



(51) International Patent Classification:

A24F 40/40 (2020.01) A24F 40/42 (2020.01)

A24F 40/485 (2020.01) A61M 11/04 (2006.01)

A24F 40/20 (2020.01) A61M 15/06 (2006.01)

(21) International Application Number:

PCT/EP2022/068630

(22) International Filing Date:

05 July 2022 (05.07.2022)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

21183775.2 05 July 2021 (05.07.2021) EP

(71) Applicant: PHILIP MORRIS PRODUCTS S.A.  
[CH/CH]; Quai Jeanrenaud 3, 2000 Neuchâtel (CH).

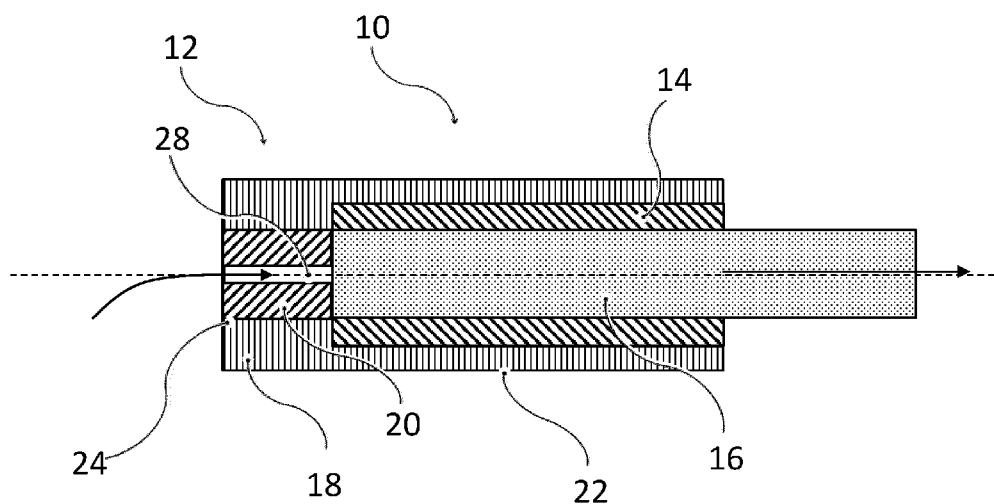
(72) Inventor: UTHURRY, Jerome; Quai Jeanrenaud 3, 2000 Neuchâtel (CH).

(74) Agent: SIEPMANN, Felix et al.; Abitz & Partner Patentanwälte mbB, Arabellastr. 17, 81925 München (DE).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: AEROSOL-GENERATING DEVICE WITH RESISTANCE-TO-DRAW MODIFYING ELEMENT



(57) Abstract: The invention relates to an aerosol-generating device comprising a resistance-to-draw modifying element. The resistance-to-draw modifying element comprises a first component, a second component and at least one airflow channel. The first component and the second component cooperate to form the airflow channel. At least one of the first component and the second component are configured to be moveable with respect to the other of the first component and second component between at least a first position and a second position. The inner surface area of the airflow channel in the first position is smaller than the inner surface area of the airflow channel in the second position. The cross-sectional area of the airflow channel in the first position and the second position remains unchanged. The invention further relates to a method for controlling the resistance-to-draw of an aerosol-generating device.

**Declarations under Rule 4.17:**

- *as to the identity of the inventor (Rule 4.17(i))*
- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

**Published:**

- *with international search report (Art. 21(3))*

## **AEROSOL-GENERATING DEVICE WITH RESISTANCE-TO-DRAW MODIFYING ELEMENT**

The present invention relates to an aerosol-generating device comprising a resistance-  
5 to-draw modifying element. The present disclosure further relates to a method for controlling  
the resistance-to-draw of an aerosol-generating device.

It is known to provide an aerosol-generating device for generating an inhalable aerosol.  
Such devices may heat aerosol-forming substrate to a temperature at which one or more  
components of the aerosol-forming substrate are volatilised without burning the aerosol-  
10 forming substrate. Aerosol-forming substrate may be provided as part of an aerosol-generating  
article. The aerosol-generating article may have a rod shape for insertion of the aerosol-  
generating article into a cavity, such as a heating chamber, of the aerosol-generating device.  
A heating element may be arranged in or around the heating chamber for heating the aerosol-  
forming substrate once the aerosol-generating article is inserted into the heating chamber of  
15 the aerosol-generating device.

The consumption experience of a user of an aerosol-generating device is largely  
determined by the resistance-to-draw (RTD) and the delivery level of the active component in  
the aerosol, such as nicotine. The consumption experience is further influenced by the stability  
of the RTD and delivery level during the consumption event. The variance of such parameters  
20 between different aerosol-generating articles further affects the consumption experience of a  
user. The delivery level depends on the amount of air entering the aerosol-generating device  
and is hence related to the RTD of the aerosol-generating device. A stable RTD hence usually  
induces a stable delivery level. It is usually difficult to achieve an appropriate balance of the  
discussed parameters.

Most users prefer to have an RTD comparable to the RTD of conventional cigarettes.  
However, aerosol-generating articles of aerosol-generating devices usually have a much lower  
RTD than conventional cigarettes, as in aerosol-generating devices the aerosol-generating  
article is not burnt but only heated.

Furthermore, the preferred user experience usually varies widely between different  
30 users. A single user may also wish to achieve varying consumption experiences in single or  
separate consumption events.

The stability of the RTD and the delivery level is usually determined by the aerosol-  
generating device and the aerosol-generating article. The RTD of aerosol-generating articles  
usually varies between aerosol-generating articles due to the manufacturing process. This  
35 results in an undesirable variation of the user's consumption experience.

It would be desirable to provide an aerosol-generating device possessing an RTD  
comparable to conventional cigarettes. It would be desirable to provide an aerosol-generating

device delivering a stable RTD. It would be desirable to provide an aerosol-generating device with an adjustable RTD. It would be desirable to provide an aerosol-generating device which allows balancing the variation of RTD between different aerosol-generating articles. It would be desirable to provide an aerosol-generating article which allows the user to modify the RTD to achieve an individually tailored consumption experience. It would be desirable to provide an aerosol-generating device allowing the adjustment of the RTD and the delivery level. It would be desirable to provide an aerosol-generating device which allows balancing the RTD, delivery level and the stability of such parameters. These beneficial effects are achieved by the invention.

According to a first aspect of the invention there is provided an aerosol-generating device that may comprise a resistance-to-draw modifying element. The resistance-to-draw modifying element may comprise a first component, a second component and at least one airflow channel. The first component and the second component may cooperate to form the airflow channel. At least one of the first component and the second component may be configured to be moveable with respect to the other of the first component and second component between at least a first position and a second position. The inner surface area of the airflow channel in the first position may be smaller than the inner surface area of the airflow channel in the second position. The cross-sectional area of the airflow channel in the first position and the second position may remain unchanged.

According to a first aspect of the invention there is provided an aerosol-generating device comprising a resistance-to-draw modifying element. The resistance-to-draw modifying element comprises a first component, a second component and at least one airflow channel. The first component and the second component cooperate to form the airflow channel. At least one of the first component and the second component are configured to be moveable with respect to the other of the first component and second component between at least a first position and a second position. The inner surface area of the airflow channel in the first position is smaller than the inner surface area of the airflow channel in the second position. The cross-sectional area of the airflow channel in the first position and the second position remains unchanged.

The invention further relates to a method for controlling the RTD of an aerosol-generating device.

The aerosol-generating device may comprise a longitudinal axis. As used herein, a “*longitudinal axis*” of a real or imaginary body may be an imaginary line running down the center of the body and running perpendicular to a transverse plane through the body.

The first component may comprise a longitudinal axis. The first component may be cylindrical. The first component may have a circular cross-section. As used herein, a “*cross-section*” of a real or imaginary body may be the intersection of a plane with the body

perpendicular to the longitudinal axis of the body. The first component may comprise a hollow cylinder. As used herein, a “*hollow cylinder*” may be the intersection of two cylinders, wherein the two cylinders have different base surfaces and wherein the longitudinal axes of the cylinders are the same. For example, the base sections of both cylinders may be circular, but  
5 the base sections of the first cylinder may have a smaller diameter than the base sections of the second cylinder. A hollow cylinder comprises a cavity. As used herein, a “*cavity*” may be an empty space in a solid body.

The first component may comprise an outer wall. The outer wall may have a circular cross-section. The outer wall may comprise an outer surface of the first component. The outer  
10 wall may enclose the first component. The outer wall may define the contour of the first component. The outer wall may form the exterior of one or both of the first component and the aerosol-generating device. The outer wall may be arranged on the outside of the aerosol-generating device.

The first component may comprise an inner wall. The inner wall may have a circular  
15 cross-section. The inner wall may have a polygonal cross-section. As used herein, a “*polygon*” may be a plane figure comprising a finite number points which are connected by straight line segments to form a closed loop. The straight line segments may be also be termed “*edges*”. The inner wall may comprise an inner surface of the first component. The inner surface may have circular or polygonal cross-section. The inner wall may be arranged inside the first  
20 component. The inner wall may line a cavity.

The second component may comprise a longitudinal axis. The second component may be cylindrical. The second component may have a circular cross-section. The second component may have a polygonal cross-section. The second component may be a solid cylinder. The second component may be a solid cylinder with a circular cross-section.

25 The second component may comprise an outer wall. The outer wall may have a circular cross-section. The outer wall may comprise an outer surface of the second component. The outer wall may enclose the second component. The outer wall may define the contour of the second component. The outer wall may form the exterior of the second component.

The first component may hold the second component. The second component may be  
30 mounted in the first component. The inner wall of the first component may be arranged opposite to the second component, preferably the outer wall of the second component. The inner wall of the first component may be arranged facing the second component, preferably the outer wall of the second component. The inner wall of the first component may be complementary to the outer wall of the second component. At least a part of the first  
35 component, preferably a part of the inner wall of the first component may be arranged in contact with at least a part of second component, preferably a part of the outer wall of the second component. The first and second component may be arranged such that airflow is

blocked at locations of contact between the first and second component. The first component and second may be arranged, such that the first and second component are temporarily fixed with respect to each, for example by frictional forces between the first and second component. In this way, the accuracy and stability of the adjustment to a particular RTD value is enhanced.

5           The second component may be configured to be rotatable with respect to the first component between at least a first position and a second position. The second component may be configured to be slidable with respect to the first component between at least a first position and a second position.

10           One of the first component and the second component may be configured to be manually movable with respect to the other of the first component and second component by the user. The user may rotate the first or second component. The user may slide the second component within the cavity of the first component by pushing and pulling the second component. The second component may comprise one or more of a handle, knob and bar, preferably at an upstream position on the second component. The user may grip the handle,  
15 knob or bar to move the second component. The user may move the second component more comfortably and easily by using the handle, knob or bar. Manual movement provides the user with a simple way of adjusting the RTD of the device according to the user's individual preferences.

20           The RTD may be adjusted automatically. The device may comprise a controller. The controller may be configured to adjust the RTD automatically, preferably by moving at least one of the first component and the second component with respect to the other of the first component and the second component. The movement may be facilitated by a motor controlled by the controller. The controller may adjust the RTD automatically according to a pre-programmed RTD profile. The device may further comprise a detection means with which  
25 characteristics of consumption are detected. The detection means may detect the RTD of the device. The controller may automatically adjust the RTD of the device in response to an input of the detection means. The controller may automatically adjust the RTD according the pre-programmed profile in response to the RTD detected by the detection means. Automatic adjustment of the RTD may increase the comfort with which the user can obtain individually  
30 preferred RTD characteristics.

          The first component may comprise a cavity. The cavity may comprise a longitudinal axis. The cavity may be an empty space inside the first component. The cavity may have a circular cross-section. The cavity may be a cylinder with a circular cross-section. The cavity may comprise an upstream opening.

35           The cavity may be configured to be complementary to the second component. The second component may be configured to be complementary to the cavity. The cavity may be configured to hold the second component. The cavity of the first component may be configured,

such that the second component may be inserted into the cavity, preferably through the opening. The inner wall of the first component may line the cavity. The inner wall of the first component may enclose the cavity. The inner wall of the first component may define the empty space of the cavity. The cavity may be configured such that the second component may at least partially be in contact with the first component. The cavity of the first component may be upstream of a heating chamber. The cavity of the first component may be configured such that at locations at which the first component is in contact with the second component, airflow is blocked.

The second component may be configured to be moveable within the cavity. One or both of the first component and the second component may be configured to be rotatable with respect to each other, preferably within the cavity. At least one of the first component and the second component may be configured to be slidable with respect to the other of the first component and second component, preferably within the cavity. The second component may be configured to be insertable into the cavity through the opening of the cavity.

In a preferred embodiment, the first component comprises a hollow cylinder and the cavity and the second component may have a cylindrical shape of circular cross-section. This embodiment may provide a smoother transition between consecutive positions. As a result of the cylindrical shape of cavity and second component, the first component and the second component may be rotated more smoothly with respect to each other. The risk of jamming between the first component and the second component may be reduced.

In a preferred embodiment, the inner wall of the first component, the cavity and the second component may have a cylindrical shape and a polygonal cross-section. The polygonal cross-section of one or both of inner wall of the first component and the cavity may be complementary to the polygonal cross-section of the second component. One or more of the edges of the polygonal cross-section of the second component may comprise a groove. One or more of the edges of the polygonal cross-section of inner wall of the first component may comprise a groove. In each consecutive position, each edge of the polygonal cross-section of the second component may abut an edge of the polygonal cross-section of the inner wall of the first component, such that the first component and the second component are temporarily locked with respect to each other in each consecutive position. In this preferred embodiment, pairs of abutted grooves may be precisely formed and aligned. In this preferred embodiment, the consumer may precisely and reliably move the first and second components between consecutive positions due to the temporary locking of the first and second component in each consecutive position. In this preferred embodiment, the risk that the first and second component move without intention with respect to each other may be reduced.

The airflow channel may be formed by at least a part of the first component and at least a part of the second component. The airflow channel may be formed by at least a part of the

inner wall of the first component and at least a part of the outer wall of the second component. The airflow channel may be formed between at least a part of the inner wall of the first component and at least a part of the outer wall the second component. At least a part of the first component and at least a part of the second component may enclose at least a part of the  
5 airflow channel. The characteristics, such as the extension or mechanical properties, of the airflow channel may be adapted by the moving the first and second component relative to each other. The adaption of the characteristics of the airflow channel may put the user in a position to adjust the RTD of the aerosol-generating device, for example by moving the first component and second component relative to each other. The adjustment of the RTD of the aerosol-  
10 generating device may be achieved by providing an airflow channel formed from at least a part of the first component and at least a part of the second component.

The airflow channel may comprise an inner wall. The inner wall may comprise an inner surface. The inner wall of the airflow channel may enclose the airflow channel.

The inner wall of the airflow channel may be formed by at least a part of the first  
15 component, preferably of the inner wall of the first component and at least a part of the second component, preferably of the outer wall of the second component. The inner wall of the airflow channel may be partially defined by the first component, preferably by at least a part of the inner wall of the first component and partially defined by the second component, preferably by at least a part of the outer wall of the second component.

At least a part of the first component and at least a part of the second component may  
20 cooperate to form the airflow channel, such that the inner wall of the airflow channel has an essentially continuous inner surface. At least a part of the first component and at least a part of the second component may cooperate to form the airflow channel, such that the inner wall of the airflow channel comprises two or more essentially continuous inner surfaces. As used  
25 herein, an “*essentially continuous surface*” includes a surface formed by at least parts of two or more contacting components. An essentially continuous surface of the present application may also include the interface at the points of contact of the two or more contacting components. The airflow channel may be defined by one or more essentially continuous inner surfaces formed by at least a part of the first component, preferably at least a part of the inner  
30 wall of the first component and at least a part of the second component, preferably at least a part of the outer wall of the second component.

The airflow channel may comprise an inner surface. The surface of the inner wall of the airflow channel may correspond to an inner surface of the airflow channel.

The inner surface of the airflow channel may comprise at least a part of a surface of  
35 the first component, preferably a part of the inner wall of the first component and a least a part of a surface of the second component, preferably a part of the outer wall of the second component. The first component and the second component may cooperate to form the inner

surface of the airflow channel. The inner surface of the airflow channel may be defined by at least part of the first component, preferably by at least a part of the surface of the inner wall of the first component and by at least part of the second component, preferably by at least a part of the surface of the outer wall of the second component.

5           The airflow channel may comprise an inner surface area. The surface area of the inner wall may correspond to the inner surface area of the airflow channel. The inner surface area of the airflow channel may be the combined surface areas of at least a part of the inner wall of the first component and at least a part of the outer wall of the second component.

10           The first component may form a first side surface of the airflow channel and the second component may form an opposing second side surface of the airflow channel. The first component and the second component may cooperate to form a lateral surface of the airflow channel. The first component and the second component may cooperate to form the airflow channel over the full length of the airflow channel.

15           The airflow channel may comprise an air inlet. The airflow channel may comprise an air outlet. The air inlet of the airflow channel and the air outlet of the airflow channel may be fluidly connected. The air inlet of the airflow channel and the air outlet of the airflow channel may define the endings of the airflow channel. The air inlet of the airflow channel may be upstream of the air outlet of the airflow channel. The air inlet of the airflow channel may be arranged at a location along the longitudinal axis of one or more of the aerosol-generating device, the first component, the second component and the cavity at which a transition to one or more essentially continuous surfaces formed by at least a part of the first and second components is arranged. The air outlet of the airflow channel may be arranged at a location along the longitudinal axis of one or more of the aerosol-generating device, the first component, the second component and the cavity at which a transition from one or more essentially continuous surfaces formed by at least a part of the first and second components is arranged. At least a part of the first component, preferably at least a part of the inner wall of the first component and at least a part of the second component, preferably at least a part of the outer wall of the second component may cooperate to form one or both of the air inlet of the airflow channel and the air outlet of the airflow channel.

30           As used herein, a "*length*" of a body may be the longest dimension of the body. As used herein, a "*length*" of a body may be the dimension of the body along its longitudinal axis. The length of the airflow channel may be the spatial dimension of the airflow channel along the longitudinal axis of one more of aerosol-generating device, the first component, the second component and the cavity. The length of the airflow channel may be equal to the distance between the air inlet of the airflow channel and the air outlet of the airflow channel. The length of the airflow channel may be the distance between upstream and downstream endings of the airflow channel.

The airflow channel may comprise one or more airflow conduits. The airflow conduit may be a part of the airflow channel. The airflow conduit may be cylindrical. The airflow conduit may have a circular cross-section. The airflow conduit may have a semi-circular cross-section. The airflow conduit may comprise an inner wall. The inner wall of the airflow conduit may line the airflow conduit. The inner wall of the airflow conduit may enclose the airflow conduit. The airflow conduit may comprise an inner surface. The inner surface of the airflow conduit may correspond to the surface of the inner wall of the airflow conduit. The airflow conduit may comprise an inner surface area. The airflow conduit may be defined by a single essentially continuous surface formed by at least a part of the inner wall of the first component and by at least a part of the outer wall of the second component.

At least a part of the first component, preferably at least a part of the inner wall of the first component and at least a part of the second component, preferably at least a part of the outer wall of the second component may cooperate to form one or more airflow conduits. The inner wall of the airflow conduit may be formed by at least a part of the first component, preferably at least a part of the inner wall of the first component and at least a part of the second component, preferably at least a part of the outer wall of the second component.

The inner surface area of the airflow channel may be the combined inner surface areas of one or more airflow conduits. The number of airflow conduits in the first position may be smaller than the number of airflow conduits in the second position. The airflow channel may comprise only a single airflow conduit in the first position. The airflow channel may comprise two or more airflow conduits in the second position. An airflow conduit may have a diameter of up to 1 mm. An airflow conduit may have a diameter of up to 0.5 mm.

The cross-sectional area of the airflow channel may be the area of a cross-section across the airflow channel perpendicular to the longitudinal axis of one or more of the aerosol-generating device, the first component, the second component and the cavity. The cross-sectional area of the airflow channel may be the combined cross-sectional areas of the airflow conduits. The cross-sectional area of the airflow channel may be constant along the length of the airflow channel. The cross-sectional area of the airflow channel may vary along the length of the airflow channel.

The cross-sectional area of the airflow channel may be the area of a cross-section across the airflow channel perpendicular to the direction of the airflow.

The aerosol-generating device may comprise one or more air outlets. The air outlet of the aerosol-generating device may be arranged downstream of the airflow channel. Aerosol produced by the aerosol-generating device may exit the device through the air outlet of the device. The user may inhale aerosol produced by the aerosol-generating device through the air outlet.

The aerosol-generating device may comprise a mouth end. The mouth end may comprise the air outlet of the aerosol-generating device. The user may inhale aerosol produced by the aerosol-generating device at the mouth end.

The aerosol-generating device may comprise one or more air inlets. The air inlet of the aerosol-generating device may be arranged upstream of the airflow channel. Ambient air may enter the aerosol-generating device through the air inlet of the aerosol-generating device.

The airflow channel may be fluidly connected to the air outlet of the aerosol-generating device. The airflow channel may be fluidly connected to an air inlet of the aerosol-generating device. The airflow channel may fluidly connect the air inlet of the aerosol-generating device and the air outlet of the aerosol-generating device.

One or both of the first component and the second component may comprise an airflow-blocking element. The airflow blocking element may comprise a polymeric material. The airflow-blocking element may be arranged on the surface of one or both of the inner wall of the first component and the outer wall of the second component. The airflow-blocking element may be a layer between the inner wall of the first component and the outer wall of the second component. The airflow-blocking element may be layer of polymeric material arranged on the surface of one or both of the inner wall of the first component and the outer wall of the second component. The airflow-blocking element may line one or both of the inner wall of the first component and the outer wall of the second component. The airflow-blocking element may line the cavity. The airflow-blocking element may separate the first component from the second component. The inner wall of the first component and the outer wall of the second component may be in contact with each other by means of the airflow-blocking element.

The airflow-blocking element may be configured to block the airflow at locations at which the first component and the second component are in contact. The airflow-blocking element may be configured to block fluid communication between the air inlet of the airflow channel and the air outlet of the airflow channel at locations at which the first and second components are in contact. Usage of the airflow-blocking element may enhance the precision with which the RTD can be adjusted. The airflow-blocking element may reduce the risk of undesired airflows between the air inlet of the aerosol-generating device and the air outlet of the aerosol-generating device.

One or both of the inner wall of the first component and the outer wall of the second component may comprise a surface coating. The surface coating may provide one or both of the first component and the second component with a smooth surface. The surface coating may be fluid impermeable. The surface coating may be friction-reducing. The surface coating may comprise polytetrafluoroethylene (PTFE).

The surface coating may be configured to decrease friction, preferably kinetic friction between the inner wall of first component and the outer wall of the second component. Due to

the surface coating, at least one of the first component and the second component may be moved more easily and more smoothly with respect to the other of the first component and the second component between different positions. Due to the surface coating, the risk that the first component and the second component get undesirably locked with respect to each other may be reduced.

One or both of the first component and the second component may be configured to be moveable with respect to the other of the first component and the second component between at least the first position, the second position and a third position. The inner surface area of the airflow channel in the first position may be smaller than the inner surface area of the airflow channel in the second position. The inner surface area of the airflow channel in the second position may be smaller than the inner surface area of the airflow channel in the third position. The cross-sectional area of the airflow channel in the first position, second position and third position may remain unchanged.

The number of airflow conduits in the second position may be smaller than the number of airflow conduits in the third position. The airflow channel may comprise four or more airflow conduits in the third position. All airflow conduits may have a semi-circular cross-section in the third position.

The first component, preferably the inner wall of the first component may comprise at least one groove, such as to form a first part of the airflow channel. The second component, preferably the outer wall of the second component may comprise at least one groove, such as to form a second part of the airflow channel. The groove of first component may be a depression of the surface of the inner wall of the first component. The groove of second component may be a depression of the surface of the outer wall of the second component. The depression of the surface may be approximately 0.5 mm deep. The groove of the first component may comprise an end wall. The end wall may be arranged at a downstream end of the groove. The end wall of the groove of the first component may be formed by a part of the first component. The groove of the first component may run parallel to the longitudinal axis of the first component. The groove of the second component may run parallel to the longitudinal axis of the second component. The groove of the second component may extend along the entire length of the second component. The groove of the first component may extend along at least a part of the length of the first component. The groove of one or both of the first component and second component may have a semi-circular cross-section.

The groove of the first component and the groove of the second component may each form an airflow conduit. The groove of the first component and the groove of the second component may cooperate to form a single airflow conduit in the first position. The groove of the first component and the groove of the second component may cooperate to form a pair of

grooves. The groove of the first component and the groove of the second component may form two separate airflow conduits in the second position.

The first component may comprise multiple grooves, such that each groove forms a part of the airflow channel. The second component may comprise multiple grooves, such that each groove forms a part of the airflow channel. The first component and the second component may each comprise the same number of grooves. The first component and the second component may each comprise at least two grooves. Preferably, the first component and the second component may each comprise at least three grooves. More preferably, the first component and the second component may each comprise at least five grooves. Each pair of grooves may form a separate airflow conduit. Each groove may form an airflow conduit.

In the first position, each groove of the first component may abut one groove of the second component to form a pair of abutted, fluidly communicating grooves. In each consecutive position the number of pairs of grooves may be consecutively reduced by one pair of grooves. An abutted pair of grooves may form a single airflow conduit. An abutted pair of grooves may form a cylindrical airflow conduit, preferably having a circular cross section. The abutted pair of grooves may have a diameter of up to 1 mm. The number of airflow conduits in the first position may be equal to the number of pairs of abutted grooves. In each consecutive position, the number of airflow conduits may be increased by two. In an abutted pair of grooves, the two pair-forming grooves may be arranged adjacent to each other. To form an abutted pair of grooves, the first component and the second component may be arranged such that the pair-forming grooves face each other. The grooves of an abutted pair of grooves form an essentially continuous surface.

The provision of multiple grooves and airflow conduits, respectively, allows the user to adjust the RTD consistently and in easily reproducible increments. The provision of multiple grooves and airflow conduits allows the user to adjust the RTD in well defined, discrete steps. The provision of multiple grooves and airflow conduits allows the user to accurately adjust the RTD.

The aerosol-generating device may comprise a heating chamber. The heating chamber may be arranged downstream of the RTD modifying element. The heating chamber may abut the RTD modifying element. The heating chamber may be in fluid communication with the RTD modifying element. The heating chamber may be in fluid communication with the air outlet of the aerosol-generating device. The heating chamber may comprise a heating element. The heating element may be arranged in or around the heating chamber. An aerosol-generating article may be inserted by the heating chamber. An aerosol-generating article inserted into heating chamber may be heated by the heating element. An aerosol-generating article may comprise an aerosol-forming substrate.

One or both of the first component and the second component may be configured to be moveable, preferably slidable, with respect to the other of the first component and the second component along a longitudinal axis of one or more of the aerosol-generating device, the first component and the second component.

5 The length of the airflow channel in each consecutive position may be larger than the length of the airflow channel in the previous position. In other words, the length of the airflow channel in one of the first position and the second position may be larger than the length of the airflow channel in the other of the first position and the second position. The length of the airflow channel may be changed by sliding the second component relative to the first  
10 component. The length of the airflow channel may be reduced when the second component is slid upstream or downstream relative to the first component. The second component may be slid downstream relative to the first component to move from the first position to the second position.

In an embodiment, first and second component may be slidable, but not rotatable with  
15 respect to each other. In this embodiment, only the first component, but not the second component may comprise the at least one groove.

The aerosol-generating device may comprise at least one air outlet channel. The first component and the second component may cooperate to at least partially form the air outlet channel. The air outlet channel may be arranged downstream of the airflow channel. The  
20 airflow channel and the air outlet channel may be in fluid communication with each other. The size of the air outlet channel in the first position may be larger than the size of the air outlet channel in the second position.

The air outlet channel may abut the air outlet of the airflow channel. The air outlet channel may be downstream of the air outlet of the airflow channel. The size of the air outlet  
25 channel may refer to the spatial dimensions of the air outlet channel. The size of the air outlet channel may refer to the distance between a part of the first component and a part of the second component. The size of the air outlet channel may refer to the spatial extent of the most restricted part of the air outlet channel. Each airflow conduit may abut an air outlet channel. Each groove of one or both of the first component and the second component may  
30 abut an air outlet channel. In embodiments comprising multiple airflow conduits, the size of each air outlet channel may be reduced in consecutive positions.

The first component and the second component may be configured to be movable with respect to each other, such that in consecutive positions, a part of the airflow channel is blocked. The airflow channel may be blocked by a part of the first component. The airflow  
35 channel may be blocked by an end wall of a groove of the first component. The grooves of the first component may be of different lengths. The end wall of each of a multitude of grooves of

the first component may be positioned at different locations along the longitudinal axis of the first component.

At least one of the first component and the second component may be configured to be movable with respect to the other of the first component and the second position to an ultimate position, such that in the ultimate position the airflow channel is fully blocked. The first component may be configured to fully block the airflow channel in the ultimate position. The airflow channel may be blocked by the end walls of the one or more grooves of the first component. In the ultimate position the airflow through all airflow conduits may be blocked. A fully blocked airflow channel may prevent fluid communication between the air inlet of the device and the air outlet of the device and a controller.

In an embodiment there is provided an aerosol-generating device comprising the above-described resistance-to-draw modifying element and a housing.

In another aspect of the invention, there is provided an aerosol-generating system comprising an aerosol-generating device according to the description herein and one or more aerosol-generating articles configured to be received in the cavity of the aerosol-generating device. During operation, an aerosol-generating article containing aerosol-forming substrate may be partially received within the aerosol-generating device. The aerosol-generating system may include additional components, such as for example a charging unit for recharging an on-board electric power supply in an electrically operated or electric aerosol-generating device.

In another aspect, the invention relates to a method for controlling the RTD of an aerosol-generating device as described herein. The method comprises the step of moving one or more of the first component and the second component between a first position and a second position.

Resistance to draw is also known as draft resistance, draw resistance, puff resistance or puffability, and is the pressure required to force air through the full length of the object under test at the rate of 17.5 ml/sec at 22°C and 760 Torr (101 kPa). It is typically expressed in units of mmH<sub>2</sub>O and is measured in accordance with ISO 6565:2015. The aerosol-forming article and the aerosol-generating device advantageously together provide an RTD of between 80 and 120 mmH<sub>2</sub>O through the first and second airflow channels. This approximates the RTD of a conventional cigarette. The aerosol-generating device, without an aerosol-forming article coupled to it, may advantageously have an RTD of between 5 and 20 mmH<sub>2</sub>O. The aerosol-forming article in isolation may have an RTD of between 40 and 80 mmH<sub>2</sub>O.

The modification of the RTD of the present invention is based on a modification of the inner surface area of the airflow channel. Enlarging the surface area of the airflow channel may increase the RTD. Without being bound to any theory, enlarging the surface area of the airflow channel may increase the friction air experiences while flowing through the airflow channel thereby increasing the RTD. The principle behind such modification of the RTD may be

rationalized by the Darcy–Weisbach equation. The Darcy–Weisbach equation provides a relation between the pressure drop ( $dp$ ) per unit length ( $l$ ) of a fluid flowing in the airflow channel and the wetted perimeter ( $P$ ) of the airflow channel. The pressure drop reflects the energy losses due to friction between the flowing fluid and the walls of the airflow channel:

5

$$\frac{dp}{dl} = \frac{1}{8} f_D \mu v^2 \frac{P}{A}$$

Herein,  $f_D$  is the Darcy friction factor,  $\mu$  is the density of the fluid,  $v$  is the mean flow velocity of the fluid,  $A$  is the cross section of the airflow channel and  $P$  is the wetted perimeter.

10

In the context of aerosol-generating devices and aerosol-generating systems, it may be approximated that  $f_D$ ,  $\mu$  and  $v$  are constant for a particular aerosol-generating device or system. As outlined above, the cross-sectional area of the airflow channel remains unchanged when moving between the different positions. Hence, in the context of the present invention,  $A$  may be also be assumed to be constant. Accordingly, above equation may be rewritten as

15

$$\frac{dp}{dl} = CP$$

Herein,  $C$  is equal to  $f_D \mu v^2 / 8A$  and hence approximately constant. Accordingly, the pressure drop  $dp$  is directly proportional to the wetted perimeter  $P$ . The pressure drop  $dp$  is approximately equal to the RTD of the aerosol-generating device. An increase in the wetted perimeter hence results in an increase of  $dp$  and in an increase of the RTD of the device. Furthermore, an increase of the length  $dl$  of the airflow channel results in an increased pressure drop  $dp$  and hence an increase RTD.

20

In the invention, a change of the wetted perimeter and hence of  $dp$  may be achieved by rotating the second component within the first component between the first, second and further positions. Furthermore, a change of the length of the airflow channel and hence of  $dp$  may be achieved by sliding the second component within the first component between the first, second and further positions. The RTD is further increased by blocking one or all of the grooves and air conduits of the device. This may be a result of the higher airflow velocity induced by the blockage of the grooves and air conduits.

25

30

The contribution of the device to the overall RTD of the system may be greater than the contribution by the aerosol-generating article. Hence, the resistance-draw of the system may mainly be determined by the RTD of the device. The RTD modifying element may hence put the user in a position to effectively adjust the RTD of the device and system.

The RTD obtained by using the RTD modifying element is stable and consistent from one aerosol-generating article to the other because it is directly related to the mechanically determined configuration of the airflow channel of the device.

5 The device of the present invention may achieve an increase of the RTD of up to 64% in increments.

The stable RTD obtained by using the RTD modifying element may also improve the stability of the delivery level.

The RTD modifying element allows the user to adapt the RTD and the delivery level according to the user's individual needs.

10 The aerosol-generating device of the present invention is configured to heat the aerosol-forming substrate to a temperature below a combustion temperature of the aerosol-forming substrate, but at or above a temperature at which one or more volatile compounds of the aerosol-forming substrate are released to form an inhalable aerosol.

15 The heating element may be in contact with the aerosol-forming substrate. The portion of the heating element, which is in contact with the aerosol-forming substrate is heated as a result of the electrical current passing through the heating element. The current is supplied by a battery. In one embodiment, this portion of the heating element is configured to reach a temperature of between about 200°C and about 350°C in use. Preferably, the heating element is configured to reach a temperature of between about 250°C and about 300°C.

20 As used herein, an 'aerosol-generating device' relates to a device that interacts with an aerosol-forming substrate to generate an aerosol. The aerosol-forming substrate may be part of an aerosol-generating article. An aerosol-generating device may interact with an aerosol-forming substrate of an aerosol-generating article to generate an aerosol that is directly inhalable into a user's lungs thorough the user's mouth. An aerosol-generating device  
25 may be a holder. The device may be electrically heated. The aerosol-generating device may comprise a housing, electric circuitry, a power supply, a heating chamber and a heating element. The housing may comprise the air inlet of the aerosol-generating device.

The device is preferably a portable or handheld device that is comfortable to hold between the fingers of a single hand. The device may be substantially cylindrical in shape and  
30 has a length of between 70 and 120mm. The maximum diameter of the device is preferably between 10 and 20mm. In one embodiment the device has a polygonal cross section and has a protruding button formed on one face. In this embodiment, the diameter of the device is between 12.7 and 13.65mm taken from a flat face to an opposing flat face; between 13.4 and 14.2 taken from an edge to an opposing edge (i.e., from the intersection of two faces on one  
35 side of the device to a corresponding intersection on the other side), and between 14.2 and 15 mm taken from a top of the button to an opposing bottom flat face.

As used herein, the terms 'upstream', 'downstream', 'proximal', 'distal', 'front' and 'rear', are used to describe the relative positions of components, or portions of components, of the aerosol-generating device in relation to the direction in which a user draws on the aerosol-generating device during use thereof.

5 The aerosol-generating system may comprise a mouth end through which in use an aerosol exits the aerosol-generating system and is delivered to a user. The mouth end may also be referred to as the proximal end. In use, a user draws on the proximal or mouth end of the aerosol-generating system in order to inhale an aerosol generated by the aerosol-generating system. The aerosol-generating system comprises a distal end opposed to the  
10 proximal or mouth end. The proximal or mouth end of the aerosol-generating system may also be referred to as the downstream end and the distal end of the aerosol-generating system may also be referred to as the upstream end. Components, or portions of components, of the aerosol-generating system may be described as being upstream or downstream of one another based on their relative positions between the proximal, downstream or mouth end and  
15 the distal or upstream end of the aerosol-generating system.

As used herein, the term 'aerosol-generating article' refers to an article comprising an aerosol-forming substrate that is capable of releasing volatile compounds that can form an aerosol. For example, an aerosol-generating article may be an article that generates an aerosol that is directly inhalable into a user's lungs through the user's mouth. An aerosol-generating  
20 article may be disposable.

The aerosol-generating article may be substantially cylindrical in shape. The aerosol-generating article may be substantially elongate. The aerosol-generating article may have a length and a circumference substantially perpendicular to the length. The aerosol-generating article may be substantially rod shaped. The aerosol-forming substrate may be substantially  
25 cylindrical in shape. The aerosol-forming substrate may be substantially elongate. The aerosol-forming substrate may also have a length and a circumference substantially perpendicular to the length. The aerosol-forming substrate may be substantially rod shaped.

The aerosol-generating article may have a total length between approximately 30 mm and approximately 100 mm. The aerosol-generating article may have an external diameter  
30 between approximately 5 mm and approximately 12 mm. The aerosol-generating article may comprise a filter plug. The filter plug may be located at a downstream end of the aerosol-generating article. The filter plug may be a cellulose acetate filter plug. The filter plug is approximately 7 mm in length in one embodiment, but may have a length of between approximately 5 mm to approximately 10 mm.

35 In one embodiment, the aerosol-generating article has a total length of approximately 45 mm. The aerosol-generating article may have an external diameter of approximately 7.2 mm. Further, the aerosol-forming substrate may have a length of approximately 10 mm.

Alternatively, the aerosol-forming substrate may have a length of approximately 12 mm. Further, the diameter of the aerosol-forming substrate may be between approximately 5 mm and approximately 12 mm. The aerosol-generating article may comprise an outer paper wrapper. Further, the aerosol-generating article may comprise a separation between the aerosol-forming substrate and the filter plug. The separation may be approximately 18 mm, but may be in the range of approximately 5 mm to approximately 25 mm.

As used herein, the term 'aerosol-forming substrate' relates to a substrate capable of releasing volatile compounds that can form an aerosol. Such volatile compounds may be released by heating the aerosol-forming substrate. An aerosol-forming substrate may conveniently be part of an aerosol-generating article.

The aerosol-forming substrate may be a solid aerosol-forming substrate. Alternatively, the aerosol-forming substrate may comprise both solid and liquid components. The aerosol-forming substrate may comprise a tobacco-containing material containing volatile tobacco flavour compounds which are released from the substrate upon heating. Alternatively, the aerosol-forming substrate may comprise a non-tobacco material. The aerosol-forming substrate may further comprise an aerosol former that facilitates the formation of a dense and stable aerosol. Examples of suitable aerosol formers are glycerine and propylene glycol.

In any of the aspects of the disclosure, the heating element may comprise an electrically resistive material. Suitable electrically resistive materials include but are not limited to: semiconductors such as doped ceramics, electrically "conductive" ceramics (such as, for example, molybdenum disilicide), carbon, graphite, metals, metal alloys and composite materials made of a ceramic material and a metallic material. Such composite materials may comprise doped or undoped ceramics. Examples of suitable doped ceramics include doped silicon carbides. Examples of suitable metals include titanium, zirconium, tantalum, platinum, gold and silver. Examples of suitable metal alloys include stainless steel, nickel-, cobalt-, chromium-, aluminium- titanium- zirconium-, hafnium-, niobium-, molybdenum-, tantalum-, tungsten-, tin-, gallium-, manganese-, gold- and iron-containing alloys, and super-alloys based on nickel, iron, cobalt, stainless steel, Timetal® and iron-manganese-aluminium based alloys. In composite materials, the electrically resistive material may optionally be embedded in, encapsulated or coated with an insulating material or vice-versa, depending on the kinetics of energy transfer and the external physicochemical properties required.

As described, in any of the aspects of the disclosure, the heating element may be part of the aerosol-generating device. The aerosol-generating device may comprise an internal heating element or an external heating element, or both internal and external heating elements, where "internal" and "external" refer to the aerosol-forming substrate. An internal heating element may take any suitable form. For example, an internal heating element may take the form of a heating blade. Alternatively, the internal heater

may take the form of a casing or substrate having different electro-conductive portions, or an electrically resistive metallic tube. Alternatively, the internal heating element may be one or more heating needles or rods that run through the center of the aerosol-forming substrate. Other alternatives include a heating wire or filament, for example a Ni-Cr (Nickel-Chromium), platinum, tungsten or alloy wire or a heating plate. Optionally, the internal heating element may be deposited in or on a rigid carrier material. In one such embodiment, the electrically resistive heating element may be formed using a metal having a defined relationship between temperature and resistivity. In such an exemplary device, the metal may be formed as a track on a suitable insulating material, such as ceramic material, and then sandwiched in another insulating material, such as a glass. Heaters formed in this manner may be used to both heat and monitor the temperature of the heating elements during operation.

An external heating element may take any suitable form. For example, an external heating element may take the form of one or more flexible heating foils on a dielectric substrate, such as polyimide. The flexible heating foils can be shaped to conform to the perimeter of the substrate receiving cavity. Alternatively, an external heating element may take the form of a metallic grid or grids, a flexible printed circuit board, a molded interconnect device (MID), ceramic heater, flexible carbon fibre heater or may be formed using a coating technique, such as plasma vapour deposition, on a suitable shaped substrate. An external heating element may also be formed using a metal having a defined relationship between temperature and resistivity. In such an exemplary device, the metal may be formed as a track between two layers of suitable insulating materials. An external heating element formed in this manner may be used to both heat and monitor the temperature of the external heating element during operation.

The heating element advantageously heats the aerosol-forming substrate by means of conduction. The heating element may be at least partially in contact with the substrate, or the carrier on which the substrate is deposited. Alternatively, the heat from either an internal or external heating element may be conducted to the substrate by means of a heat conductive element.

As an alternative to an electrically resistive heating element, the heating element may be configured as an induction heating element. The induction heating element may comprise an induction coil and a susceptor. In general, a susceptor is a material that is capable of generating heat, when penetrated by an alternating magnetic field. When located in an alternating magnetic field.

When an induction heating element is employed, the induction heating element may be configured as an internal heating element as described herein or as an external heater as described herein. If the induction heating element is configured as an internal heating element, the susceptor element is preferably configured as a pin or blade for penetrating the aerosol-

generating article. If the induction heating element is configured as an external heating element, the susceptor element is preferably configured as a cylindrical susceptor at least partly surrounding the cavity or forming the sidewall of the cavity.

During operation, the aerosol-forming substrate may be completely contained within the aerosol-generating device. In that case, a user may puff on a mouth end of the aerosol-generating device. Alternatively, during operation a aerosol-generating article containing the aerosol-forming substrate may be partially contained within the aerosol-generating device. In that case, the user may puff directly on the aerosol-generating article.

Features described in relation to one embodiment may equally be applied to other embodiments of the invention.

The invention will be further described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 shows a part of an embodiment of an aerosol-generating device of the invention.

Fig. 2 shows an embodiment of a resistance-to-draw modifying element of the invention. Fig. 2a shows a 2/3 view of the element, while Fig. 2b shows a cross-section through the element perpendicular to the longitudinal axis of the second component.

Fig. 3 shows a cross-section through an embodiment of a resistance-to-draw modifying element of the invention comprising an airflow channel with multiple airflow conduits in a first and a second position.

Fig. 4 shows a part of an embodiment of an aerosol-generating device of the invention in a first and second position.

Fig. 5 shows an embodiment of a resistance-to-draw modifying element of the invention comprising a slidable second component in two positions.

Fig. 6 shows a part of an embodiment of the aerosol-generating device of the invention comprising a slidable second component in a first and an ultimate position.

Fig. 7 shows cross-section through an embodiment of a resistance-to-draw modifying element of the invention comprising two large grooves in different positions.

Fig. 1 shows an embodiment of the aerosol-generating device 10 of the invention. The device 10 comprises a resistance-to-draw modifying element 12. The device comprises a heating chamber 14. The heating chamber 14 is configured to receive an aerosol-generating article 16. An aerosol-generating article 16 comprising an aerosol-forming substrate is shown inserted into the heating chamber 14. The aerosol-generating device 10 comprises a longitudinal axis (dotted line).

The RTD modifying element 12 comprises a first component 18 and a second component 20. The first component 18 holds the heating chamber 14. The first component 18

is configured cylindrical. The first component 18 comprises a hollow cylinder. The first component 18 comprises an outer wall 22 and an inner wall 24. The first component 18 comprises at least one groove (not shown). The outer wall 22 is the outer layer of the device 10. The outer wall 22 forms the exterior of the device 10. The inner wall 24 encloses a cavity.

5 The cavity holds the second component 20.

The second component 20 is configured as a cylindrical rod. The second component 20 comprises at least one groove 28. The groove 28 extends along the longitudinal axis of the aerosol-generating device 10. The groove 28 extends along the entire length of the second component 20. The second component 20 abuts the heating chamber 14. The second component 20 is configured to be rotatable with respect to the first component 18.

The first and second components 18, 20 cooperate to form an airflow channel. The groove of the first component 18 and the groove 28 of the second component 20 form the airflow channel. The airflow channel is fluidly connected to the heating chamber 14.

The groove 28 of the second component 20 can be moved relative to the first component 18 by rotating the second component 20 between a first and a second position. By moving of the groove 28 of the second component 20 relative to the first component 18 from the first position to the second position, the inner surface area of the airflow channel is increased, while the cross-sectional area of the airflow channel remains unchanged. In this way the RTD is increased by moving from the first position to the second position.

20 In use, the consumer draws on the device 10 at a downstream end of the article 16. The arrows in Fig. 1 show the direction of the airflow through the device 10. Air entering the device 10 is drawn through the grooves 28 of the first and second components 18, 20 into the heating chamber 14 and through the aerosol-generating article 16 into the mouth of the consumer at the downstream end of the article 16.

25 Fig. 2 shows a part of the RTD modifying element 12 of the invention. Fig. 2a shows a 2/3 view of the element 12. The element 12 comprises the first component 18 and the second component 20. A part of the first component 18 surrounding the second component 20 has been removed in order to provide an unrestricted view of the second component 20. The second component comprises an outer wall 26. Both, the first and the second components 18, 20 are shown with a single groove 28. The arrow indicates the direction of flow of the airflow through the airflow channel. The grooves 28 are both of cylindrical shape and have a semi-circular cross section.

30 The element 12 illustrated on the left-hand side of Fig. 2a shows a configuration in which the groove 28 of the first component 18 abuts the groove 28 of the second component 20. This configuration corresponds to a first position. The two grooves 28 together form a single airflow conduit. The two grooves 28 form an airflow conduit with an essentially continuous inner surface. The inner surface of the airflow conduit corresponds to the inner surface of the airflow

channel. The surface area of the inner surface of the airflow channel corresponds to the inner surface area of the airflow channel. The element 12 shown on the left-hand side of Fig. 2b shows the same configuration of the element 12 in a cross-sectional view.

The element 12 illustrated on the right-hand side of Fig. 2a shows a configuration in which the groove 28 of the second component 20 is offset from the groove 28 of the first component 18. This corresponds to a second position. The configuration shown on the right-hand side of Fig. 2a can be obtained, starting from the configuration shown on the left-hand side of Fig. 2a, by rotating the second component 20 relative to the first component 18 in a clockwise direction (indicated by the curved arrow on the second component).

The groove 28 of the first component 18 is part of a first airflow conduit. The groove 28 of the second component 20 is part of a second airflow conduit. The inner surface of the first airflow conduit is formed from the surface area of the groove 28 of the first component 18 and the surface area of a part of the outer wall of the second component 20 abutting the groove 28 of the first component 18. The inner surface of the second airflow conduit is formed from the surface area of the groove 28 of the second component 20 and the surface area of a part of the inner wall of the first component 18 abutting the groove 28 of the first component 18. The airflow channel is formed by both the first and second airflow conduit. As indicated by the arrows at the grooves, air can flow through both airflow conduits. The inner surface area of the airflow channel is the combined surface area of the first and second airflow conduits.

In the configuration shown on the right-hand side of Fig. 2a, the surface area of the airflow channel is greater than in the configuration shown on the left-hand side of Fig. 2a. The increase in the surface area is equal to the surface area of the part of the second component 20 abutting the groove 28 of the first component 18 and the surface area of the part of the first component 18 abutting the groove 28 of the second component 20. The right-hand side of Fig. 2b shows the same configuration of the element 12 in the second position in a cross-sectional view. Due to the increase of the surface area of the airflow channel, the RTD is increased in the second position in comparison with the first position.

Fig. 3 shows an embodiment of the RTD modifying element 12 in which the first component 18 and the second component 20 each comprise a multitude of grooves 28. More precisely, the first component 18 and second component 20 are each shown to have five grooves 28. The element 12 shown on the left-hand side of Fig. 3 shows the element 12 in an initial configuration corresponding to the first position. In the first position, each groove 28 of the first component 18 abuts a groove 28 of the second component 20. Hence, five pairs of abutted grooves 28 are formed. The airflow channel is formed by the five pairs of abutted grooves 28. The five pairs of abutted grooves 28 each form an airflow conduit. In this configuration, the inner surface area of the airflow channel is the sum of the surface areas of

the five grooves 28 of the first component 18 and the surface areas of the five grooves 28 of the second component 20.

In use, the second component 20 may be rotated relative to the first component 18. In the present embodiment, the second component 20 is rotated clockwise as indicated by the curved arrow on the second component 20.

The element 12 shown on the right-hand side of Fig. 3 shows the configuration of the element 12 in the second position resulting from the rotation. In this configuration, four grooves 28 of the first component 18 abut four grooves 28 of the second component 20 to form four pairs of abutted grooves 28. This configuration comprises two unpaired grooves 28. The four pair of abutted grooves 28 and two unpaired grooves 28 together form the airflow channel. The four pair of abutted grooves 28 and two unpaired grooves 28 form six airflow conduits. In this configuration, the inner surface area of the airflow channel is the combined surface area of the five grooves 28 of the first component 18, the five grooves 28 of the second component 20, the surface area of the part of the first component 18 abutting the unpaired groove 28 of the second component 20 and the surface area of the part of the second component 20 abutting the unpaired groove 28 of the first component 18. The inner surface area of the airflow channel in the second position is hence increased relative to the inner surface area of the airflow channel in the first position by the surface area of the part of the first component 18 abutting the unpaired groove 28 of the second component 20 and the surface area of the part of the second component 20 abutting the unpaired groove 28 of the first component 18. The increase surface area leads to an increase in the frictional force exerted by the surface of the airflow channel on the airflow through the airflow channel. The increased frictional force results in a higher pressure drop across the length of the airflow channel. Hence, the RTD of the airflow channel and hence of the aerosol-generating device 10 is increased by the augmentation of the inner surface area of the airflow channel.

Although not shown in Fig. 3, the second component 20 can be further rotated clockwise to a third position. In the third position, the number of abutted pairs of grooves 28 is reduced to three pairs. By the same token, a further unpaired groove 28 of the first component 18 and a further unpaired groove 28 of the second component 20 are formed, giving a total of four unpaired grooves 28. Accordingly, by rotating the second component 20 to a third position, the inner surface area of the airflow channel is further increased by the surface area of the part of the first component 18 abutting the second unpaired groove 28 of the second component 20 and the surface area of the part of the second component 20 abutting the second unpaired groove 28 of the first component 18. The increase in the inner surface area of the airflow channel further increases the energetic losses resulting from frictional forces exerted by the inner surface of the airflow channel on the airflow through the airflow channel. This results in

an increased pressure drop across the length of the airflow channel. Hence, the RTD of the device 10 is further increased in third position relative to the second position.

The second component 20 can further be rotated stepwise until in an ultimate position all five grooves 28 of the first component 18 and all five grooves 28 of the second component 20 are unpaired. In the ultimate position, the inner surface area of the airflow channel is maximised (corresponding to the surface area of ten grooves 28 and the corresponding part of the first and second components 18, 20 abutting the respective unpaired groove 28). In the ultimate position, the RTD of the aerosol-generating device 10 is maximised. In the ultimate position, the RTD is increased by approximately 64% compared to the first position. Each rotating step may increase the RTD by approximately 13%. The number of pairs of grooves 28 and the number of positions can be chosen appropriately depending upon the desired options of adjusting the RTD of the device.

Fig. 4 shows a part of an aerosol-generating device 10 of the invention. The left-hand side of Fig. 4 shows a transverse cross-section of the aerosol-generating device 10 through the RTD modifying element 12 and a cross-section through the aerosol-generating device 10 parallel to the longitudinal axis of the aerosol-generating device 10. The first and second components 18, 20 each have two grooves 28. The grooves 28 extend along the whole length of the first and second components 18, 20, respectively. The RTD modifying element 12 is shown in a first position, in which both grooves 28 on the first component 18 are paired with a groove 28 of the second component 20. The two pairs of abutted grooves 28 form the airflow channel.

The right-hand side of Fig. 4 shows a cross-section of the RTD modifying element 12 in a first position and a second position. In the first position, the element 12 comprises two pairs of abutted grooves 28. In the second position, the element 12 comprises one pair of abutted grooves 28 and two unpaired grooves 28. The second position is obtained by rotating the second component 20 relative to the first component 18. As indicated by the curved, double-headed arrow, the element 12 can be moved back and forth between the first position and the second position.

Fig. 5 shows a part of an embodiment of the aerosol-generating device 10. The second component 20 may be slid relative to the first component 18 along the longitudinal axis of the aerosol-generating device 10. The left-hand side of Fig. 5 shows a configuration corresponding to a first position. The second component 20 is offset relative to the first component 18 in an upstream direction. The airflow channel is formed by a part of the inner wall 24 of the first component 18 and a part of the outer wall of the second component 20. The airflow channel has a certain length 30. The first component 18 comprises two grooves 28. The two grooves 28 are arranged opposite each other on the inner wall 24 of the first component 18. A part of the two grooves 28 of the first component 18 define the airflow channel of the aerosol-

generating device 10 together with the groove-abutting part of the second component. The airflow channel begins at the location along the longitudinal axis of the aerosol-generating device 10 at which at the upstream end of the first component 18 is arranged. The airflow channel ends at the location along the longitudinal axis of the aerosol-generating device 10 at which the downstream end of second component 20 is arranged.

The aerosol-generating device 10 comprises an air outlet channel 32. The air outlet channel 32 abuts the heating chamber 14.

An aerosol-generating article 16 is shown inside the heating chamber 14. In use, the user draws air into device 10. The air flows through the airflow channel and then through the air outlet channel 32 into the heating chamber 14 with the aerosol-generating article 16. The direction of airflow is indicated by the arrows. Aerosol formed from an aerosol-generating substrate of the aerosol-generating article 16 then enters the users mouth through the mouth end of the aerosol-generating device 10.

Both grooves 28 only extend partially along the length of the inner wall of first component 18. The grooves 28 on the first component 18 are of different lengths. The upper groove 28 is longer than the lower groove 28. The lower groove 28 ends at a location along the longitudinal axis of the second component 20 which is further upstream than the upper groove 28.

The second component 20 may be slid relative to the first component 18 to a second position, such that the length 30 of the airflow channel is increased. By increasing the length 30 of the airflow channel, the inner surface area of the airflow channel is increased. Due to the larger inner surface area of the airflow channel, the frictional losses of the airflow due to interactions with the surface of the airflow channel are increased thereby leading to a higher RTD.

The right-hand side of Fig. 5 shows a configuration corresponding to a further position. This further position is obtained by sliding the second component 20 further downstream relative to the first component 18, such that airflow through the lower groove 28 is blocked. The airflow through the lower groove 28 is blocked by the second component 20 and the end wall 34 of the lower groove 28. The downstream end of the second component 20 is arranged at a location along the longitudinal axis of the device 10 which is further downstream than the end wall 34 of the lower groove 28 of the first component 18, but is upstream of the end wall of the upper groove 28. In this further position, air can still flow through the upper groove 28. In this further position, the size of the air outlet channel is smaller than in the first position. In this further position, the resistance to draw is increased relative to the first position by increasing the length 30 of the airflow channel and by blocking the lower groove 28.

In an ultimate position (not shown), the second component 20 is further slid downstream relative to the first component 18 until the first component 18 blocks the airflow

through the upper groove 28 of the first component 18. In this position, the second component 20 extends to a position along the longitudinal axis of the aerosol-generating device 10 which is further downstream than the end wall of the upper groove 28 of the first component 18. In this ultimate position, airflow through the airflow channel is fully blocked.

5 Fig. 6 shows a part of an embodiment of the aerosol-generating device 10. The device 10 comprises a RTD modifying element 12 comprising a first component 18 with two grooves 28 on the inner wall 24 of the first component 18. The second component 20 does not comprise grooves 28. The left-hand side of Fig. 6 shows a transverse cross-section through the RTD modifying element 12. The central part and right-hand side of Fig. 6 show a cross-section of  
10 the aerosol-generating device 10 parallel to the longitudinal axis of the device 10. The central part of Fig. 6 shows a configuration corresponding to the first position. The right-hand side of Fig. 6 shows a configuration corresponding to further position. The further position is obtained by sliding downstream the second component 20 relative to the first component 18. In the further position, the airflow through the upper grooves 28 is blocked by the second component  
15 20 and the end wall of the groove of first component 18. In the further position, air can still exit the lower groove through a restricted air outlet channel.

Fig. 7 shows transverse cross-sections through an embodiment of the RTD modifying element 12 of the invention. The RTD modifying element 12 comprises a single groove 28 on the inner wall 24 of the first component 18 and a single groove 28 on the outer wall of the  
20 second component 20. The groove 28 of the first component 18 extends across half of the surface of the inner wall 24 of the first component 18. The groove 28 of the second component 20 extends across half of the surface of the outer wall of the second component 20.

The left-hand part of Fig. 7 shows a configuration corresponding to the first position. In this position the grooves 28 of the first and second components 18, 20 are aligned. The aligned  
25 pair of grooves 28 forms the airflow channel. The inner surface area of the airflow channel is equal to the surface areas of the grooves 28

The right-hand part of Fig. 7 shows a configuration corresponding a further position. This position is obtained by rotating the second component 20 relative to the first component 18. In this further position, the inner surface area of the airflow channel is increased by the  
30 surface area of the part of the inner wall 24 of the first component 18 that does not abut a part of the groove 28 of the second component 20 and the part of the outer wall of the second component 20 that does not abut a part of the groove 28 of the first component 18. The embodiment allows a stepless RTD modification by rotating the second component 20 in small increments.

**CLAIMS**

1. An aerosol-generating device comprising a resistance-to-draw modifying element, wherein the resistance-to-draw modifying element comprises:

5 a first component,

a second component,

at least one airflow channel, wherein the first component and the second component cooperate to form the airflow channel,

10 wherein at least one of the first component and the second component are configured to be moveable with respect to the other of the first component and second component between at least a first position and a second position,

wherein an inner surface area of the airflow channel formed by the first component and the second component is smaller when the first component and the second component are in the first position than the inner surface area of the airflow channel when the first component  
15 and the second component are in the second position, and

wherein the cross-sectional area of the airflow channel in the first position and in the second position remains unchanged.

2. The aerosol-generating device according to claim 1, wherein the first  
20 component comprises a cavity, and wherein the second component is configured to be moveable within the cavity.

3. The aerosol-generating device according to any of the preceding claims, wherein one or both of the first component and the second component are configured to be  
25 rotatable with respect to each other.

4. The aerosol-generating device according to any of the preceding claims, wherein one or both of the first component and the second component are configured to be moveable with respect to the other of the first component and the second component between  
30 at least the first position, the second position and a third position,

wherein the inner surface area of the airflow channel in the first position is smaller than the inner surface area of the airflow channel in the second position,

wherein the inner surface area of the airflow channel in the second position is smaller than the inner surface area of the airflow channel in the third position, and

35 wherein the cross-sectional area of the airflow channel in the first position, second position and third position remains unchanged.

5. The aerosol-generating device according to any of the preceding claims, wherein the first component comprises at least one groove, such as to form a first part of the airflow channel, and wherein the second component comprises at least one groove, such as to form a second part of the airflow channel.

5

6. The aerosol-generating device according to any of the preceding claims, wherein the first component comprises multiple grooves, such that each groove forms a part of the airflow channel, wherein the second component comprises multiple grooves, such that each groove forms a part of the airflow channel, and wherein preferably the first component and the second component each comprise the same number of grooves.

10

7. The aerosol-generating device according to claims 5 and 6, wherein in the first position, each groove of the first component abuts one groove of the second component to form a pair of abutted, fluidly communicating grooves, wherein in each consecutive position the number of pairs of grooves is consecutively reduced by one pair of grooves.

15

8. The aerosol-generating device according to any of the preceding claims, wherein one or more of the first component, the cavity and the second component have a cylindrical shape.

20

9. The aerosol-generating device according to any of the preceding claims, wherein the aerosol-generating device comprises a heating chamber, wherein the heating chamber is arranged downstream of the resistance-to-draw modifying element, and wherein the heating chamber abuts the resistance-to-draw modifying element.

25

10. The aerosol-generating device according to any of the preceding claims, wherein one or both of the first component and the second component are configured to be moveable, preferably slidable, with respect to the other of the first component and the second component along a longitudinal axis of one or more of the aerosol-generating device, the first component and the second component.

30

11. The aerosol-generating device according to claim 10, wherein the length of the airflow channel in one of the first position and the second position is larger than the length of the airflow channel in the other of the first position and the second position.

35

12. The aerosol-generating device according to any of claims 10 and 11, wherein the aerosol-generating device comprises at least one air outlet channel, wherein the first

component and the second component cooperate to at least partially form the air outlet channel, wherein the air outlet channel is arranged downstream of the airflow channel, wherein the airflow channel and the air outlet channel are optionally in fluid communication with each other, and wherein the size of the air outlet channel in the first position is larger than the size of the air outlet in the second position.

13. The aerosol-generating device according to any of claims 10 to 12, wherein the first component and the second component are configured to be movable with respect to each other, such that in consecutive positions, a part of the airflow channel is blocked.

14. The aerosol-generating device according to any of claims 10 to 13, wherein at least one of the first component and the second component are configured to be movable with respect to the other of the first component and the second position to an ultimate position, such that in the ultimate position the airflow channel is fully blocked.

15. The aerosol-generating device according to any of claims 1 to 14, comprising a housing and the resistance-to-draw modifying element.

16. A method for controlling the resistance-to-draw of an aerosol-generating device of claims 1 to 15, wherein the method comprises:

moving one or more of the first component and the second component between a first position and a second position.

Fig. 1

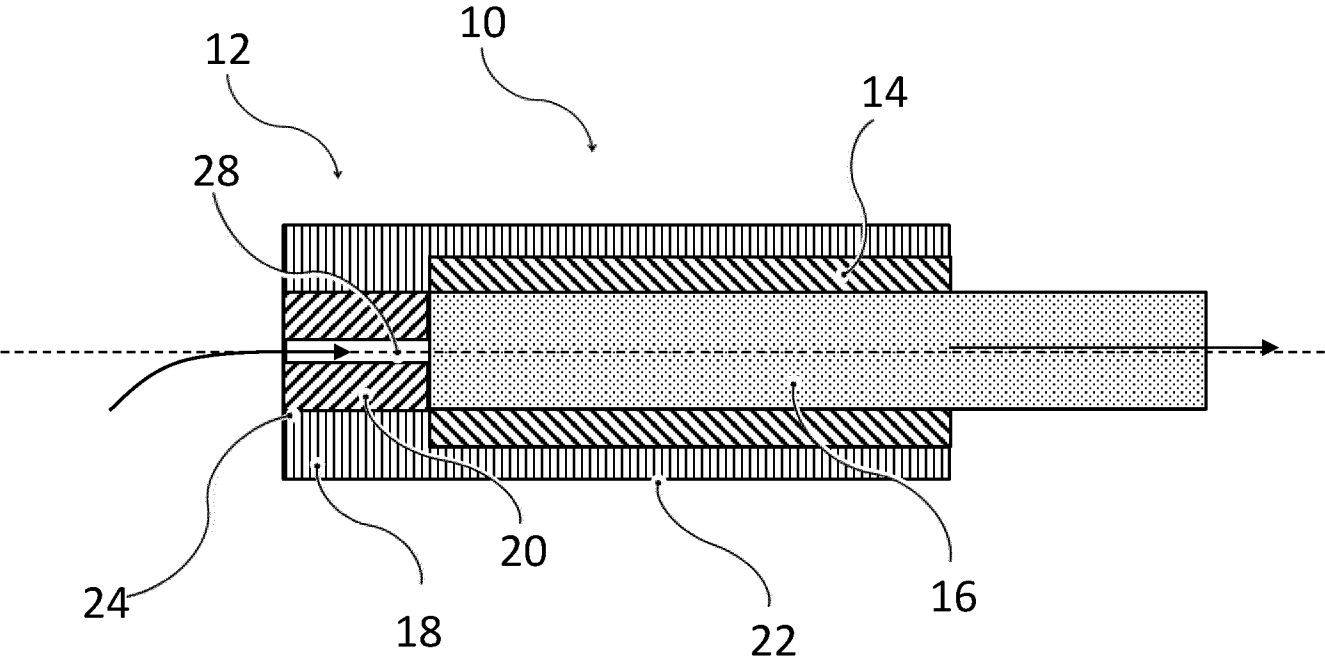


Fig. 2

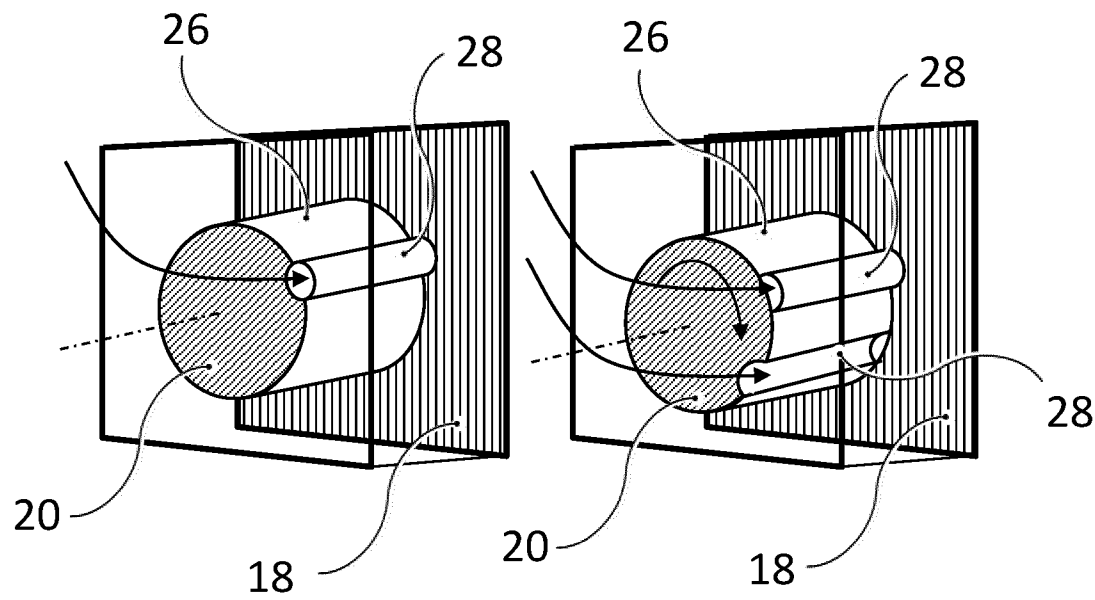


Fig. 2a

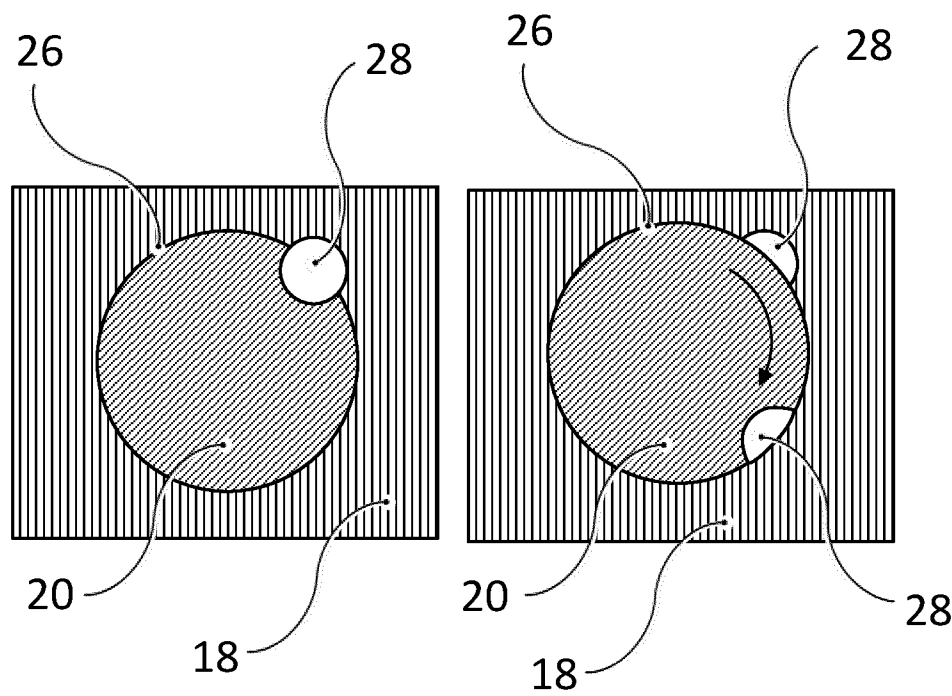


Fig. 2b

Fig. 3

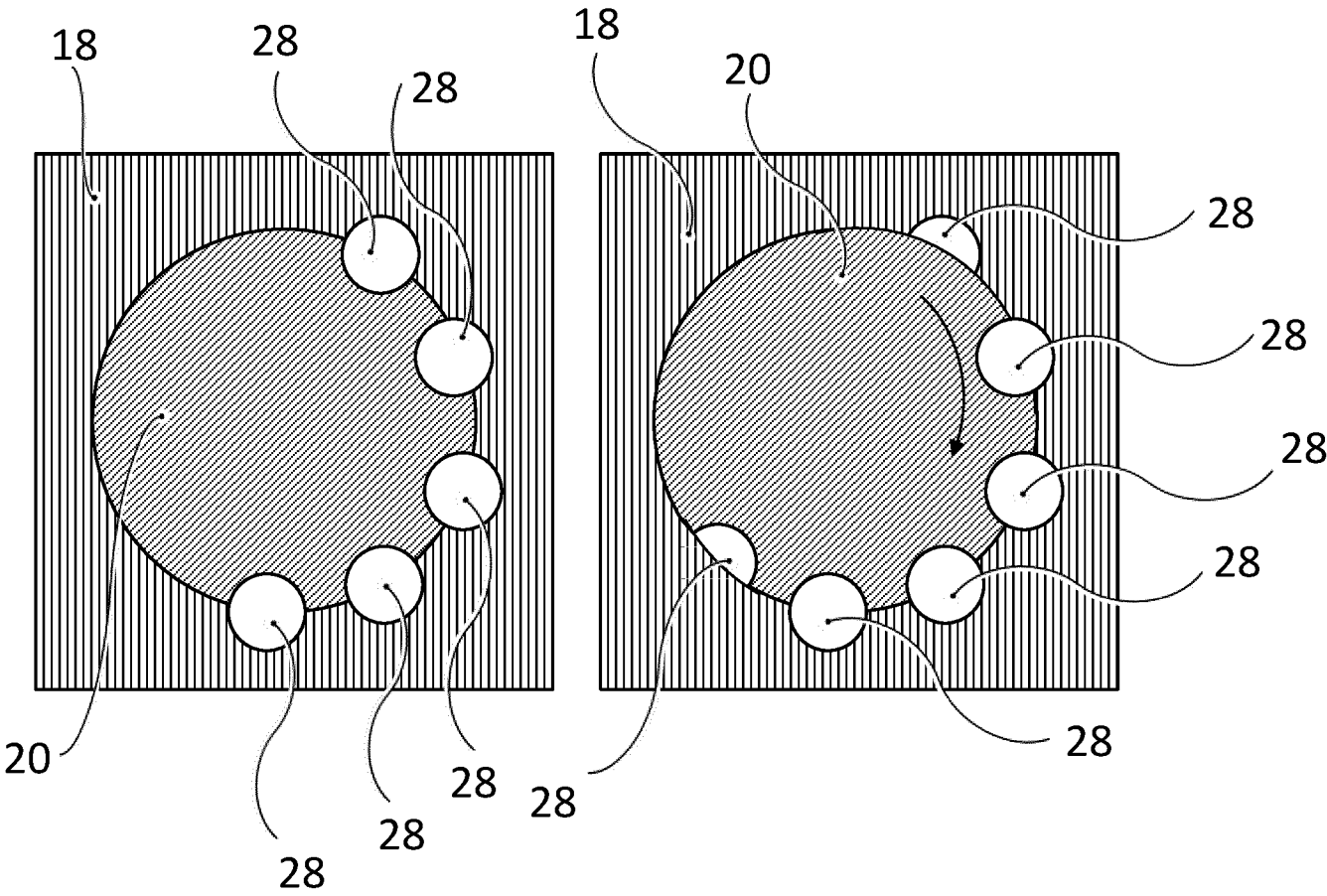


Fig. 4

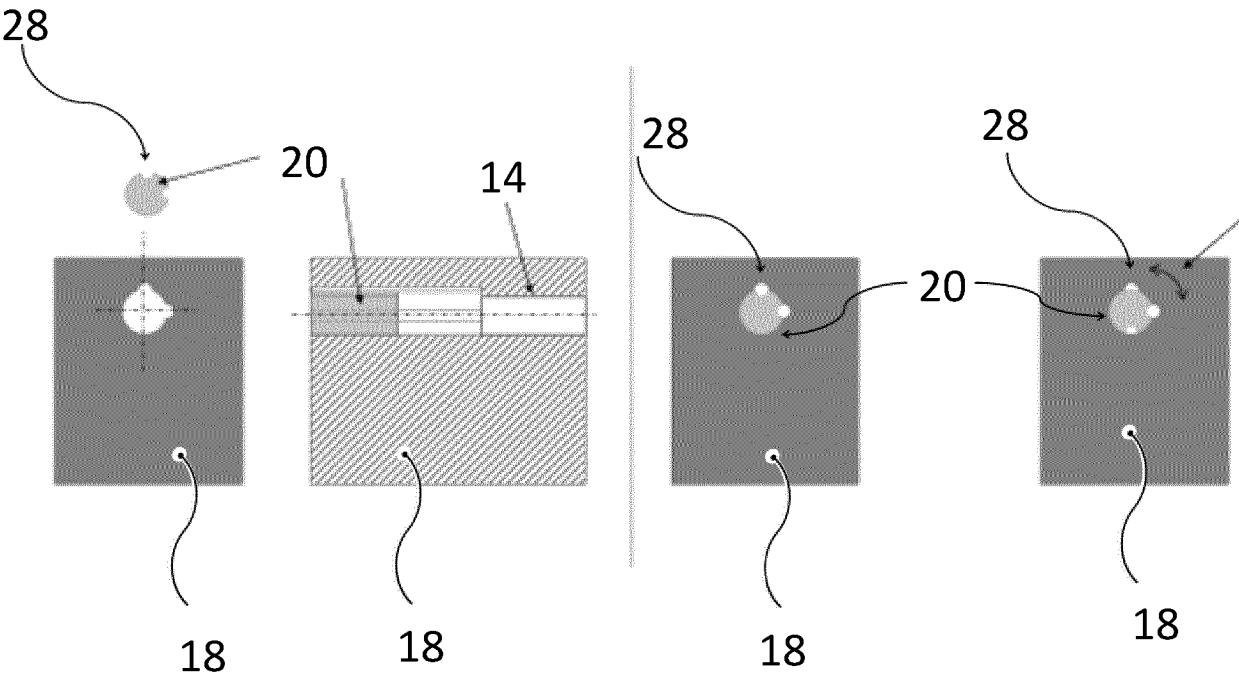


Fig. 5

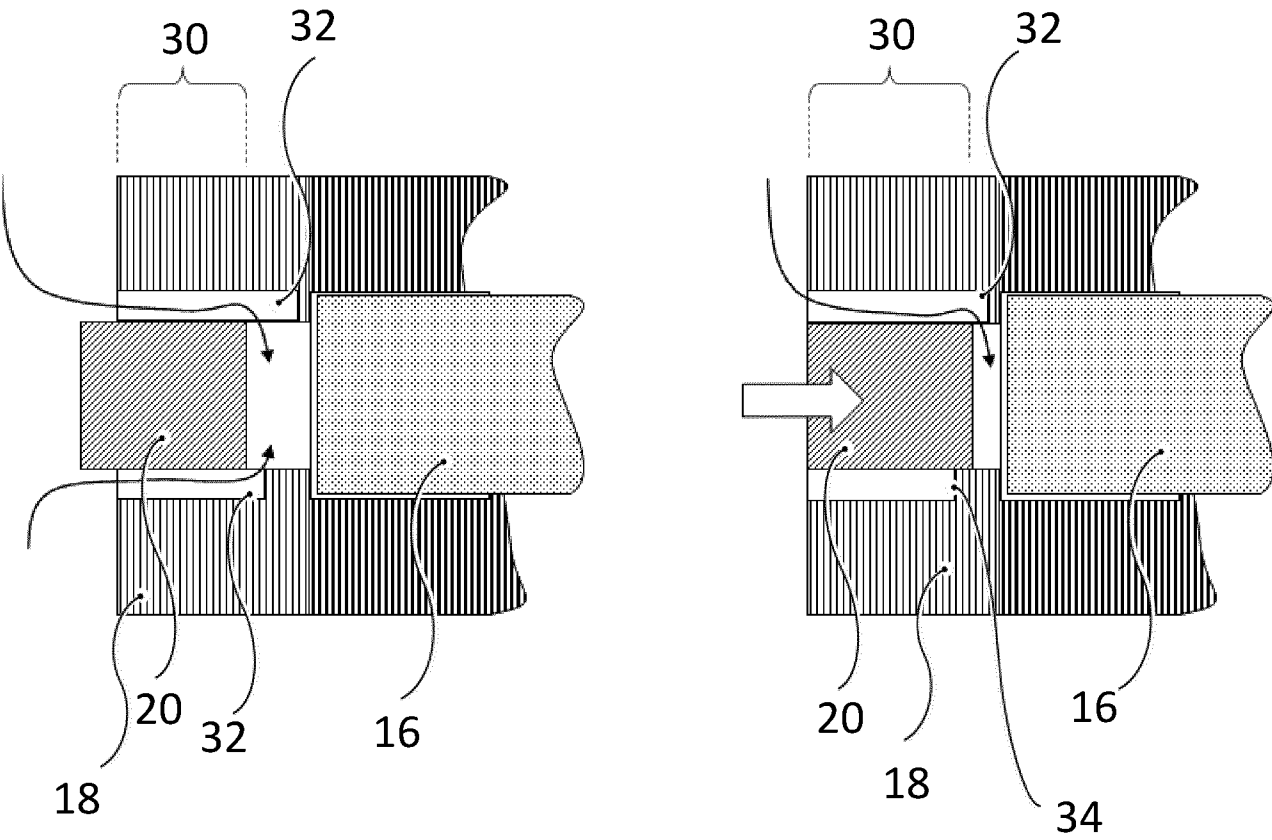


**Fig. 6**

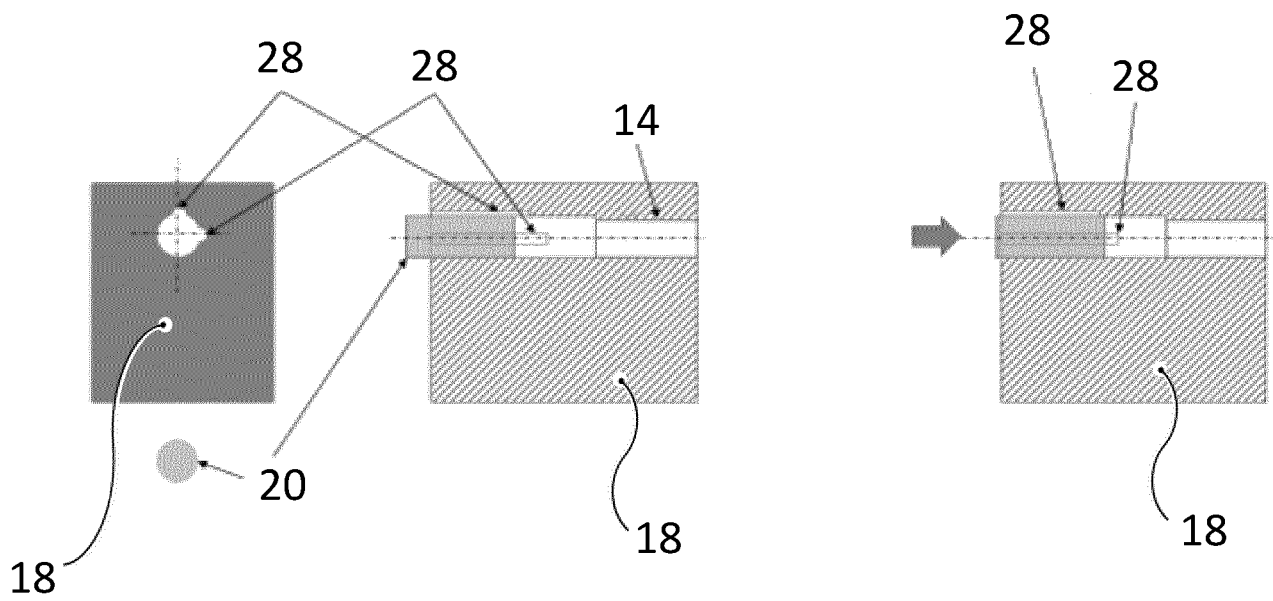
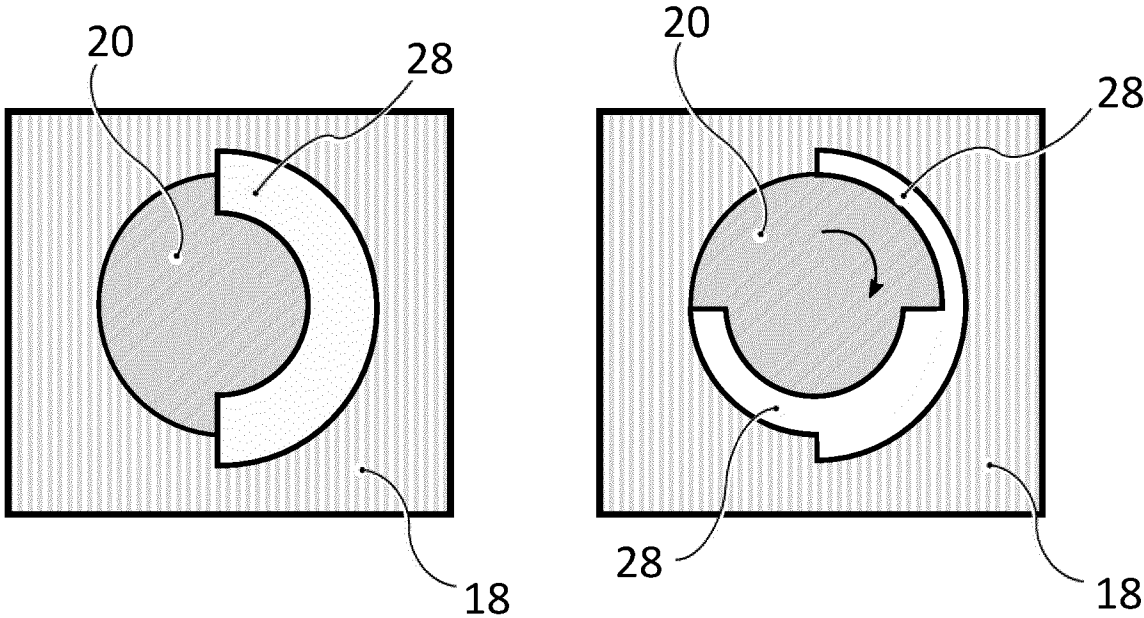


Fig. 7



## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2022/068630

| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br><b>INV.</b> <b>A24F40/40</b> <b>A24F40/485</b> <b>A24F40/20</b> <b>A24F40/42</b> <b>A61M11/04</b><br><b>A61M15/06</b><br><b>ADD.</b><br>According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                       |                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| <b>B. FIELDS SEARCHED</b><br>Minimum documentation searched (classification system followed by classification symbols)<br><b>A24F   A61M   A24D</b><br>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched<br>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)<br><b>EPO-Internal, WPI Data</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                       |                                                                             |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                       |                                                                             |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Citation of document, with indication, where appropriate, of the relevant passages                                                                                    | Relevant to claim No.                                                       |
| <b>X</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>KR 2020 0122668 A (KT &amp; G CORP [KR])</b><br><b>28 October 2020 (2020-10-28)</b>                                                                                | <b>1-4, 8,</b><br><b>10-12,</b><br><b>14-16</b>                             |
| <b>A</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>paragraph [0075]; figures 1-7</b><br><b>paragraph [0095] - paragraph [0104]</b><br>-----                                                                           | <b>5-7</b>                                                                  |
| <b>X</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>WO 2020/127501 A1 (JT INT SA)</b><br><b>25 June 2020 (2020-06-25)</b>                                                                                              | <b>1, 2, 4, 8,</b><br><b>9, 11-16</b>                                       |
| <b>A</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>page 7 - page 12; figures 2a-3</b><br>-----                                                                                                                        | <b>5-7</b>                                                                  |
| <b>A</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>EP 3 491 945 A1 (JAPAN TOBACCO INC [JP])</b><br><b>5 June 2019 (2019-06-05)</b><br><b>paragraph [0028] - paragraph [0051];</b><br><b>figures 1, 8a-8c</b><br>----- | <b>1-16</b>                                                                 |
| <input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                       |                                                                             |
| * Special categories of cited documents :<br>"A" document defining the general state of the art which is not considered to be of particular relevance<br>"E" earlier application or patent but published on or after the international filing date<br>"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)<br>"O" document referring to an oral disclosure, use, exhibition or other means<br>"P" document published prior to the international filing date but later than the priority date claimed<br>"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<br>"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<br>"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<br>"&" document member of the same patent family |                                                                                                                                                                       |                                                                             |
| Date of the actual completion of the international search<br><br><b>10 August 2022</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                       | Date of mailing of the international search report<br><br><b>19/08/2022</b> |
| Name and mailing address of the ISA/<br>European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                       | Authorized officer<br><br><b>Schwertfeger, C</b>                            |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2022/068630

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s)                                                                                                                                                               | Publication<br>date                                                                                                                      |
|-------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| KR 20200122668 A                          | 28-10-2020          | NONE                                                                                                                                                                                     |                                                                                                                                          |
| WO 2020127501 A1                          | 25-06-2020          | CA 3124218 A1<br>CN 113226416 A<br>EA 202191392 A1<br>EP 3897793 A1<br>JP 2022515753 A<br>KR 20210104061 A<br>US 2022007735 A1<br>WO 2020127501 A1                                       | 25-06-2020<br>06-08-2021<br>22-09-2021<br>27-10-2021<br>22-02-2022<br>24-08-2021<br>13-01-2022<br>25-06-2020                             |
| EP 3491945 A1                             | 05-06-2019          | CA 3031874 A1<br>CN 109475182 A<br>EA 201990378 A1<br>EP 3491945 A1<br>JP 6704454 B2<br>JP WO2018020599 A1<br>KR 20190032504 A<br>TW 201806504 A<br>US 2019142073 A1<br>WO 2018020599 A1 | 01-02-2018<br>15-03-2019<br>31-07-2019<br>05-06-2019<br>03-06-2020<br>16-05-2019<br>27-03-2019<br>01-03-2018<br>16-05-2019<br>01-02-2018 |