

(19)



(11)

EP 4 111 890 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.01.2023 Bulletin 2023/01

(51) International Patent Classification (IPC):
A24F 40/51 ^(2020.01) **A24F 40/53** ^(2020.01)

(21) Application number: **21183228.2**

(52) Cooperative Patent Classification (CPC):
A24F 40/60; A24F 40/53; A24F 40/10

(22) Date of filing: **01.07.2021**

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

(71) Applicant: **JT International SA**
1202 Geneva (CH)

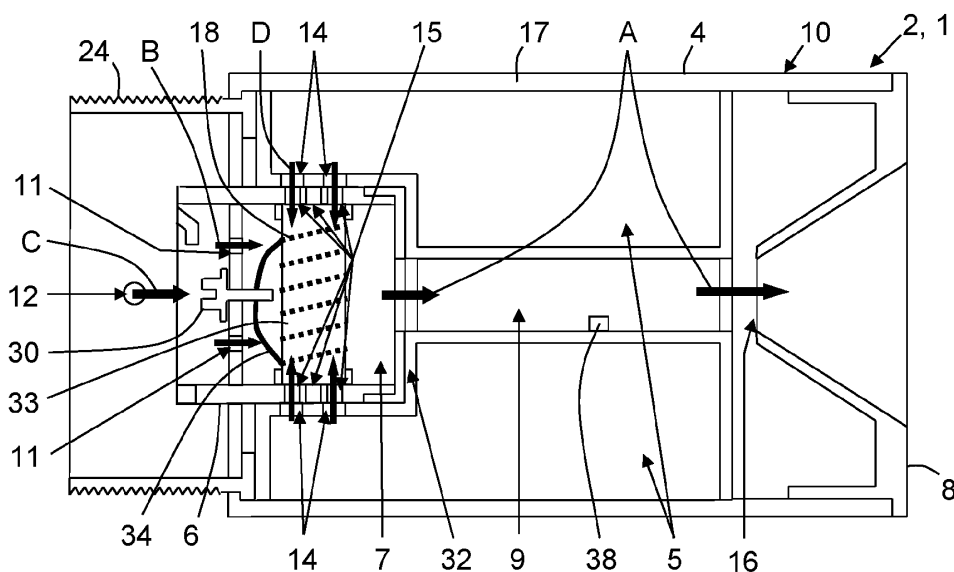
(72) Inventor: **POPOOLA, Olayiwola Olamiposi**
WALTON-ON-THAMES, KT12 2SJ (GB)

(74) Representative: **Serjeants LLP**
Dock
75 Exploration Drive
Leicester, LE4 5NU (GB)

(54) **AEROSOL GENERATION DEVICE ALERTING OF A FORTHCOMING CAPILLARY ELEMENT DRYING**

(57) An aerosol generation device (1) comprises:
- a reservoir (5) storing an aerosol-forming liquid,
- a heater (18) arranged, when supplied with electrical power, for heating this aerosol-forming liquid to induce generation of an aerosol that can be inhaled by a user during a puff, and
- an electrical and control device comprising a controller arranged for controlling electrical power supply to this heater (18) and, after each puff, for estimating a first

quantity of aerosol-forming liquid consumed from at least an electrical power supplied to the heater (18), a puff duration and a flow rate of the generated aerosol, and a second quantity remaining in the reservoir (5) by subtracting the estimated first quantity from the last second quantity remaining before the puff, and for triggering an alert for the user when this estimated second quantity is smaller than a chosen threshold.

**FIG.2****EP 4 111 890 A1**

Description

Field of the invention

[0001] The present invention relates to an aerosol generation device, and more precisely to the estimation of the aerosol-forming liquid remaining in the reservoir of an aerosol generation device during a vaping session.

Background

[0002] The invention concerns aerosol generation devices comprising a reservoir storing an aerosol-forming liquid, a heater and an electrical and control device, and often named "E-vapor devices".

[0003] Generally the electrical and control device comprises at least:

- a power source, possibly a rechargeable battery, storing electrical energy,
- a controller (or control device) electrically coupled to the power source and controlling electrical power supply to the heater at least during a vaping session (and possibly during a charging session), and
- optionally, a user interface coupled to this controller and allowing a user to control the controller, at least to switch on the aerosol generation device.

[0004] The heater is arranged, when it is supplied with electrical power, for heating the aerosol-forming liquid originating from the reservoir, generally via a capillary element (for instance a capillary wick), to induce generation of an aerosol that can be inhaled by a user during successive puffs (or inhalation phases) of a vaping session.

[0005] During each puff of a vaping session a small quantity of aerosol-forming liquid is consumed for producing the aerosol inhaled by the user, and therefore the quantity of aerosol-forming liquid remaining in the reservoir keeps decreasing. When the remaining quantity becomes very low, the capillary element does not receive enough aerosol-forming liquid and therefore starts drying and finally may burn. So, the user may feel a dry-capillary element sensation or even a burnt-capillary element sensation that may be unpleasant and possibly irritating or harmful.

[0006] To avoid drying of the capillary element the controller generally starts a countdown of the successive puffs obtained since the reservoir is full in the aerosol generation device, and when the remaining number of puffs becomes smaller than a threshold, depending on the maximal number of puffs that a user may have with the full reservoir, the controller triggers an alert for the user. This maximal number of puffs is determined in a laboratory under controlled conditions and all the puffs are considered to be the same. But in real use all these controlled conditions are not present for every puff and therefore the number of puffs with a full reservoir will vary

widely due to the aerosol generation device, the power source (battery), the heater, and environmental and human factors. This means that the real number of puffs that a user may have with the full reservoir is often different from the maximal number of puffs predetermined for this full reservoir, and therefore the user is often alerted too early or too late.

[0007] It has been also proposed in the patent document EP-A1 2468116 to configure the controller of the electrical and control device in order that it estimates after each puff a first quantity of aerosol-forming liquid consumed, and a second quantity remaining in the reservoir by subtracting the estimated first quantity from the last second quantity remaining before this puff. The second quantity is estimated by means of a complex model that is fed with measures of the current temperature or resistance of the heater element. But, this complex model has been determined in a laboratory under controlled conditions, and in practice the estimation of the second quantity is not accurate enough and therefore the user may sometimes be alerted too early or too late.

[0008] So, an object of this invention is to improve the situation, and notably to allow an accurate estimation of the quantity of aerosol-forming liquid remaining in the reservoir after each puff (or inhalation phase).

Summary of the invention

[0009] The proposed invention provides notably an embodiment of an aerosol generation device comprising:

- a reservoir storing an aerosol-forming liquid,
- a heater arranged, when supplied with electrical power, for heating the aerosol-forming liquid to induce generation of an aerosol that can be inhaled by a user during a puff, and
- an electrical and control device comprising a controller arranged for controlling electrical power supply to this heater and, after each puff, for estimating a first quantity of aerosol-forming liquid consumed, and a second quantity remaining in the reservoir by subtracting the estimated first quantity from a last second quantity remaining before this puff.

[0010] This aerosol generation device is characterized in that its controller is arranged after each puff for estimating the first quantity from at least an electrical power supplied to the heater, a puff duration and a flow rate of the generated aerosol, and for triggering an alert for the user when the estimated second quantity is smaller than a chosen threshold.

[0011] Thanks to the invention, a real time and accurate estimation of the quantity of aerosol-forming liquid remaining in the reservoir is obtained after each puff, and therefore the user may be alerted just before the capillary element starts drying.

[0012] The embodiment of aerosol generation device may comprise other aspects or features, considered sep-

arately or combined, and notably:

- the electrical and control device may comprise an electrical circuit arranged for estimating the electrical power supplied to the heater during each puff;
- the electrical and control device may comprise a puff sensor arranged for detecting when the user inhales during a puff, and for informing the controller each time such a detection starts and ends. In this embodiment, the controller may be arranged for determining the puff duration from a time interval between a puff start detection and a puff end detection;
- it may comprise an aerosol path through which the generated aerosol flows when the user sucks in via an aerosol outlet, and a pressure sensor set in this aerosol path and arranged for estimating a pressure drop during a puff and for providing this estimated pressure drop to the controller. In this embodiment, the controller may be arranged for estimating the generated aerosol flow rate from the estimated pressure drop;
- the controller may be arranged for estimating the first quantity from a result of the estimated electrical power supplied to the heater multiplied by the estimated puff duration multiplied by the estimated generated aerosol flow rate;
- the controller may be arranged after each puff for estimating the first quantity from also an ambient temperature and/or a puff start temperature and/or an orientation of the aerosol generation device during the puff and/or a ratio of quantities of two different constituents of the aerosol-forming liquid;
- the controller may be arranged, when it is informed of a predetermined quantity of aerosol-forming liquid stored in the reservoir when it is full, for estimating the second quantity remaining in the reservoir after a puff by subtracting a sum of every first quantity estimated since a first puff with the full reservoir from the predetermined quantity;
- it may comprise a cartomizer comprising a body mechanically and electrically coupled to the electrical and control device and comprising the reservoir, the heater, an aerosol chamber in which the aerosol is generated, at least one air inlet set upstream of this aerosol chamber and in fluid communication therewith, and an aerosol outlet set downstream of this aerosol chamber and in fluid communication therewith and through which the user inhales;
- the electrical and control device may comprise a user interface arranged for providing the triggered alert to the user;
- the user interface may comprise a buzzer arranged for emitting a predefined sound message representative of the triggered alert;
- in a variant, the user interface may comprise a display screen arranged for displaying a predefined message representative of the triggered alert;
- in another variant, the user interface may comprise

a haptic feedback arranged for vibrating a chosen part of the aerosol generation device to alert the user;

- the electrical and control device may comprise a power source storing electrical energy and to which the controller is electrically coupled;
- the power source may be a rechargeable battery;
- the aerosol generation device may constitute an electronic cigarette (or e-cigarette).

Brief description of the figures

[0013] The invention and its advantages will be better understood upon reading the following detailed description, which is given solely by way of non-limiting examples and which is made with reference to the appended drawings, in which :

- Figure 1 (FIG.1) schematically illustrates an example of embodiment of an electrical and control device of an aerosol generation device according to the invention, and
- Figure 2 (FIG.2) schematically illustrates an example of embodiment of a cartomizer intended for being coupled to the electrical and control device of figure 1.

Detailed description of embodiments

[0014] The invention aims, notably, at offering an aerosol generation device (or E-vapor device) 1 intended for alerting of a forthcoming capillary element drying.

[0015] In the following description it will be considered that the aerosol generation device 1 is an electronic cigarette (or e-cigarette or else personal vaporizer). But an aerosol generation device 1 according to the invention could be of another type, as soon as it comprises a reservoir 5 storing an aerosol-forming liquid and allows the generation of an aerosol by heating this aerosol-forming liquid. So, for instance, the aerosol generation device 1 could be an inhaler.

[0016] Moreover, in the following description the aerosol-forming liquid may comprise one or more of nicotinoïd(s), cannabinoid(s), caffeine, tobacco material, polyol, flavoring or other active components. An active component may be carried by a carrier which may include propylene glycol or glycerin, for instance.

[0017] Furthermore, in the following description the term "aerosol" may include a suspension of substance as one or more of solid particles, liquid droplets and gas. Such a suspension may be in a gas including air.

[0018] As illustrated partially in figures 1 and 2, an aerosol generation device 1, according to the invention, comprises at least an electrical and control device 3, a reservoir 5 and a heater 18.

[0019] For instance, and as illustrated in the non-limiting example of figure 2, the reservoir 5 and the heater 18 may be contained in the body 4 of a cartomizer 2 intended for being mechanically and electrically coupled

to the body 13 of the electrical and control device 3. But this is not mandatory, and the aerosol generation device 1 could comprise any components (or elements) in a single body (and notably the reservoir 5, heater 18 and electrical and control device 3).

[0020] The reservoir 5 is arranged for storing an aerosol-forming liquid having initially (i.e. when it is full) a predetermined quantity *pq* that is known by a controller (or control device) 27 of the electrical and control device 3.

[0021] The heater 18 is arranged, when it is supplied with electrical power, for heating the aerosol-forming liquid originating from the reservoir 5 to induce generation of an aerosol that can be inhaled by a user during a puff of a vaping session. For instance, the heater 18 may be arranged for aerosolizing the aerosol-forming liquid in an aerosol chamber 7 in order to generate an aerosol when the latter (7) is supplied with air.

[0022] In the non-limiting example illustrated in figure 2 the cartomizer body 4 comprises at least a first air inlet 11 set upstream of the aerosol chamber 7 and in fluid communication therewith, in order to supply it with air originating from outside, and an aerosol outlet 16 set downstream of the aerosol chamber 7 and in fluid communication therewith, in order to receive the generated aerosol when a user of the aerosol generation device 1 inhales during a vaping session.

[0023] For instance, and as illustrated in the non-limiting example of figure 2, the cartomizer 2 may comprise a first sleeve 6 defining the aerosol chamber 7. Also for instance, this first sleeve 6 may have an annular shape. The aerosol chamber 7 is fed with air (sucked in by the user) through each first air inlet 11 defined in a wall of the first sleeve 6 (as illustrated by the two small arrows B in figure 2). This air comes from outside through at least one second air inlet 12 defined in the cartomizer body 4 (as illustrated by the arrow C in figure 2). But, each second air inlet 12 could be defined in a wall of the body 13 of the electrical and control device 3.

[0024] The first sleeve 6 (with all the elements coupled to it) may be removable, and therefore the cartomizer 2 may be sold with or without the first sleeve 6.

[0025] Also for instance, and as illustrated in the non-limiting example of figure 2, the cartomizer body 4 may comprise a mouthpiece 8 comprising the aerosol outlet 16 and allowing the user to inhale the generated aerosol through this aerosol outlet 16 during a vaping session (as illustrated by the arrows A in figure 2). In this case, the aerosol chamber 7 is fluidly coupled to the mouthpiece 8 by an aerosol path (or conduit or passage) 9 leading to the aerosol outlet 16. Also for instance, the cartomizer body 4 comprises an end 10 that receives the generated aerosol from the aerosol path 9 and to which the mouthpiece 8 is fixed, for instance by screwing or clipping.

[0026] Also for instance, and as illustrated in the non-limiting example of figure 2, the cartomizer body 4 may comprise an outer wall 17 defining a cavity, and the res-

ervoir 5 may be delimited at least partially by this outer wall 17 and the aerosol path 9.

[0027] In the illustrated example, the aerosol chamber 7 comprises the heater 18, and the latter (18) is supplied with electrical energy originating from a power source 23 of the electrical and control device 3, under control of the controller 27. For instance, and as illustrated in the non-limiting example of figure 1, the electrical and control device 3 may comprise a group of electronic components 35 (such as switch(es)) supplying the electrical power (stored in the power source 23) to the heater 18 under control of the controller 27.

[0028] This heater 18 may be a resistive heater, such as a resistive coil, and/or an inductive heater, such as a metallic susceptor. In this case, the heater 18 may comprise one or more electrically activated resistive and/or inductive heating elements. But in a variant not illustrated the heater 18 could be at least partially housed in the cartomizer 2 and therefore partly outside the aerosol chamber 7. The heating can be made by conduction, convection and/or radiation.

[0029] The aerosol-forming liquid can leave the reservoir 5 to reach the aerosol chamber 7 (see the four arrows D) through corresponding openings 14 and 15 defined respectively in the reservoir 5 and first sleeve 6.

[0030] The reservoir 5 or the aerosol chamber 7 may comprise a fastening member configured for fastening the cartomizer 2 to the body 13 of the electrical and control device 3.

[0031] The first sleeve 6 may have at least one first fastening member configured to cooperate with a corresponding and complementary second fastening member of the electrical and control device 3 for connecting mechanically the first sleeve 6 to the electrical and control device 3 (and more precisely to the body 13 of the latter (3)). As illustrated in figure 2, the second fastening member may belong to a second sleeve 26 which is housed in the body 13 of the electrical and control device 3.

[0032] Also for instance, and as illustrated in the non-limiting example of figure 2, the reservoir 5 may have an annular shape and a central passage defining the aerosol path (or passage or conduit) 9 and communicating with a recess 32 housing a part of the first sleeve 6.

[0033] For instance, and as illustrated in the non-limiting example of figures 1 and 2, the coupling between the cartomizer body 4 and the body 13 of the electrical and control device 3 can be done by screwing by means of two corresponding threaded portions 24 and 25.

[0034] As illustrated in figure 1 the body 13 of the electrical and control device 3 may comprise a user interface 28 in addition to the controller (or control device) 27 and the power source 23 (storing electrical energy).

[0035] For instance, the power source 23 may be a rechargeable battery. In this case the body 13 may comprise an electrical connector to which a charger cable may be connected during a charging session of the rechargeable battery 23. Such a charger cable may be coupled to an (AC) adapter or to a wall socket.

[0036] The controller 27 is electrically coupled to the power source 23 and controls operation of the cartomizer 2 (and notably its heater 18) during a vaping session and also during a possible charging session. For instance, and as illustrated in the non-limiting example of figure 1, the controller 27 may be fixed onto a printed circuit board 29 (housed in the body 13).

[0037] This controller 27 comprises at least a processor and a memory arranged for performing operations for controlling the aerosol generation device 1.

[0038] For instance, the processor may be a digital signal processor (or DSP), or an application specific integrated circuit (ASIC), or else a field programmable gate array (FPGA). More generally, the processor may comprise integrated (or printed) circuits, or several integrated (or printed) circuits connected therebetween through wired or wireless connections. The term "integrated (or printed) circuits" refers here to any type of device capable of carrying out at least one electric or electronic operation.

[0039] Also for instance, the memory may be a random access memory (or RAM). But it may be any type of device arranged for storing program instructions for the processor.

[0040] Explicit use of the term "controller" should not be construed to refer exclusively to hardware capable of executing software, and may implicitly include, without limitation, digital signal processor hardware, processor, application specific integrated circuit, field programmable gate array, read only memory (ROM) for storing software, random access memory, and non volatile storage. Other hardware, conventional and/or custom, may also be included. The functions of the controller 27 may be carried out through the operation of program logic, through dedicated logic, through the interaction of program control and dedicated logic, or even manually (by the user). These functions may be provided through the use of dedicated hardware as well as hardware capable of executing software in association with appropriate software.

[0041] The user interface 28 is coupled to the controller 27 and the power source 23 to allow the user to control at least partly the controller 27. For instance, the user interface 28 may comprise a display (such as a screen or light emitting diode (or LED)-type interface) arranged for displaying information relative to a current vaping session or a possible current charging session and for allowing the user to control the controller 27. Also for instance, and as illustrated in the non-limiting example of figure 1, the user interface 28 may be fixed partly to the printed circuit board 29 to ease and simplify its connections with the controller 27.

[0042] Also for instance, and as illustrated in the non-limiting example of figures 1 and 2, the cartomizer 2 and the electrical and control device 3 may comprise respectively first 30 and second 31 electrical pins intended for contacting each other during their coupling to allow the supply of the first sleeve 6 with electrical energy during a vaping session.

[0043] Also for instance, and as illustrated in the non-

limiting example of figure 2, the aerosol chamber 7 may comprise an aerosol-forming liquid transport element 33 to transport aerosol-forming liquid from the second openings 15 of the first sleeve 6 to the heater 18. For instance, this aerosol-forming liquid transport element 33 may be a capillary element (possibly a capillary wick) having two opposite ends set in front of the second openings 15, and preferably against the latter (and therefore against the internal surface of the first sleeve 6). This capillary element 33 can be a fiber or ceramic rod, for instance. For instance, the heater 18 may comprise a resistive coil wound around the capillary element 33 and connected to the first electrode 30 via lead wires 34.

[0044] The controller 27 is also arranged after each puff (ending at an instant t) for estimating a first quantity $q1(t)$ of aerosol-forming liquid consumed, and a second quantity $q2(t)$ remaining in the reservoir 5 by subtracting this estimated first quantity $q1(t)$ from the last second quantity $q2(t-1)$ that was remaining before this puff. In other words, $q2(t) = q2(t-1) - q1(t)$.

[0045] According to the invention, each first quantity $q1(t)$ is estimated by the controller 27 from at least an electrical power $ep(t)$ supplied to the heater 18 during the considered puff, the puff duration $pd(t)$ of this considered puff, and the flow rate $afr(t)$ of the aerosol generated during this considered puff. Moreover, the controller 27 is arranged for triggering an alert for the user of its aerosol generation device 1 when the estimated second quantity $q2(t)$ is smaller than a chosen threshold. This chosen threshold corresponds to a remaining quantity of aerosol-forming liquid under which the capillary element 33 will start drying before burning.

[0046] So, the invention allows a real time and accurate estimation of the quantity of aerosol-forming liquid remaining in the reservoir 5 after each puff, and therefore allows to alert the user just before the capillary element 33 starts drying so that he can decide either to refill the reservoir 5 (or to replace the consumable defining the reservoir 5 with a new one), or else to continue his vaping session without being surprised by the next strange sensation induced by the capillary element drying during the next puff.

[0047] For instance, and as illustrated in the non-limiting example of figure 1, the electrical and control device 3 may comprise an electrical circuit 36 arranged for estimating the electrical power $ep(t)$ that is supplied to the heater 18 during each puff. As illustrated, this electrical circuit 36 may be coupled to the group of electronic components 35 (supplying the electrical power to the heater 18). For instance, the controller 27 measures the resistance across the heater 18, and on user request (i.e. sucking) applies the corresponding voltage/current to match a pre-determined power setting or a dynamic power-setting based on sucking pressure.

[0048] Also for instance, and as illustrated in the non-limiting example of figure 1, the electrical and control device 3 may comprise a puff sensor 37 arranged for detecting when the user inhales during a puff, and for in-

forming the controller 27 each time such a detection starts (puff start) and each time such a detection ends (puff end). In this case, the controller 27 is arranged for determining the puff duration $pd(t)$ from the time interval between the puff start detection and the puff end detection.

[0049] This puff sensor 37 may be a flow or pressure sensor or a microphone or else a thermistor detecting drops of temperature, for instance. Moreover the puff sensor 37 may inform the controller 27 of a puff start detection or puff end detection by means of a dedicated digital or analog signal.

[0050] Also for instance, and as illustrated in the non-limiting example of figure 2, the aerosol generation device 1 (and here its cartomizer 2) may comprise a pressure sensor 38 set in the aerosol path 9 (through which the generated aerosol flows when the user sucks in via the aerosol outlet 16), and arranged for estimating a pressure drop during a puff and for providing this estimated pressure drop to the controller 27. In this case, the controller 27 is arranged for estimating the generated aerosol flow rate $afr(t)$ from this estimated pressure drop. For instance, the pressure sensor 38 monitors the pressure in the cavity when the user does not suck in and when the user starts sucking in, the negative pressure forces the pressure sensor 38 to detect a lower pressure than the previous ambient. As an example, the normal pressure may be equal to 1000 mbar, and during a first sucking the pressure may become equal to 998 mbar. This -2 mbar difference may equate to a generated aerosol flow rate $afr(t)$ equal to 11 ml/sec. Now, if during a second sucking the pressure difference is equal -4 mbar, then the generated aerosol flow rate $afr(t)$ is equal to 18 ml/sec.

[0051] In an example of embodiment, the controller 27 may be arranged for estimating the first quantity $q1(t)$ from the result of the estimated electrical power $ep(t)$ supplied to the heater 18 during the considered puff multiplied by the estimated puff duration $pd(t)$ of this considered puff multiplied by the estimated generated aerosol flow rate $afr(t)$ during this considered puff. So, $q1(t) = ep(t) * pd(t) * afr(t)$, where $q1(t)$ is given in μl , $ep(t)$ is given in watts, $pd(t)$ is given in seconds, and $afr(t)$ is given in ml/sec (but is based on mbar delta). This equation appears to be linear, but more complicated (and nonlinear) equations may be used with at least the same parameters $ep(t)$, $pd(t)$ and $afr(t)$.

[0052] Also for instance, the controller 27 may be arranged after each puff for estimating the first quantity $q1(t)$ not only from $ep(t)$, $pd(t)$ and $afr(t)$, but also from the ambient temperature and/or the puff start temperature and/or the orientation of the aerosol generation device 1 during this puff and/or a ratio of quantities of two different constituents of the aerosol-forming liquid. This allows to increase the accuracy of the estimation of the second quantity $q2(t)$.

[0053] As an example, the chosen model initially built for $q1(t)$ can be expanded to capture more features possibly contained in a table that needs to be completed.

When such a table is complete a supervised machine learning technique (like multiple regression) can be used to create a model like $q1(t) = B1 * x1 + B2 * x2 + \dots + Bn * xn + A$.

[0054] The use of the ambient temperature and/or the puff start temperature requires the aerosol generation device 1 to comprise a temperature sensor.

[0055] The use of the orientation of the aerosol generation device 1 requires the aerosol generation device 1 to comprise a tilt sensor.

[0056] The use of the ratio of quantities of two different constituents requires the controller 27 to be informed beforehand. For instance, the two different constituents may be the propylene glycol (or PG) and the vegetable glycerin (or VG). In other words, if the cartomizer 2 is capable of communicating the constituents to the controller 27, then the correct ratio (or factor) is used in the calculation. Otherwise, for dumb cartomizers 2 an average weighting of all the possible constituent ratios is used for all calculations.

[0057] In another example of embodiment, the controller 27 may be arranged, when it is informed of the predetermined quantity pq of aerosol-forming liquid stored in the reservoir 5 when it is full, for estimating the second quantity $q2(t)$ remaining in the reservoir (5) after a puff by subtracting the sum of every first quantity $q1(t)$ estimated since a first puff (at instant $t1$) with the full reservoir 5 from this predetermined quantity pq . So, after the n -th puff at instant tn the sum is $q2(tn) = pq - q1(t1) - q1(t2) - q1(t3) \dots - q1(tn-1) - q1(tn)$. But in a variant of embodiment the controller 27 may compute $q2(tn) = pq - q2(tn-1)$.

[0058] Also for instance, the user interface 28 of the electrical and control device 3 may be arranged for providing the triggered alert to the user. In this case the user interface 28 may comprise a buzzer arranged for emitting a predefined sound message representative of the triggered alert, or a display screen arranged for displaying a predefined message representative of the triggered alert or else a haptic feedback arranged for vibrating a chosen part of the aerosol generation device 1 to alert the user.

[0059] It should be appreciated by those skilled in the art that some block diagrams of figures 1 and 2 herein represent conceptual views of illustrative elements embodying the principles of the invention.

[0060] The description and drawings merely illustrate the principles of the invention. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the principles of the invention and are included within its spirit and scope. Furthermore, all examples recited herein are principally intended expressly to be only for pedagogical purposes to aid the reader in understanding the principles of the invention and the concepts contributed by the inventor(s) to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions. Moreover, all statements herein reciting princi-

ples, aspects, and embodiments of the invention, as well as specific examples thereof, are intended to encompass equivalents thereof.

Claims

1. Aerosol generation device (1) comprising i) a reservoir (5) storing an aerosol-forming liquid, ii) a heater (18) arranged, when supplied with electrical power, for heating said aerosol-forming liquid to induce generation of an aerosol that can be inhaled by a user during a puff, and iii) an electrical and control device (3) comprising a controller (27) arranged for controlling electrical power supply to said heater (18) and, after each puff, for estimating a first quantity of aerosol-forming liquid consumed, and a second quantity remaining in said reservoir (5) by subtracting said estimated first quantity from a last second quantity remaining before said puff, wherein said controller (27) is arranged after each puff for estimating said first quantity from at least an electrical power supplied to said heater (18), a puff duration and a flow rate of said generated aerosol, and for triggering an alert for said user when said estimated second quantity is smaller than a chosen threshold.
2. Aerosol generation device according to claim 1, wherein said electrical and control device (3) comprises an electrical circuit (36) arranged for estimating the electrical power supplied to said heater (18) during each puff.
3. Aerosol generation device according to claim 1 or 2, wherein said electrical and control device (3) comprises a puff sensor (37) arranged for detecting when said user inhales during a puff, and for informing said controller (27) each time such a detection starts and ends, and wherein said controller (27) is arranged for determining said puff duration from a time interval between a puff start detection and a puff end detection.
4. Aerosol generation device according to any one of claims 1 to 3, wherein it comprises i) an aerosol path (9) through which said generated aerosol flows when said user sucks in via an aerosol outlet (16), and ii) a pressure sensor (38) set in said aerosol path (9) and arranged for estimating a pressure drop during a puff and for providing said estimated pressure drop to said controller (27), and wherein said controller (27) is arranged for estimating said generated aerosol flow rate from said estimated pressure drop.
5. Aerosol generation device according to any one of claims 1 to 4, wherein said controller (27) is arranged for estimating said first quantity from a result of said estimated electrical power supplied to said heater (18) multiplied by said estimated puff duration multiplied by said estimated generated aerosol flow rate.
6. Aerosol generation device according to any one of claims 1 to 5, wherein said controller (27) is arranged after each puff for estimating said first quantity from also an ambient temperature and/or a puff start temperature and/or an orientation of said aerosol generation device (1) during said puff and/or a ratio of quantities of two different constituents of said aerosol-forming liquid.
7. Aerosol generation device according to any one of claims 1 to 6, wherein said controller (27) is arranged, when it is informed of a predetermined quantity of aerosol-forming liquid stored in said reservoir (5) when it is full, for estimating said second quantity remaining in said reservoir (5) after a puff by subtracting a sum of every first quantity estimated since a first puff with the full reservoir (5) from said predetermined quantity.
8. Aerosol generation device according to any one of claims 1 to 7, wherein it comprises a cartomizer (2) comprising a body (4) mechanically and electrically coupled to said electrical and control device (3) and comprising said reservoir (5), said heater (18), an aerosol chamber (7) in which said aerosol is generated, at least one air inlet (11) set upstream of said aerosol chamber (7) and in fluid communication therewith, and an aerosol outlet (16) set downstream of said aerosol chamber (7) and in fluid communication therewith and through which said user inhales.
9. Aerosol generation device according to any one of claims 1 to 8, wherein said electrical and control device (3) comprises a user interface (28) arranged for providing said triggered alert to said user.
10. Aerosol generation device according to claim 9, wherein said user interface (28) comprises a buzzer arranged for emitting a predefined sound message representative of said triggered alert.
11. Aerosol generation device according to claim 9, wherein said user interface (28) comprises a display screen arranged for displaying a predefined message representative of said triggered alert.
12. Aerosol generation device according to claim 9, wherein said user interface (28) comprises a haptic feedback arranged for vibrating a chosen part of said aerosol generation device (1) to alert the user.
13. Aerosol generation device according to any one of claims 1 to 12, wherein said electrical and control device (3) comprises a power source (23) storing

electrical energy and to which said controller (27) is electrically coupled.

14. Aerosol generation device according to claim 13, wherein said power source (23) is a rechargeable battery. 5
15. Aerosol generation device according to any one of claims 1 to 14, wherein it constitutes an electronic cigarette. 10

15

20

25

30

35

40

45

50

55

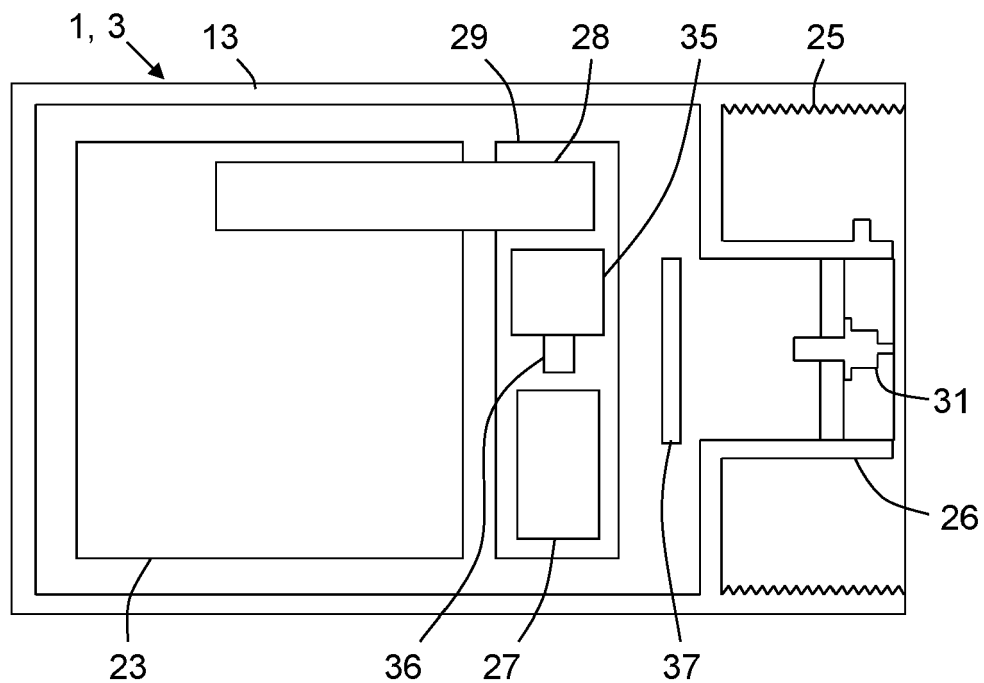


FIG.1

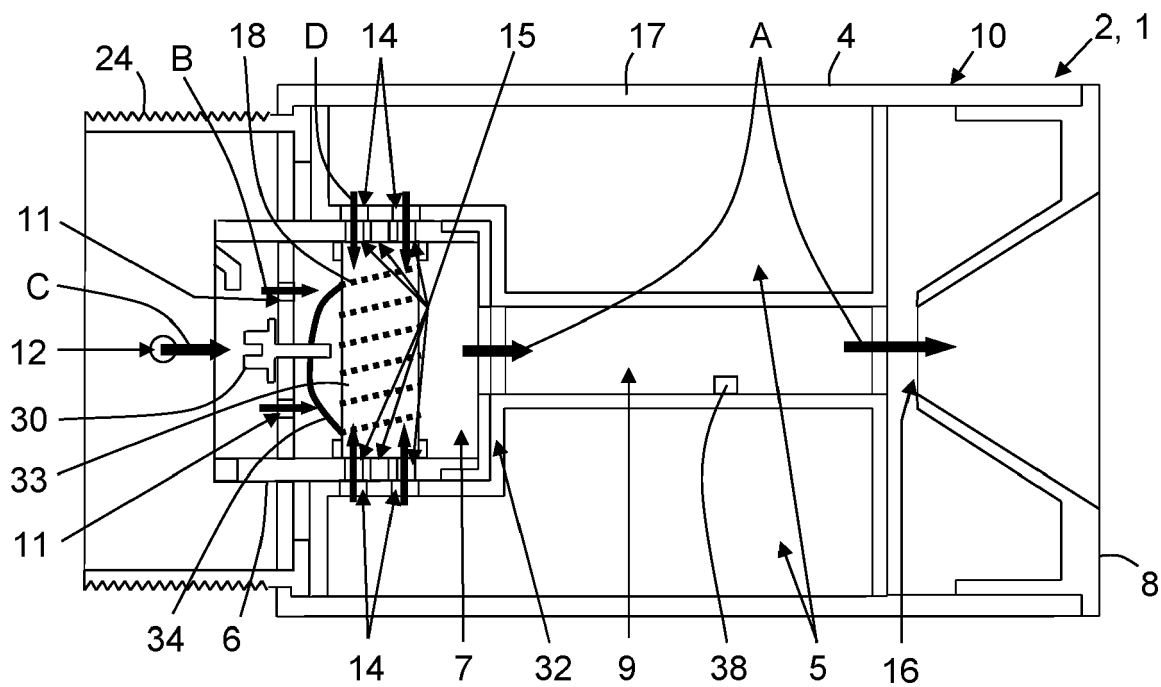


FIG.2



EUROPEAN SEARCH REPORT

Application Number

EP 21 18 3228

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2016/090303 A1 (PAX LABS INC [US]) 9 June 2016 (2016-06-09) * figures 1-10 *	1-15	INV. A24F40/51 A24F40/53
A	WO 2018/184861 A1 (PHILIP MORRIS PRODUCTS SA [CH]) 11 October 2018 (2018-10-11) * page 5 - page 7; figures 1-3 *	1-15	
A	WO 2021/011739 A1 (INSTRUMEMS INC [US]) 21 January 2021 (2021-01-21) * figures 1-11 *	1-15	
A,D	EP 2 468 116 A1 (PHILIP MORRIS PROD [CH]) 27 June 2012 (2012-06-27) * paragraph [0054] - paragraph [0086]; figures 1-9 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			A24F A61M
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 December 2021	Examiner Dartis, Daniel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 21 18 3228

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-12-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2016090303 A1	09-06-2016	AU 2015357509 A1	29-06-2017
		AU 2021218151 A1	09-09-2021
		CA 2969728 A1	09-06-2016
		CN 107427067 A	01-12-2017
		CN 112155255 A	01-01-2021
		EP 3226704 A1	11-10-2017
		EP 3821735 A1	19-05-2021
		HK 1245026 A1	24-08-2018
		IL 252658 A	29-04-2021
		JP 6802792 B2	23-12-2020
		JP 2017538410 A	28-12-2017
		KR 20170091737 A	09-08-2017
		NZ 732534 A	30-07-2021
		RU 2017123539 A	09-01-2019
		RU 2019140840 A	03-03-2020
		UA 124185 C2	04-08-2021
		US 2016157524 A1	09-06-2016
		US 2020120987 A1	23-04-2020
		WO 2016090303 A1	09-06-2016
WO 2018184861 A1	11-10-2018	BR 112019018180 A2	07-04-2020
		CN 110418583 A	05-11-2019
		EP 3606364 A1	12-02-2020
		JP 6847251 B2	24-03-2021
		JP 2020509764 A	02-04-2020
		KR 20190120826 A	24-10-2019
		RU 2728013 C1	28-07-2020
		WO 2018184861 A1	11-10-2018
WO 2021011739 A1	21-01-2021	NONE	
EP 2468116 A1	27-06-2012	AU 2011347189 A1	11-07-2013
		BR 112013018323 A2	11-09-2018
		CA 2822728 A1	28-06-2012
		CN 103338664 A	02-10-2013
		CO 6761317 A2	30-09-2013
		EA 201390963 A1	28-02-2014
		EP 2468116 A1	27-06-2012
		EP 2654470 A1	30-10-2013
		ES 2618906 T3	22-06-2017
		IL 226909 A	31-07-2017
		JP 5959532 B2	02-08-2016
		JP 2014501107 A	20-01-2014
		KR 20140004656 A	13-01-2014
		KR 20180135990 A	21-12-2018
		MX 343872 B	25-11-2016

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 21 18 3228

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-12-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		MY 166116 A	24-05-2018
		NZ 611897 A	30-01-2015
		PL 2654470 T3	31-07-2017
		PT 2654470 T	29-03-2017
		SG 191276 A1	31-07-2013
		UA 110631 C2	25-01-2016
		US 2013319435 A1	05-12-2013
		WO 2012085207 A1	28-06-2012
		ZA 201304320 B	26-03-2014

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 2468116 A1 [0007]