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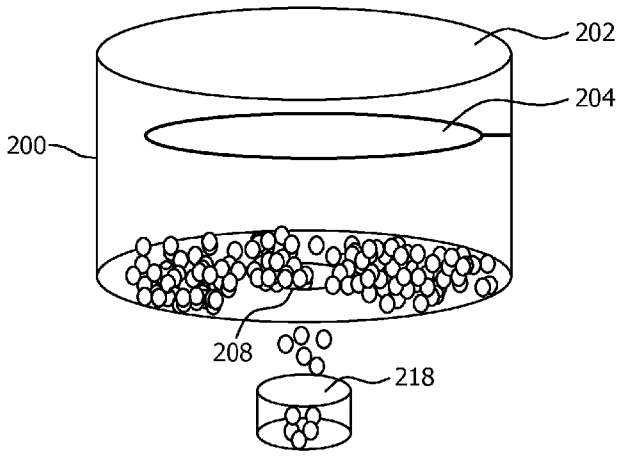


FIG. 2b

(57) Abstract: The present invention proposes an apparatus (100,200) for processing coffee beans, comprising a roasting chamber (102,202) configured to accommodate said coffee beans; a heating element (104,204), configured to roast said coffee beans in said roasting chamber (102,202) at a predetermined temperature; and a delivering element (108,208), configured to conditionally deliver different portions of said coffee beans out of said roasting chamber (102,202) through an outlet of said roasting chamber (102,202) at different times; wherein said coffee beans are inputted into said roasting chamber (102,202) at one time. The present invention also provides a method for roasting coffee beans using above described apparatus.

A METHOD AND APPARATUS FOR PROCESSING COFFEE BEANS

Field of the Invention

The present invention relates to coffee, and particularly to methods and apparatus for processing coffee beans.

Background of the Invention

Different tastes of coffee drinks include acidity, bitter, body, astringency, sweetness, and so forth may be resulted from different roasting levels of coffee beans. For example, the greater the time spent for roasting, the darker, the more full-bodied, and the more flavorful the resulted coffee drink would be.

Current home coffee roasters can only roast coffee beans inputted into the coffee roasters at one time to a single roasting level. This is not convenient for consumers with different roasting preferences. The fact is that consumers from various countries, at various ages and gender may have different taste preferences and roasting habits. The current solution to this problem is to roast coffee beans at different time and generate coffee beans of different roasting levels accordingly, which is time and energy consuming because heaters in such coffee roasters have to stop heating and cool down between the roasting of coffee beans inputted at different time.

Summary of the Invention

Because of the issues stated above, it would be advantageous to achieve a method and apparatus to roast coffee beans inputted into the apparatus at one time to various roasting levels.

One embodiment of the present application provides an apparatus for processing coffee beans comprising a roasting chamber configured to accommodate said coffee beans; a heating element, configured to roast said coffee beans in said roasting chamber at a predetermined temperature; and a delivering element, configured to conditionally deliver different portions of said coffee beans out of said roasting chamber through an outlet of said roasting chamber at different time; wherein said coffee beans are inputted into said roasting chamber at one time.

In this arrangement, different portions of coffee beans inputted into the roasting chamber at one time are roasted for different time periods, which automatically offers users coffee beans of various roasting levels without requirement for more operations than simply inputting desired roasting levels and amounts of coffee beans of each of the desired roasting levels.

Specifically, said outlet is on one side of said roasting chamber, and said delivering element is an lever attached to said roasting chamber configured to conditionally tip said roasting chamber and to pour said different portions of said coffee beans out through said outlet of said roasting chamber. Such arrangement takes advantage of gravity for outputting the coffee beans and is therefore energy efficient.

Specifically, said outlet is on bottom of said roasting chamber, and said delivering element is a door associated with said outlet of said roasting chamber configured to conditionally open and close said outlet to allow said different portions of said coffee beans drop out of said roasting beans. Such arrangement takes advantage of gravity for outputting the coffee beans and is therefore energy efficient.

Specifically, the apparatus further comprises a controlling element, configured to control operations of said delivering element based at least on any of roasting time, roasting temperature and/or desired roasting levels. Such arrangement provides more accuracy to determination of roasting levels.

Specifically, said controlling element is configured to control said different portions of said coffee beans to be delivered out of said roasting chamber by weighing said different portions of said coffee beans. Such arrangement provides more accuracy to the determination of roasting levels.

Specifically, the apparatus further comprises a resting chamber with an inlet coupled with said outlet of said roasting chamber configured to receive said different portions of said coffee beans from said roasting chamber, wherein said resting chamber comprises any of venting holes, fans, and/or vibrators configured to release heat and waste gas of said received coffee beans. Such arrangement helps to put the roasted coffee beans ready for further processes such as grinding or brewing.

Specifically, said heating element comprises any of a heating coil, a positive temperature coefficient (PTC) porcelain heating element, or an infrared lamp. Such arrangement offers many heating options to meet different roasting preferences.

Specifically, the apparatus comprises a grinding element with an inlet coupled with said

outlet of said roasting chamber, wherein said grinding element is configured to grind said coffee beans from said roasting chamber into coffee grounds; and further comprises a brewing element with an inlet coupled with an outlet of said grinding element, wherein said brewing element is configured to brew said coffee grounds into coffee drinks. By using such an apparatus, users' needs for coffee drinks of various flavors within very short time can be met.

Another embodiment of the present application provides an apparatus for processing coffee beans comprising a roasting chamber, configured to accommodate said coffee beans; a heating element, configured to roast said coffee beans in said roasting chamber at a predetermined temperature; and a plurality of holding elements, configured to hold said coffee beans, wherein said plurality of holding elements are positioned within said roasting chamber and are at different perpendicular distances from said heating element; wherein said coffee beans are inputted into the chamber at one time. In this arrangement, different portions of coffee beans inputted into the roasting chamber at one time are roasted for different time periods, which automatically offers users coffee beans of various roasting levels without requirement for more operations than simply inputting desired roasting levels and amounts of coffee beans of each of the desired roasting levels.

Specifically, said plurality of holding elements are arranged in a cascaded manner and perpendicular distance between said heating element and a most adjacent holding element ranges from 4 to 5 centimeters, and perpendicular distance between two adjacent holding elements ranges from 4 to 5 centimeters. A balance of roasting time and roasting levels may be achieved by using this arrangement.

Specifically, each of said plurality of holding elements is plate-shaped and comprises a plurality of holes, and area of each of said holes is not more than 9 square millimeters. Such arrangement can prevent coffee beans from falling off the holding elements.

Specifically, said heating element comprises any of a heating coil, a positive temperature coefficient (PTC) porcelain heating element, or an infrared lamp. Such arrangement offers many heating options based on different roasting preferences.

Specifically, the apparatus comprises a grinding element with an inlet coupled to an outlet of said roasting chamber, wherein said grinding element is configured to grind said coffee beans from said roasting chamber into coffee grounds; and further comprises a brewing element with an inlet coupled with an outlet of said grinding element, wherein said brewing element is configured to brew said coffee grounds into coffee drinks. By using such an

apparatus, users' needs for coffee drinks of various flavors within very short time can be met.

A further embodiment of the present application provides a method for roasting coffee beans comprising roasting said coffee beans in a chamber of a coffee machine at a predetermined temperature; monitoring, by said coffee machine, roasting time and/or roasting temperature of said coffee beans; and delivering, by the coffee machine, different portions of said coffee beans out of said chamber of said coffee machine to complete said roasting at different time based at least on results of said monitoring and/or desired roasting levels wherein said coffee beans are inputted into the chamber at one time. In this arrangement, different portions of coffee beans inputted into the roasting chamber at one time are roasted for different time periods, which automatically offers users coffee beans of various roasting levels without requirement for more operations than simply inputting desired roasting levels and amounts of coffee beans of each of the desired roasting levels.

Specifically, the method further comprises determining said different portions of said coffee beans to be delivered by weighing said different portions of said coffee beans. Such arrangement provides more accuracy to determination of roasting levels.

Brief Description of the Drawings

The above and other objects and features of the present invention will become more apparent from the following detailed description considered in connection with the accompanying drawings, in which:

FIG. 1 (a) and (b) show an apparatus for roasting coffee beans in accordance with one embodiment of the present invention;

FIG. 2 (a) and (b) show another apparatus for roasting coffee beans in accordance with another embodiment of the present invention;

FIG. 3 shows yet another apparatus roasting coffee beans in accordance with yet another embodiment of the present invention;

FIG. 4 shows an apparatus for processing coffee beans in accordance with one embodiment of the present invention; and

FIG. 5 is a flowchart of a method for roasting coffee beans in accordance with one embodiment of the present invention.

Detailed Description of Embodiments

Reference will now be made to embodiments of the invention, one or more examples of which are illustrated in the figures. The embodiments are provided by way of explanation of the invention, and are not meant as a limitation of the invention. For example, features illustrated or described as part of one embodiment may be used with another embodiment to yield still a further embodiment. It is intended that the invention encompass these and other modifications and variations as come within the scope and spirit of the invention.

FIG. 1(a) and (b) illustrate an apparatus 100 for roasting coffee beans in accordance with one embodiment of the present application. Coffee beans may be inputted into a roasting chamber 102 of apparatus 100 at one time. Container 102 may be made of glass, metal, plastic or other materials with good thermal stability and can endure high temperature.

Apparatus 100 may also comprise a heating element 104 configured to roast coffee beans at a predetermined temperature which may be around or higher than 180 degrees Celsius, such as 177, 180, 198 or 200 degrees Celsius which may be preferred because a moderate time period for roasting may be allowed to more accurately control the roasting levels of the coffee beans. The predetermined temperature may be selected based on types of coffee beans, desired roasting levels and so forth. Heating element 104 may be a physical heating element positioned within or outside roasting chamber 102. In one embodiment, heating element 104 may be a heating coil, an induction heating element made of metallic material, a positive temperature coefficient (PTC) porcelain heating element, or an infrared lamp. In other embodiments, heating element 104 may be heated air flow.

Apparatus 100 may have an inlet and/or outlet 106 for inputting and outputting coffee beans. In one embodiment, the inlet and outlet may be the same opening illustrated as 106. In another embodiment, the inlet may be separate from outlet 106.

Apparatus 100 may further include a delivering element 108 (not shown in FIG. 1) to deliver coffee beans of different roasting levels out of roasting chamber 102 at different time. In one embodiment, delivering element 108 may be a lever attached to roasting chamber 102, for example attached to the bottom floor of roasting chamber 102, to conditionally tip roasting chamber 102 to pour a portion of the roasted coffee beans out of roasting chamber 102, as shown in FIG 1(b).

Apparatus 100 may further include a controlling element 110 (not shown in FIG. 1) configured to control operations of delivering element 108. In one embodiment, controlling

element 110 may receive instructions from users regarding desired roasting levels and amounts of coffee beans to be roasted corresponding to each of the desired roasting levels. In one embodiment, controlling element 110 may determine the actual roasting level of coffee beans based at least on roasting time, roasting temperature and/or ambient conditions in roasting chamber 102. In one embodiment, controlling element 110 may be configured to determine a corresponding amount of coffee beans to be delivered out of roasting chamber 102 by weighing the coffee beans. In one embodiment, controlling element 110 may instruct the lever to tip when a desired roasting level is achieved and let the determined corresponding amount coffee beans out of roasting chamber 102.

Controlling element 110 may be a micro processor or other units configured to perform the above described controlling operations.

In one embodiment, apparatus 100 may further include a thermometer 112 (not shown in FIG. 1) configured to measure roasting temperature of the coffee beans and a timer 114 (not shown in FIG. 1) configured to measure roasting time of the coffee beans, and hygrometer 116 (not shown in FIG. 1) configured to measure relative humidity in roasting chamber 102.

In one embodiment, apparatus 100 may further include a resting chamber 118 with an inlet coupled with outlet 106 of roasting chamber 102 configured to receive coffee beans delivered out of roasting chamber 102. In one embodiment, resting chamber 118 may comprise any of venting holes, fans, and/or vibrators configured to release heat and waste gas from the coffee beans.

Figure 2(a) and (b) illustrate apparatus 200 for roasting coffee beans according to another embodiment of the present application. Apparatus 200 may include a roasting chamber 202 configured to accommodate coffee beans inputted at one time, a heating element 204, a thermometer 212, a timer 214, a hygrometer 216, and a resting chamber 218 that may be the same as 102, 104, 112, 114, 116, and 118 of apparatus 100. Similar to apparatus 100, apparatus 200 may also include a delivering element 208, except that delivering element 208 may be an opening covered with a retractable door(s) on the bottom floor of roasting chamber 202.

Apparatus 200 may further include a controlling element 210 configured to control delivering element 208. Controlling element 210 may have similar functions to controlling element 110, except that controlling element 210 may control status of the retractable door(s) of delivering element 208 based at least on users' instructions, roasting time, roasting

temperature, and/or ambient condition in roasting chamber 202. As shown in Figure 2(b), controlling element 210 may instruct the retractable door(s) of delivering element 208 to open when one of the desired roasting levels is achieved, in order to let a corresponding amount of coffee beans fall out of roasting chamber 202. In one embodiment, controlling element 210 may be configured to determine a corresponding amount of coffee beans to be delivered out of roasting chamber 202 by weighing the coffee beans.

Besides above described exemplary structures, there may be other structures for achieving the same function. For example, delivering element 108 or 208 may be a rotatable stick attached to the bottom floor of roasting chamber 102 or 202. When a desired roasting level is achieved, controlling element 110 or 120 may be configured to instruct the stick to rotate and drive a corresponding amount of coffee beans out of roasting chamber 102 or 202.

In other example, roasting chamber 102 or 202 may be a rotatable drum-like container that having a horizontal central axis. Delivering element 108 or 208 may be configured to let different portions of the coffee beans fall out of roasting chamber 102 or 202 as described above even when roasting chamber 102 and 202 is still rotating.

Figure 3 illustrates an apparatus 300 for roasting coffee beans in accordance with a further embodiment of the present application. Apparatus 300 may also include a roasting chamber 302 configured to accommodate coffee beans inputted at one time and a heating element 304, which may be the same as heater 104 of apparatus 100, configured to roast coffee beans in chamber 302.

Apparatus 300 may further include a plurality of holding elements, for example 306a, 306b and 306c as illustrated in FIG. 3. Holding elements 306a, 306b and 306c may be positioned within roasting chamber 302 and at different perpendicular distances from heating element 304. Therefore, coffee beans held by holding elements 306a, 306b and 306c may be of different roasting levels even being roasted for the same period of time, due to the various distance from heating element 304.

In one embodiment, holding elements 306a, 306b and 306c may be arranged in a cascaded manner and the perpendicular distance between heating element 304 and holding element 306a may be 4 to 5 centimeters, and the perpendicular distance between holding element 306a and 306b, and 306b and 306c may be 4 to 5 centimeters.

In one embodiment, holding elements 306a and 306b, and 306b and 306c may be plate-shaped and may have a plurality of small holes. In one embodiment, area of each of

the holes is not more than 9 square millimeters. In one embodiment, holding element 306a and 306b, and 306b and 306c may be made of any materials with good thermal stability and can endure high temperature.

In one embodiment, apparatus 300 may include an outlet (not shown in FIG. 3) for outputting the roasted coffee beans.

In operation, coffee beans in apparatus 300 may be roasted at a predetermined temperature for a predetermined period of time. Due to the different distances between heater 304 and holding elements 306a, 306b and 306c, the coffee beans held by 306a, 306b and 306c may be roasted to different roasting levels. In one embodiment, the distances between heater 304 and holding 306a, 306b and 306c may be adjustable in order to achieve desired roasting levels. The predetermined temperature may be selected based on types of coffee beans, desired roasting levels and so forth. The predetermined temperature may be around or higher than 180 degrees Celsius, such as 177, 180, 198 or 200 degrees Celsius which may be preferred because a moderate time period for roasting may be allowed to more accurately control the roasting levels of the coffee beans.

FIG. 4 illustrates apparatus 400 for processing coffee beans in accordance another embodiment of the present application. Apparatus 400 may comprise a roasting unit 402 same as 100, 200 or 300 which may be able to produce coffee beans of various roasting levels. Apparatus 400 may also comprise a grinding unit 404 having an inlet coupled with the outlet of apparatus 100, 200 or 300 and configured to receive roasted coffee beans from roasting unit 402 and grind the roasted coffee beans into coffee grounds. Apparatus may further comprise a brewing unit 406 having an inlet coupled with an outlet of grinding unit 404 and configured to receive coffee grounds from grinding unit 404 and brew the coffee grounds into coffee drinks, and a controlling unit 408 configured to control the operations of 402, 404, and 406.

FIG. 5 illustrates a method for roasting coffee beans inputted into roasting chamber 102 or 202 at one time in accordance with one embodiment of the present application. At block 502, apparatus 100 or 200 may be configured to roast coffee beans in roasting chamber 102 or 202 at a predetermined temperature for example around or higher than 180 degrees Celsius, such as 177, 180, 198 or 200 degrees Celsius may be preferred because a moderate time period for roasting may be allowed to more accurately control the roasting levels of the coffee beans. The predetermined temperature may be selected based on types of coffee beans, desired roasting levels and so forth.

At block 504, timer 114 or 214 and thermometer 112 or 212 may be configured to measure roasting time and roasting temperature of the coffee beans in roasting chamber 102 or 202, and may be configured to provide such data to controlling element 110 or 210.

At block 506, controlling element 110 or 210 may be configured to instruct delivering element 108 or 208 to deliver a corresponding amount of the coffee beans out of roasting chamber 102 or 202 according to instructions from users.

In one embodiment, operation taken at block 506 may be repeated when there are instructions for producing coffee beans of different roasting levels or for providing coffee drinks of various flavors. In one embodiment, at block 506 controlling element 110 or 210 may also be configured to weigh the coffee beans to determine the amount to be delivered out.

Exemplary data of coffee beans prepared using the above method are presented in Table 1, wherein the color of coffee beans surface are defined according to the color theory by Hunter Lab (http://www.hunterlab.com/ColorEducation/ColorTheory).

Roasting level	Roasting temperature (℃)	Roasting time (minute)	Color of coffee bean surface by Hunter Lab (instrument)
light	177.4 ℃	6:40	41.13
medium	180 ℃	7:29	38.58
dark	198.1℃	9:04	37.29

Table 1

It should be noted that the above described embodiments are given for describing rather than limiting the invention, and it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention as those skilled in the art readily understand. Such modifications and variations are considered to be within the scope of the invention and the appended claims. The protection scope of the invention is defined by the accompanying claims. In addition, any of the reference numerals in the claims should not be interpreted as a limitation to the claims. Use of the verb “comprise” and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The indefinite article “a” or “an” preceding an element or step does not exclude the presence of a plurality of such elements or steps.

What is claimed is:

1. An apparatus for processing coffee beans, comprising:

a roasting chamber configured to accommodate said coffee beans;

a heating element, configured to roast said coffee beans in said roasting chamber at a predetermined temperature ; and

a delivering element, configured to conditionally deliver different portions of said coffee beans out of said roasting chamber through an outlet of said roasting chamber at different time;

wherein said coffee beans are inputted into said roasting chamber at one time.

2. The apparatus of claim 1, wherein said outlet is on one side of said roasting chamber, and said delivering element is an lever attached to said roasting chamber configured to conditionally tip said roasting chamber and to pour said different portions of said coffee beans out through said outlet of said roasting chamber.

3. The apparatus of claim 1, wherein said outlet is on bottom of said roasting chamber, and said delivering element is a door associated with said outlet of said roasting chamber configured to conditionally open and close said outlet to allow said different portions of said coffee beans drop out of said roasting chamber.

4. The apparatus of claim 1, 2 or 3 further comprises a controlling element, configured to control operations of said delivering element based at least on any of roasting time, roasting temperature and/or desired roasting levels.

5. The apparatus of claim 1, 2 or 3, wherein said controlling element is configured to control said different portions of said coffee beans to be delivered out of said roasting chamber by weighing said different portions of said coffee beans.

6. The apparatus of claim 1 further comprises a resting chamber with an inlet coupled with said outlet of said roasting chamber configured to receive said different portions of said coffee beans from said roasting chamber, wherein said resting chamber

comprises any of venting holes, fans, and/or vibrators configured to release heat and waste gas of said received coffee beans.

7. The apparatus of claim 1, wherein said heating element comprises any of a heating coil, a positive temperature coefficient (PTC) porcelain heating element, or an infrared lamp.

8. The apparatus of claim 1 further comprises a grinding element with an inlet coupled with said outlet of said roasting chamber, wherein said grinding element is configured to grind said coffee beans from said roasting chamber into coffee grounds; and further comprises a brewing element with an inlet coupled with an outlet of said grinding element, wherein said brewing element is configured to brew said coffee grounds into coffee drinks.

9. An apparatus for processing coffee beans, comprising:

a roasting chamber, configured to accommodate said coffee beans; and

a heating element, configured to roast said coffee beans in said roasting chamber at a predetermined temperature ; and

a plurality of holding elements, configured to hold said coffee beans, wherein said plurality of holding elements are positioned within said roasting chamber and are at different perpendicular distances from said heating element;

wherein said coffee beans are inputted into the roasting chamber at one time.

10. The apparatus of claim 9, wherein said plurality of holding elements are arranged in a cascaded manner and perpendicular distance between said heating element and a most adjacent holding element ranges from 4 to 5 centimeters, and perpendicular distance between two adjacent holding elements ranges from 4 to 5 centimeters.

11. The apparatus of claim 9, wherein each of said plurality of holding elements is plate-shaped and comprises a plurality of holes, and area of each of said holes is not more than 9 square millimeters.

12. The apparatus of claim 9, wherein said heating element comprises any of a heating coil, a positive temperature coefficient (PTC) porcelain heating element, or an infrared lamp.

13. The apparatus of claim 9 further comprises a grinding element with an inlet coupled to an outlet of said roasting chamber, wherein said grinding element is configured to grind said coffee beans from said roasting chamber into coffee grounds; and further comprises a brewing element with an inlet coupled with an outlet of said grinding element, wherein said brewing element is configured to brew said coffee grounds into coffee drinks.

14. A method for roasting coffee beans, comprising:

roasting said coffee beans in a chamber of a coffee machine at a predetermined temperature ;

monitoring, by said coffee machine, roasting time and/or roasting temperature of said coffee beans; and

delivering, by the coffee machine, different portions of said coffee beans out of said chamber of said coffee machine to complete said roasting at different time based at least on results of said monitoring and/or desired roasting levels;

wherein said coffee beans are inputted into the chamber at one time.

15. The method of claim 14 further comprises determining said different portions of said coffee beans to be delivered by weighing said different portions of said coffee beans.

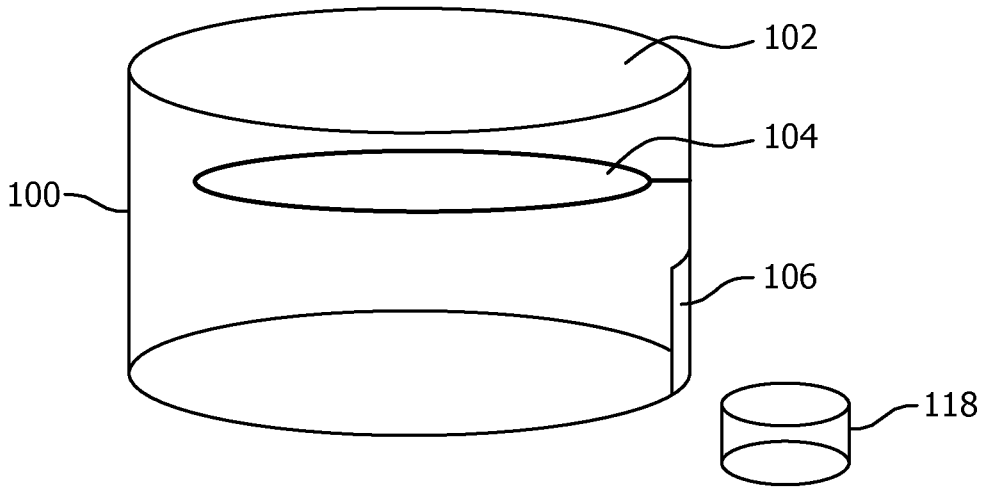


FIG. 1a

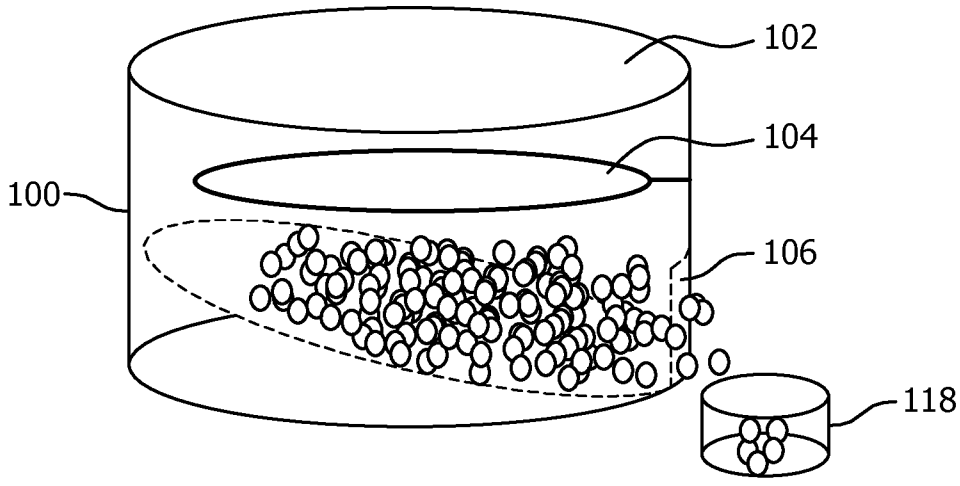


FIG. 1b

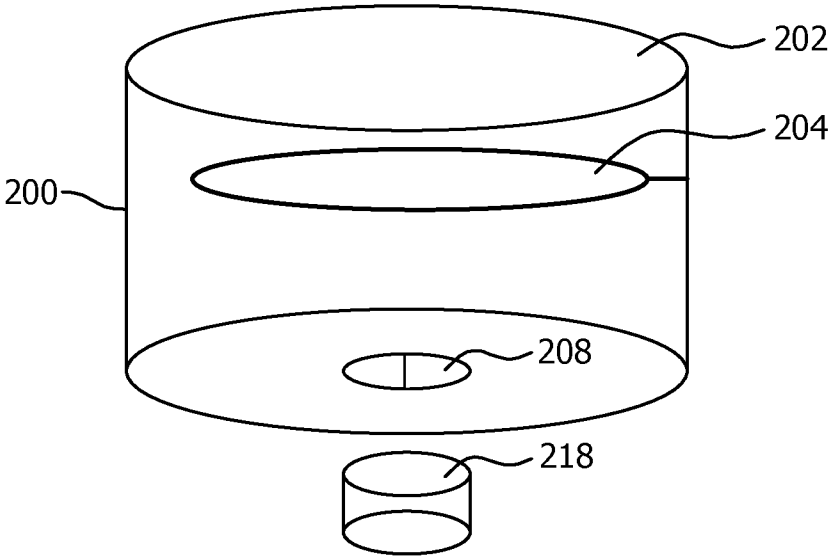


FIG. 2a

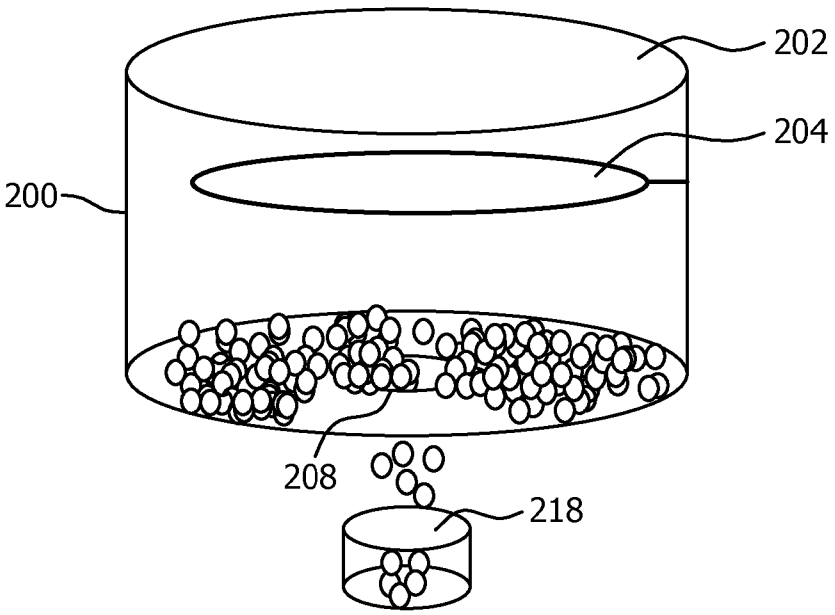


FIG. 2b

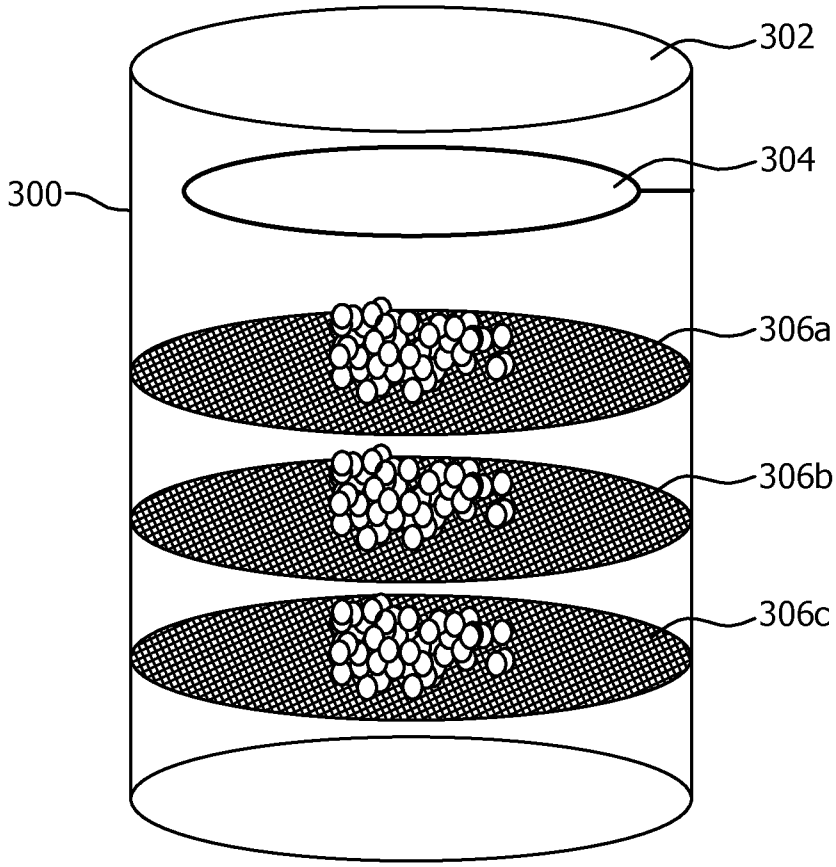


FIG. 3

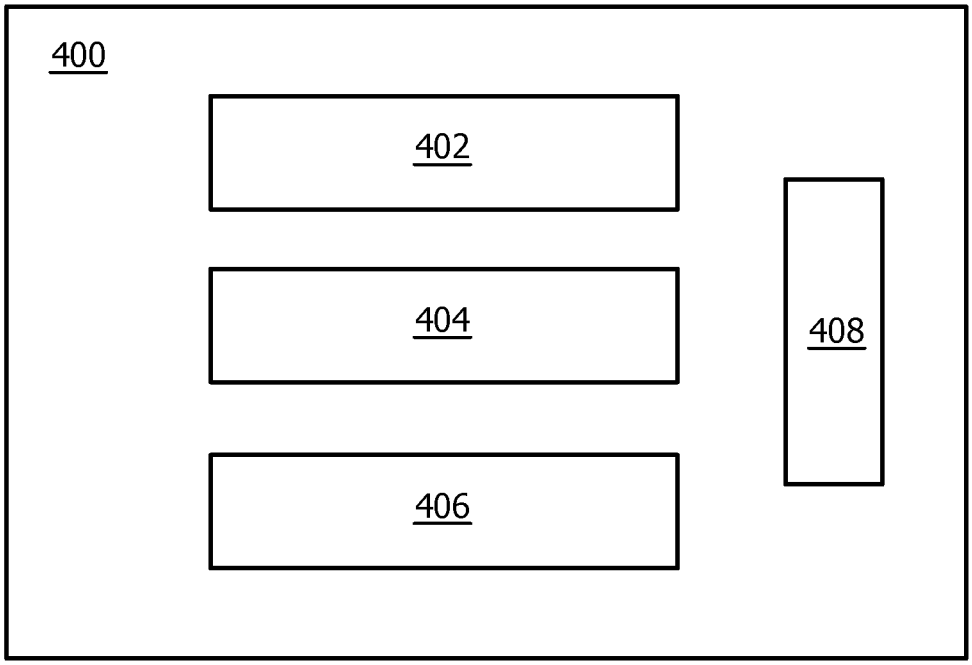


FIG. 4

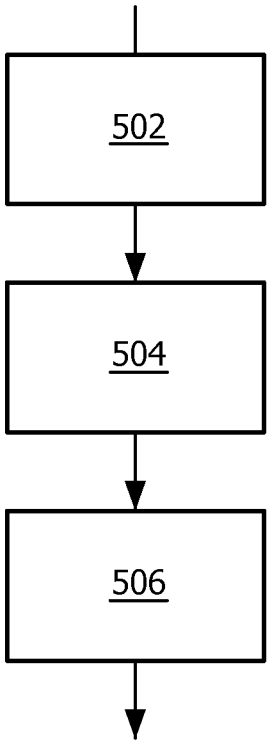


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/062340

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23N12/08 A47J31/42 A23F5/04
ADD.

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)
A23N A47J A23F

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 213 645 A1 (INNOVI NV SA [BE]) 11 March 1987 (1987-03-11) column 1, line 36 - column 3, line 11; claims 1,2,6; figures 1,3	1,3,4,8, 14
X	US 3 149 976 A (SMITH JR JOSEPH L) 22 September 1964 (1964-09-22) column 1, line 50 - column 3, line 9; figures 1-3 column 4, line 43 - line 51	1,3,4,9, 14
X	US 2 906 193 A (MCCAULEY RAYMOND E) 29 September 1959 (1959-09-29) column 3, line 10 - column 4, line 60; claim 1; figure 1	1,4,5,7, 8,14,15

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
24 September 2014	06/10/2014

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INTERNATIONAL SEARCH REPORT

International application No
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