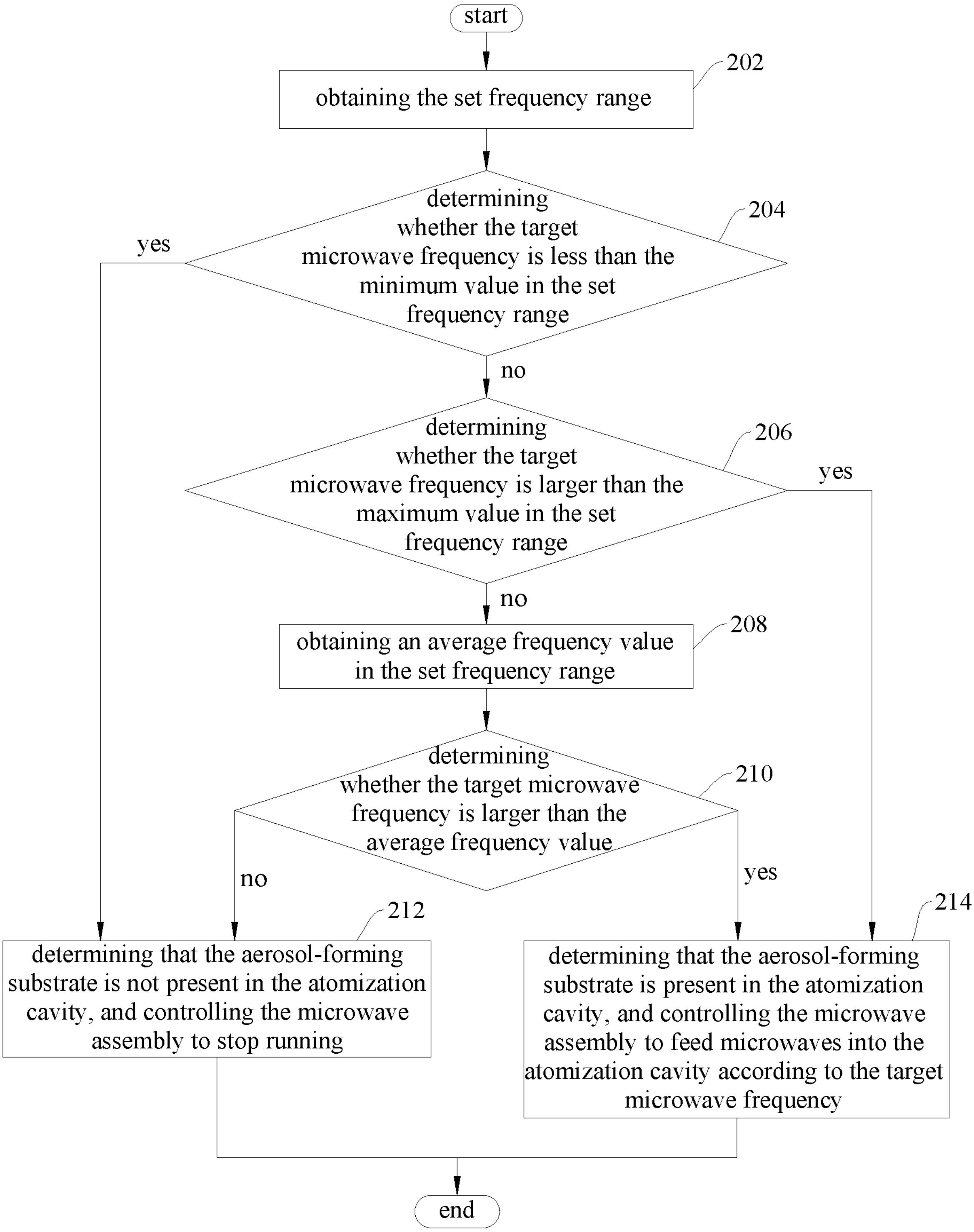
start
obtaining the set frequency range
202
determining whether the target microwave frequency is less than the minimum value in the set frequency range
204
yes
no
determining whether the target microwave frequency is larger than the maximum value in the set frequency range
206
yes
no
obtaining an average frequency value in the set frequency range
208
determining whether the target microwave frequency is larger than the average frequency value
210
no
yes
212
determining that the aerosol-forming substrate is not present in the atomization cavity, and controlling the microwave assembly to stop running
214
determining that the aerosol-forming substrate is present in the atomization cavity, and controlling the microwave assembly to feed microwaves into the atomization cavity according to the target microwave frequency
end

FIG. 2

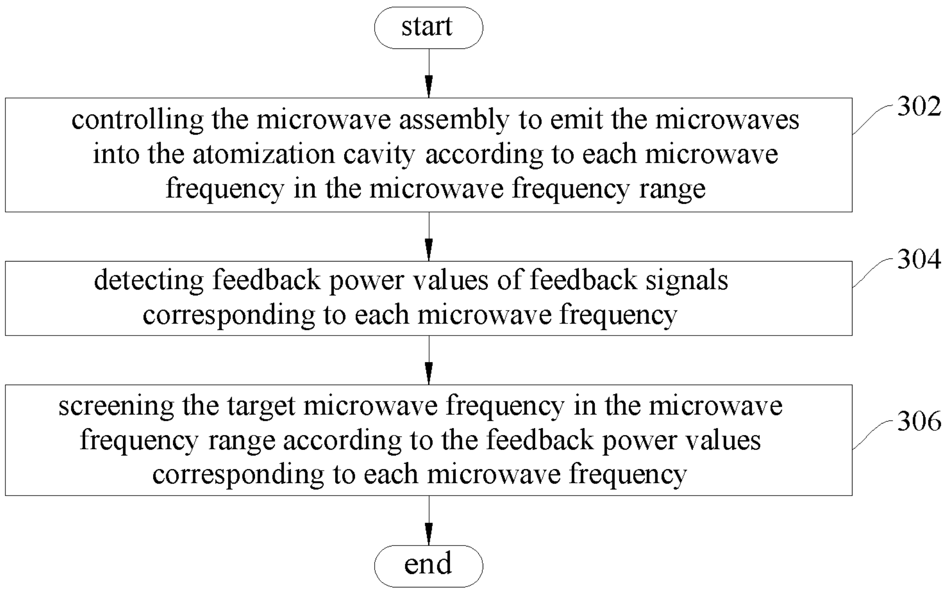
start
controlling the microwave assembly to emit the microwaves into the atomization cavity according to each microwave frequency in the microwave frequency range
302
detecting feedback power values of feedback signals corresponding to each microwave frequency
304
screening the target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency
306
end

FIG. 3

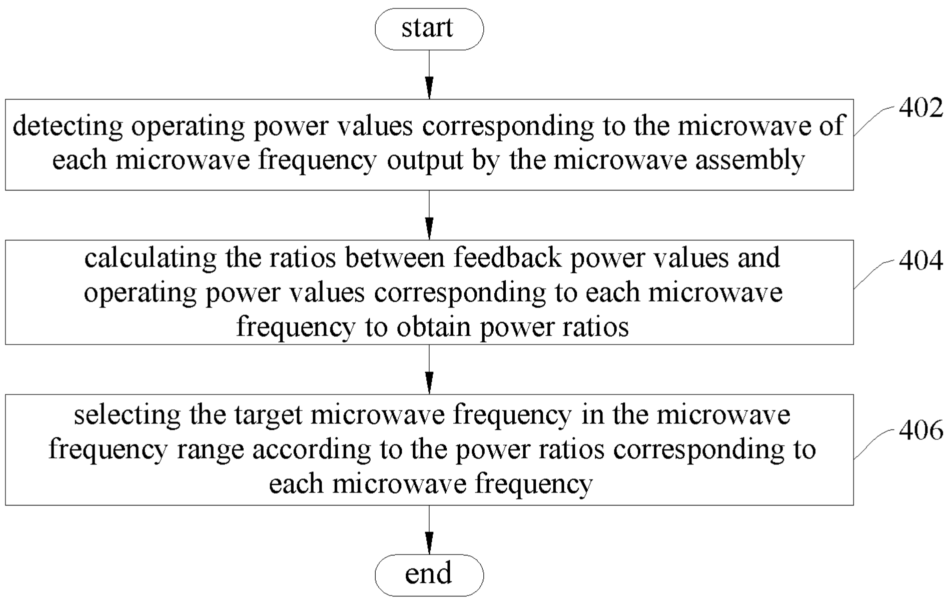
start
detecting operating power values corresponding to the microwave of each microwave frequency output by the microwave assembly
402
calculating the ratios between feedback power values and operating power values corresponding to each microwave frequency to obtain power ratios
404
selecting the target microwave frequency in the microwave frequency range according to the power ratios corresponding to each microwave frequency
406
end

FIG. 4

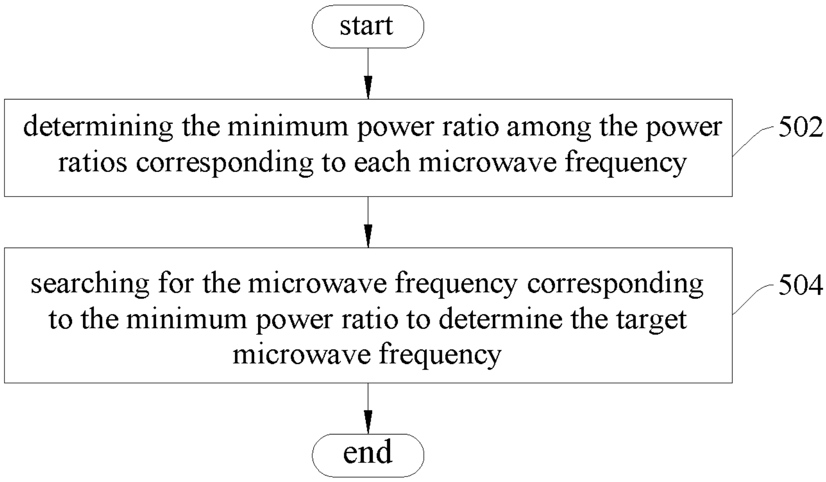
start
determining the minimum power ratio among the power ratios corresponding to each microwave frequency
502
searching for the microwave frequency corresponding to the minimum power ratio to determine the target microwave frequency
504
end

FIG. 5

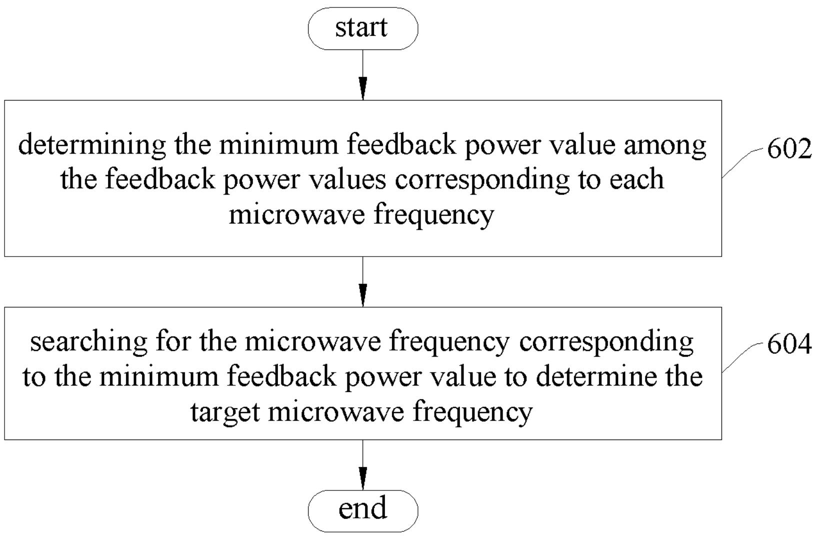
start
determining the minimum feedback power value among the feedback power values corresponding to each microwave frequency
602
searching for the microwave frequency corresponding to the minimum feedback power value to determine the target microwave frequency
604
end

FIG. 6

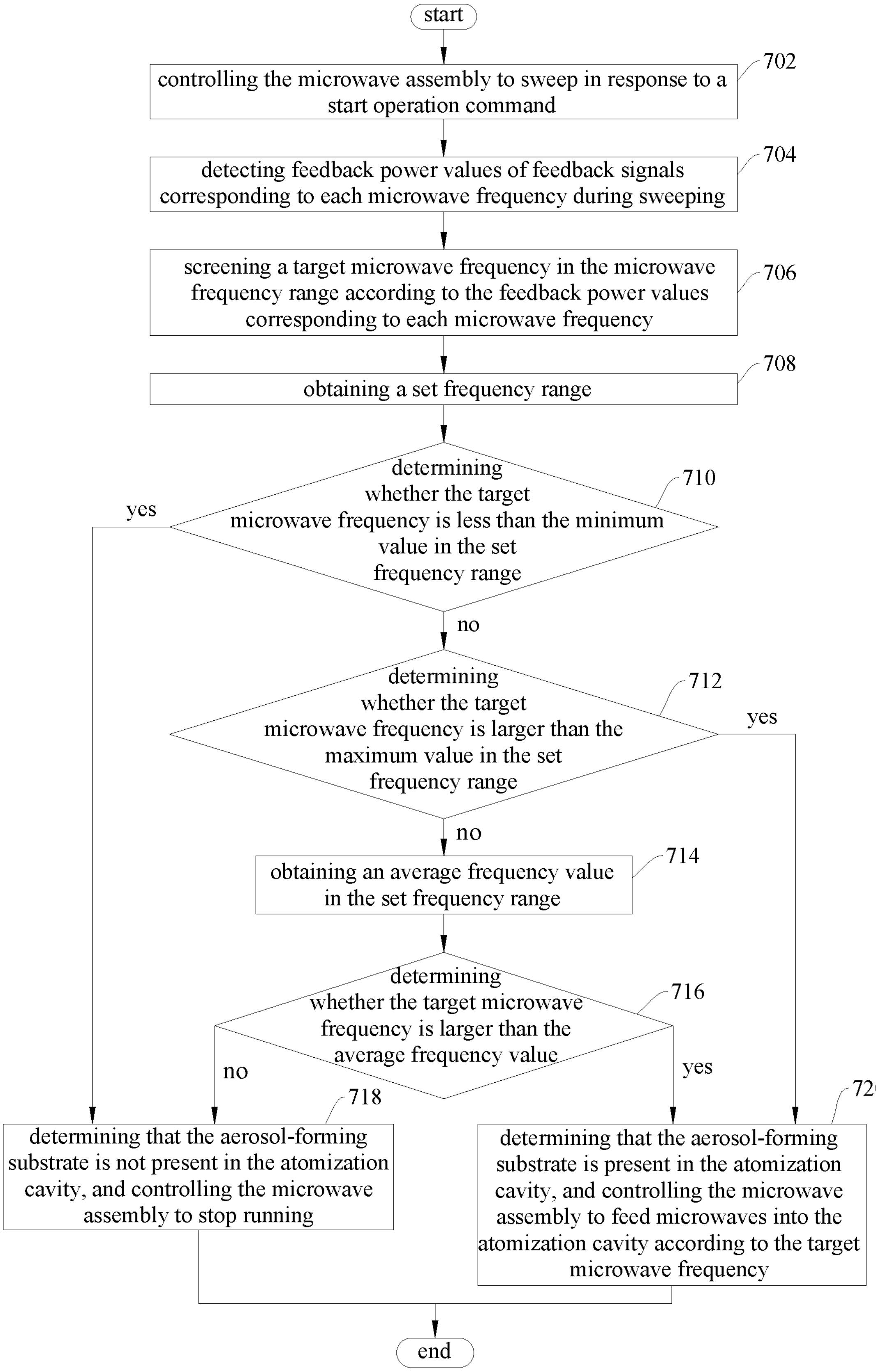
start
controlling the microwave assembly to sweep in response to a start operation command
702
detecting feedback power values of feedback signals corresponding to each microwave frequency during sweeping
704
screening a target microwave frequency in the microwave frequency range according to the feedback power values corresponding to each microwave frequency
706
obtaining a set frequency range
708
determining whether the target microwave frequency is less than the minimum value in the set frequency range
710
yes
no
determining whether the target microwave frequency is larger than the maximum value in the set frequency range
712
yes
no
obtaining an average frequency value in the set frequency range
714
determining whether the target microwave frequency is larger than the average frequency value
716
no
yes
718
720
determining that the aerosol-forming substrate is not present in the atomization cavity, and controlling the microwave assembly to stop running
determining that the aerosol-forming substrate is present in the atomization cavity, and controlling the microwave assembly to feed microwaves into the atomization cavity according to the target microwave frequency
end

FIG. 7

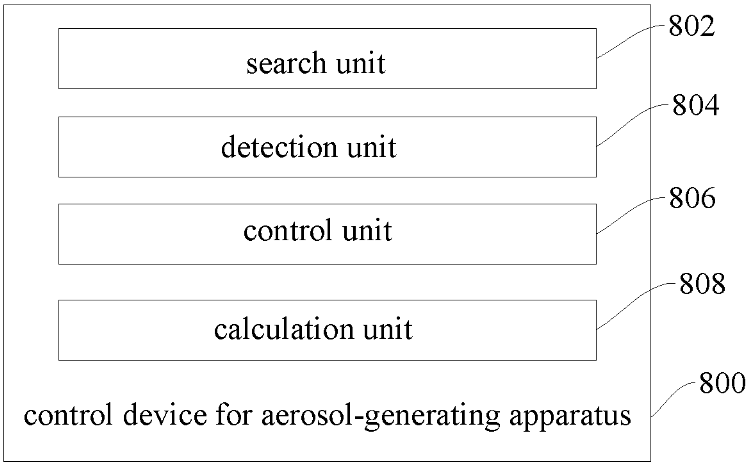
search unit
802
detection unit
804
control unit
806
calculation unit
808
control device for aerosol-generating apparatus
800

FIG. 8

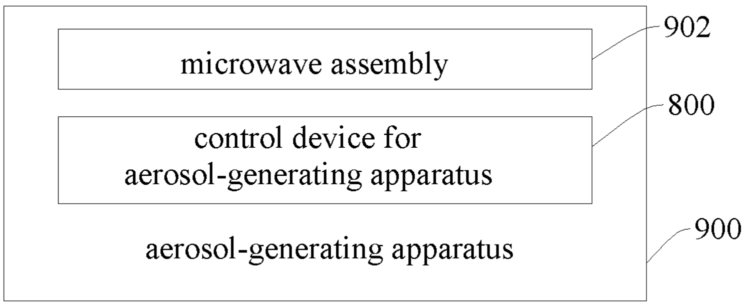
microwave assembly
902
control device for aerosol-generating apparatus
800
aerosol-generating apparatus
900

FIG. 9

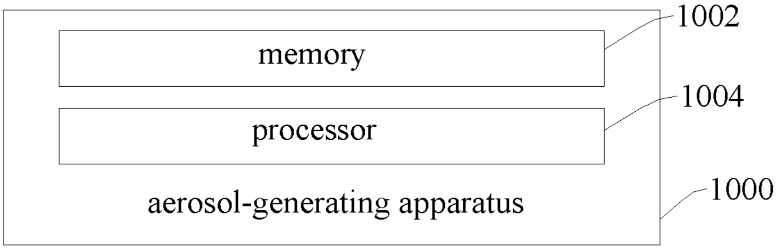
memory
processor
aerosol-generating apparatus
1002
1004
1000

FIG. 10

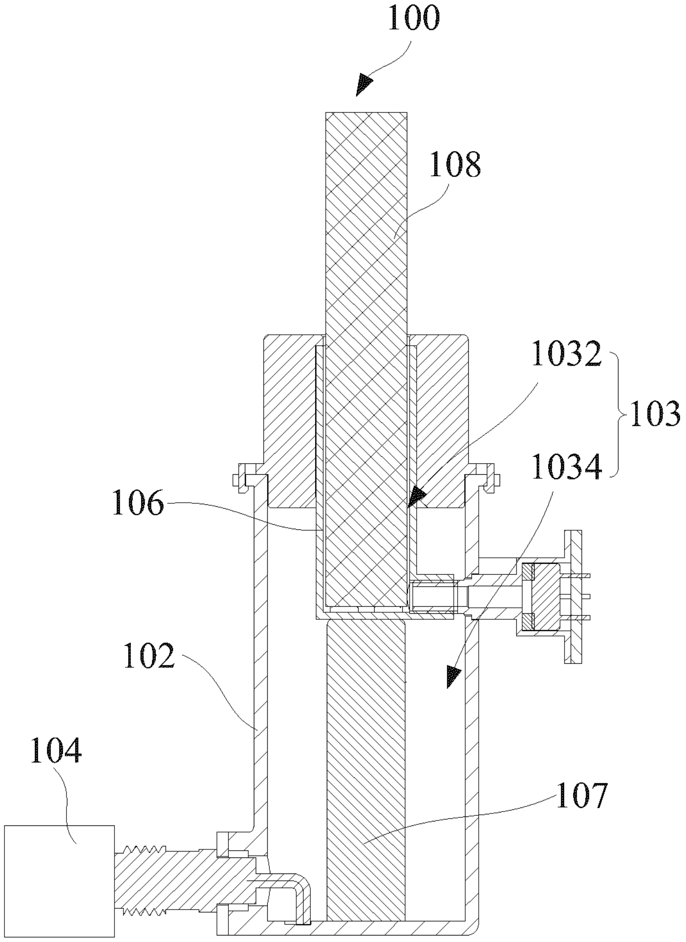
100
108
1032
103
1034
106
102
104
107

FIG. 11

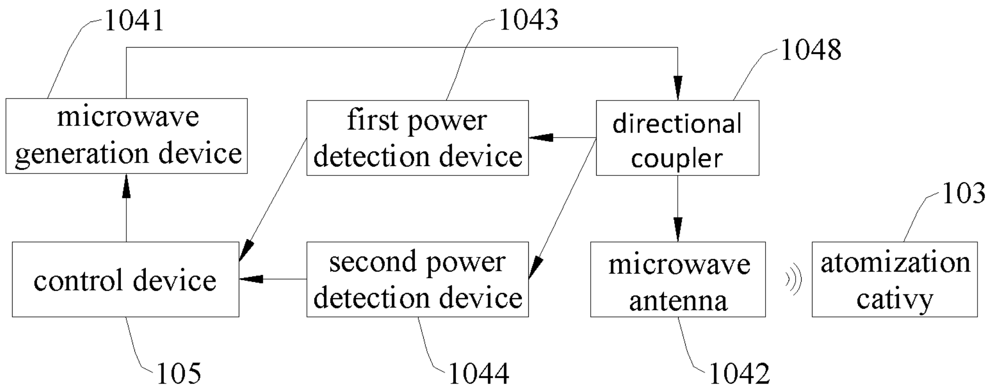
1041
1043
1048
microwave generation device
first power detection device
directional coupler
103
control device
second power detection device
microwave antenna
atomization cativy
105
1044
1042

FIG. 12

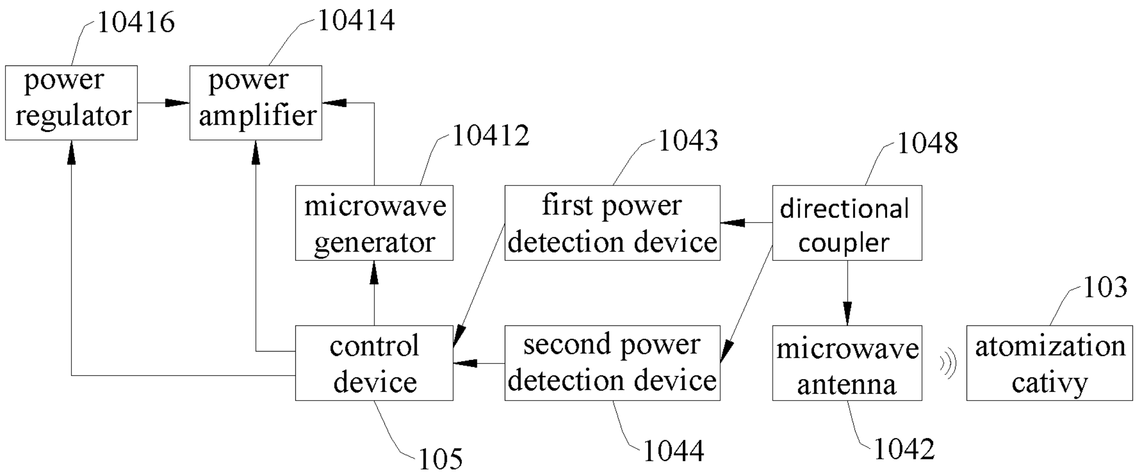
10416
10414
power regulator
power amplifier
10412
1043
1048
microwave generator
first power detection device
directional coupler
103
control device
second power detection device
microwave antenna
atomization cativy
105
1044
1042

FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/109223

A. CLASSIFICATION OF SUBJECT MATTER

A24F 40/40(2020.01)i；A24F 40/46(2020.01)i；A24F 40/50(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)

A24F 40/-; A24F 47/-

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)

CNKI, CNTXT, VEN: 电子烟, 气溶胶, 雾化, 加热, 控制, 微波, 频率, electronic, electrical, ciagr+, smoking, tobacco, aerosol, atomiz+, heat+, control+, microwave, frequency

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 112512351 A (KT & G CORPORATION) 16 March 2021 (2021-03-16) description, paragraphs 22-53 and 102, and figures 1-3	1-19
Y	CN 110088643 A (SHENZHEN MERRYTEK TECHNOLOGY CO., LTD.) 02 August 2019 (2019-08-02) description, paragraph 85	1-19
Y	CN 106115386 A (GUILIN JIUMA NEW POWER SCIENCE & TECHNOLOGY CO., LTD.) 16 November 2016 (2016-11-16) description, paragraphs 32-33	1-19
A	CN 108552613 A (CHINA TOBACCO YUNNAN INDUSTRIAL CO., LTD.) 21 September 2018 (2018-09-21) entire document	1-19
A	CN 113115998 A (SHENZHEN FIRST UNION TECHNOLOGY CO., LTD.) 16 July 2021 (2021-07-16) entire document	1-19
A	CN 111436665 A (CHINA TOBACCO YUNNAN INDUSTRIAL CO., LTD.) 24 July 2020 (2020-07-24) entire document	1-19

☑ 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
17 March 2022	**25 March 2022**

Name and mailing address of the ISA/CN	Authorized officer
China National Intellectual Property Administration (ISA/CN) **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China**	
Facsimile No. **(86-10)62019451**	Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/109223

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 20200079693 A (EM-TECH CO., LTD.) 06 July 2020 (2020-07-06) entire document	1-19
A	KR 20210071459 A (INNO-IT CO., LTD.) 16 June 2021 (2021-06-16) entire document	1-19
A	WO 2021090022 A1 (NICOVENTURES TRADING LTD.) 14 May 2021 (2021-05-14) entire document	1-19

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/109223

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	112512351	A	16 March 2021	WO	2020256292	A1	24 December 2020
				KR	20200144403	A	29 December 2020
				EP	3818848	A1	12 May 2021
				JP	2021531728	A	25 November 2021
CN	110088643	A	02 August 2019	CN	110088643	B	07 December 2021
				TW	202011053	A	16 March 2020
				TW	202012953	A	01 April 2020
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CN	108552613	A	21 September 2018	WO	2020015223	A1	23 January 2020
				CN	208798698	U	30 April 2019
CN	113115998	A	16 July 2021	WO	2021143838	A1	22 July 2021
CN	111436665	A	24 July 2020	CN	212590290	U	26 February 2021
KR	20200079693	A	06 July 2020	KR	102214675	B1	10 February 2021
KR	20210071459	A	16 June 2021		None		
WO	2021090022	A1	14 May 2021	GB	2589560	A	09 June 2021

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