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(54) **MEASUREMENT DEVICE AND PROCESS
FOR AN AEROSOL GENERATING DEVICE
LIFECYCLE TESTING ARRANGEMENT**

(52) **U.S. Cl.**

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ABSTRACT

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There is provided a testing apparatus for analysing an aerosol generated by an aerosol-generating system comprising an aerosol-forming substrate and a mouthpiece. The testing apparatus comprises an airflow channel that extends from a first channel opening that is configured to receive a mouthpiece of an aerosol-generating system. The testing apparatus further comprises a sensing assembly comprising an emitter configured to emit electromagnetic radiation into the airflow channel and a receiver configured to receive at least some of the electromagnetic radiation from the airflow channel. The testing apparatus further comprises a pump assembly that, in a first configuration of the testing apparatus, is configured to draw air through the airflow channel in a first direction such that an aerosol generated by the aerosol-generating system in use is drawn from the mouthpiece received in the first channel opening and through the airflow channel; and a controller configured to determine at least one characteristic of the aerosol drawn through the airflow channel based on signals received from the sensing assembly. There is also provided a method of analysing an aerosol using the testing apparatus and a method detecting a defect in an aerosol-generating system.

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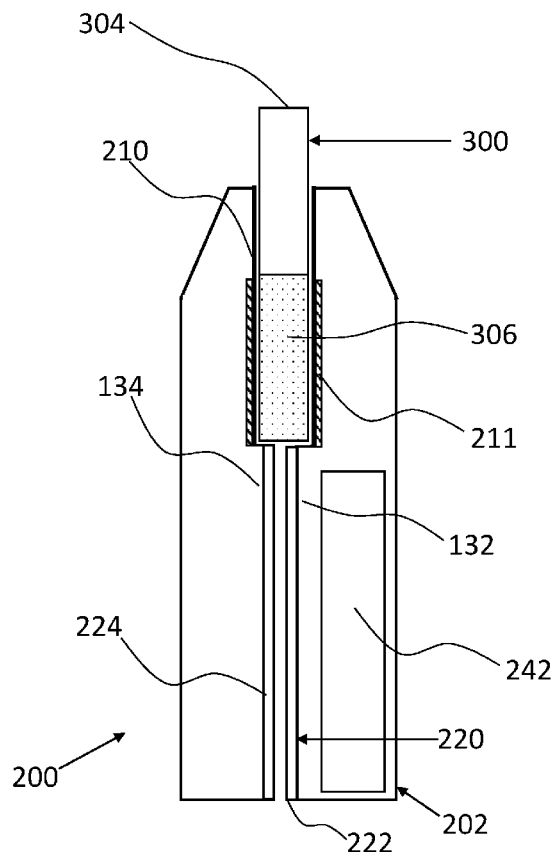
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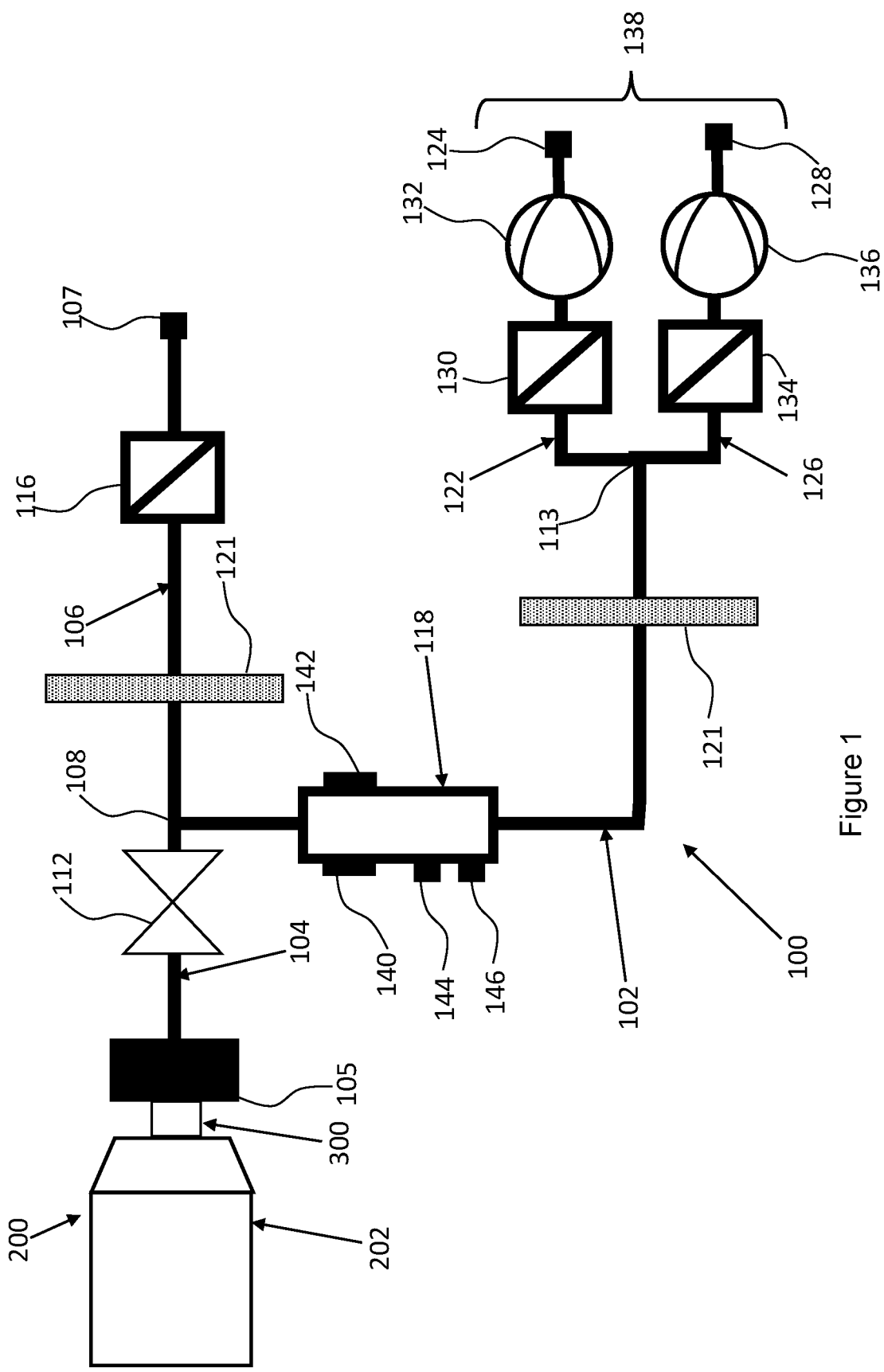


Figure 1

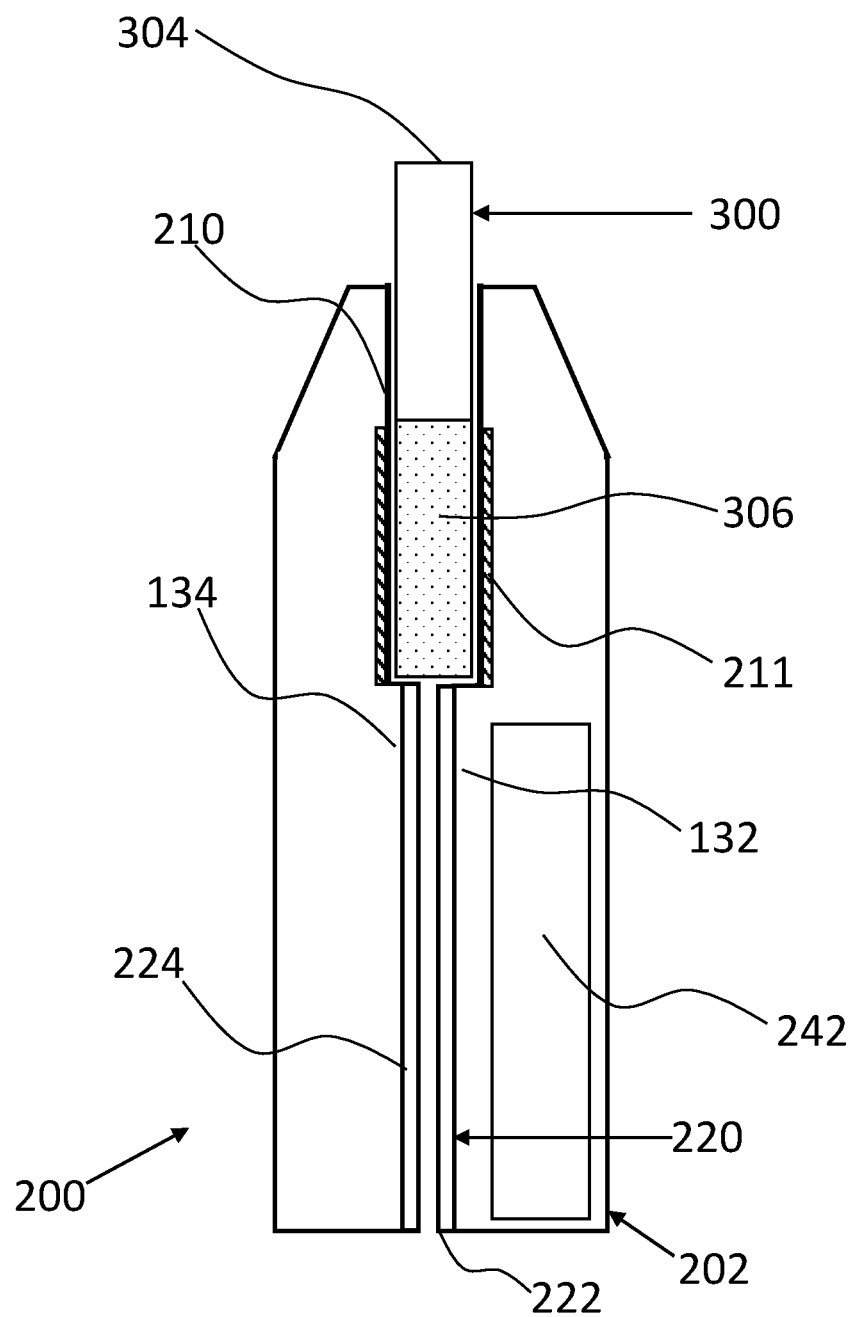


Figure 2

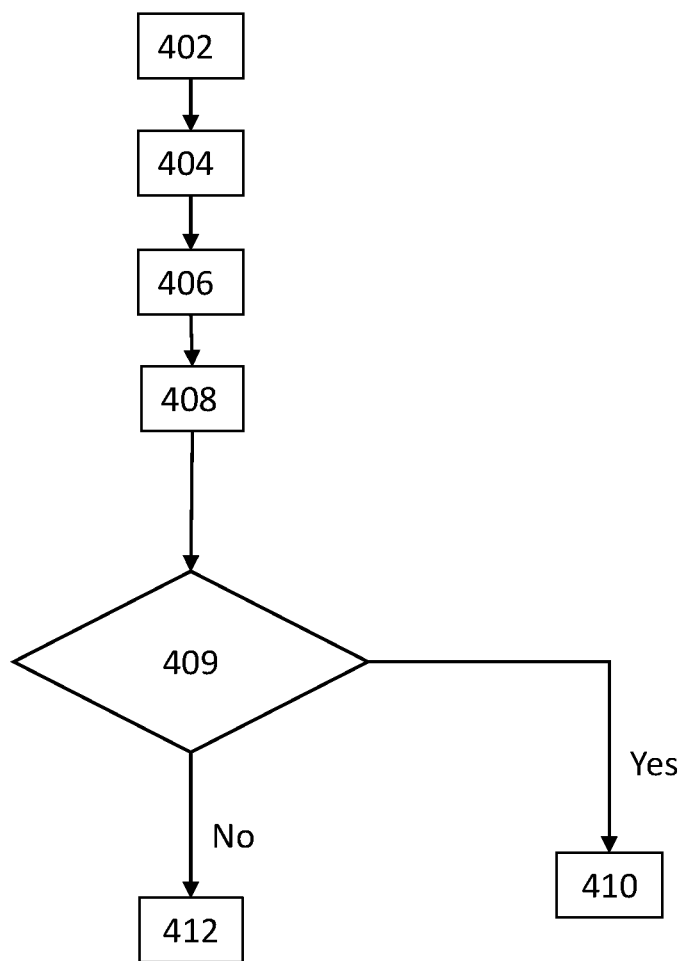


Figure 3

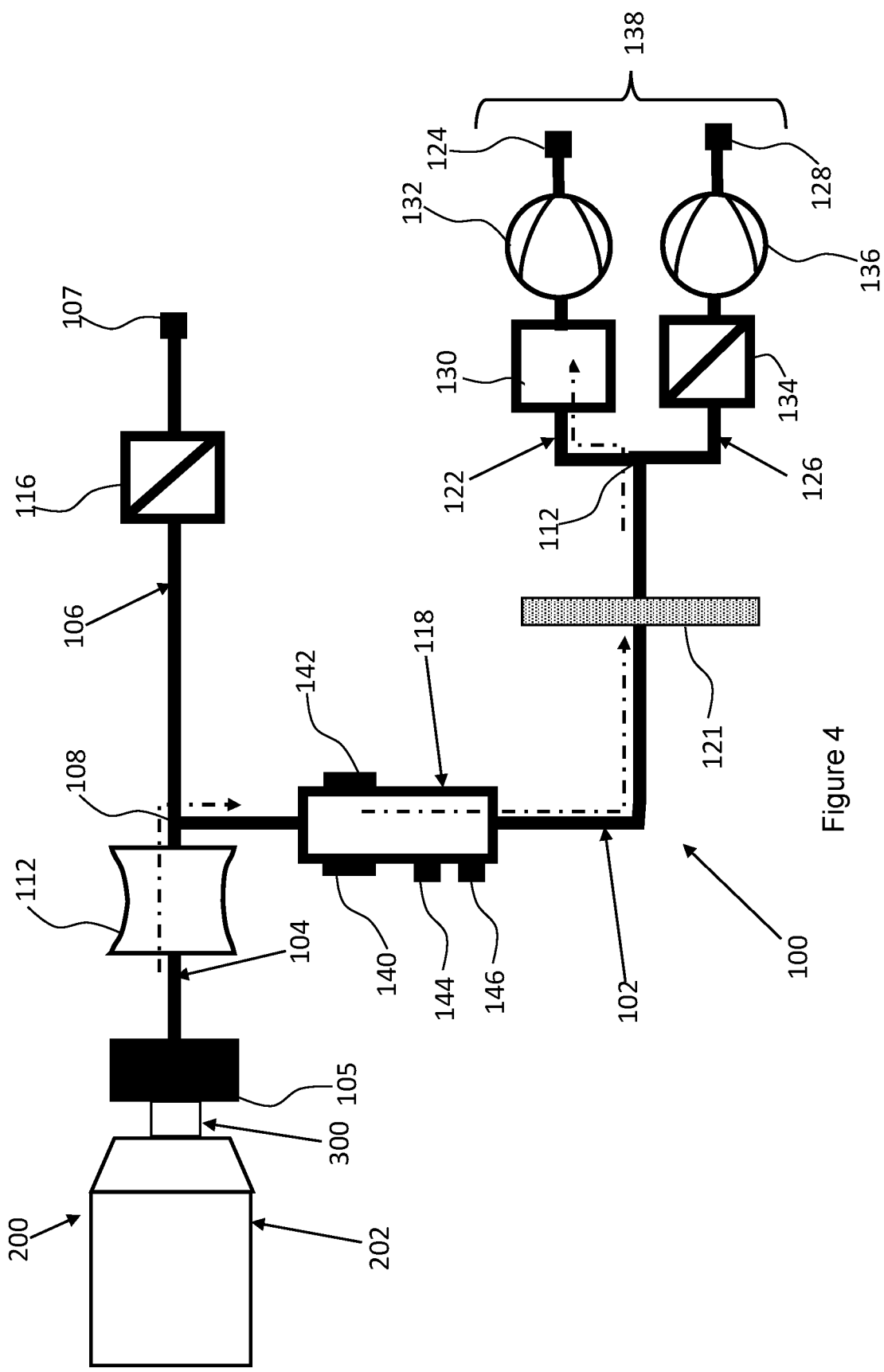
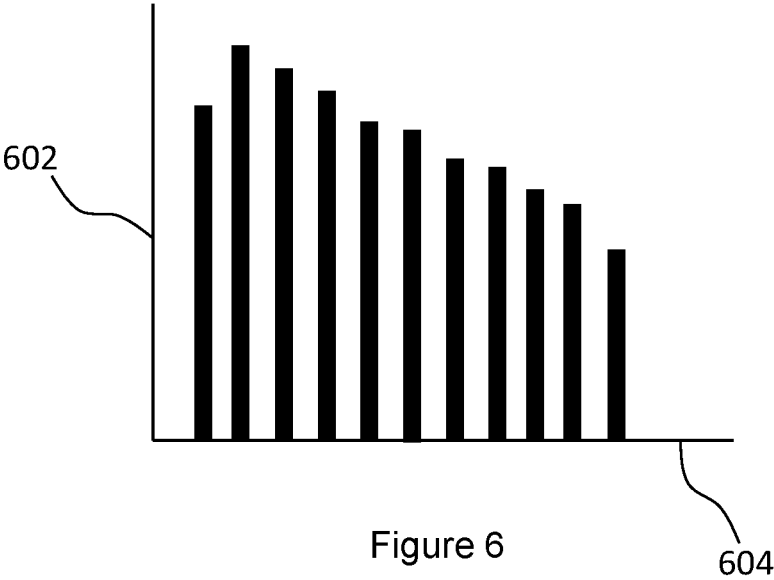
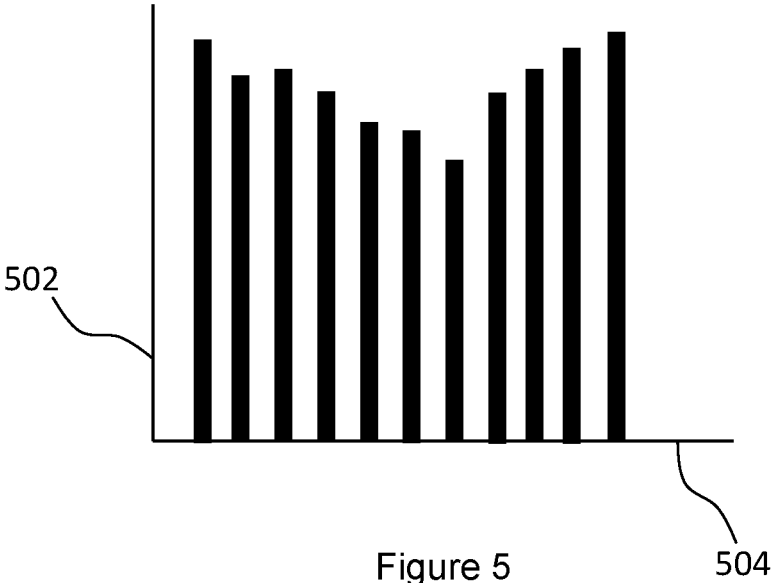


Figure 4



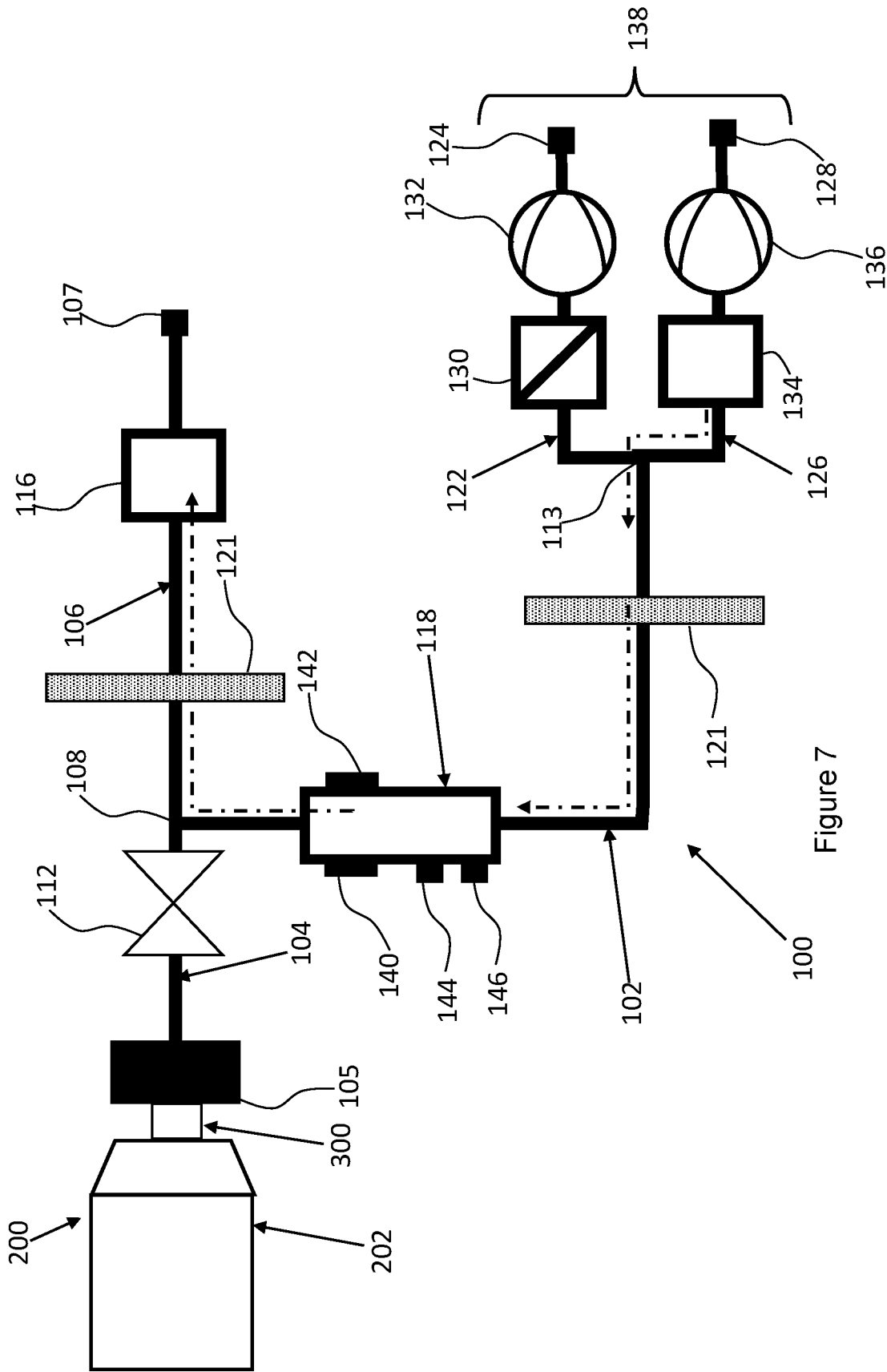


Figure 7

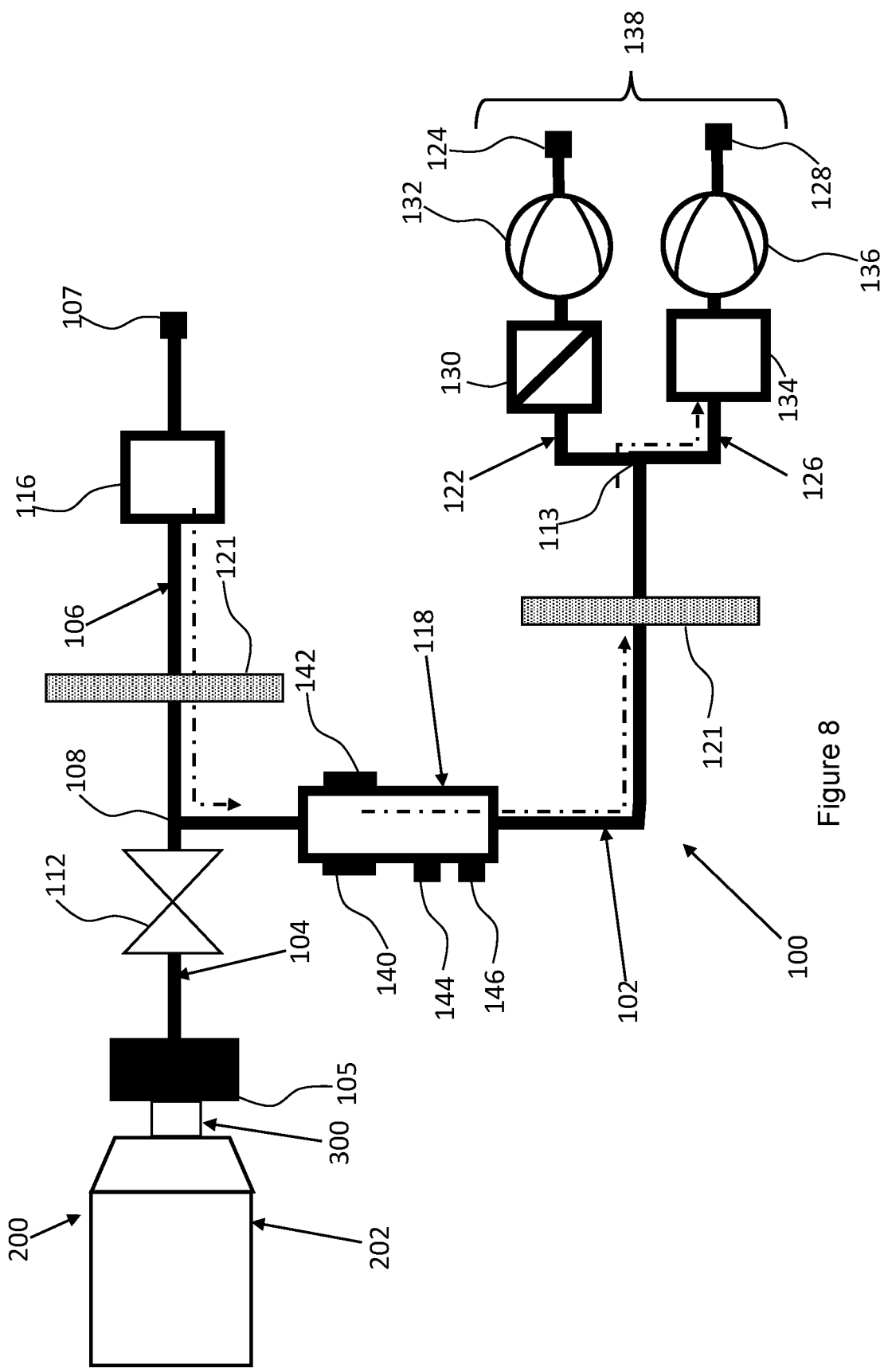
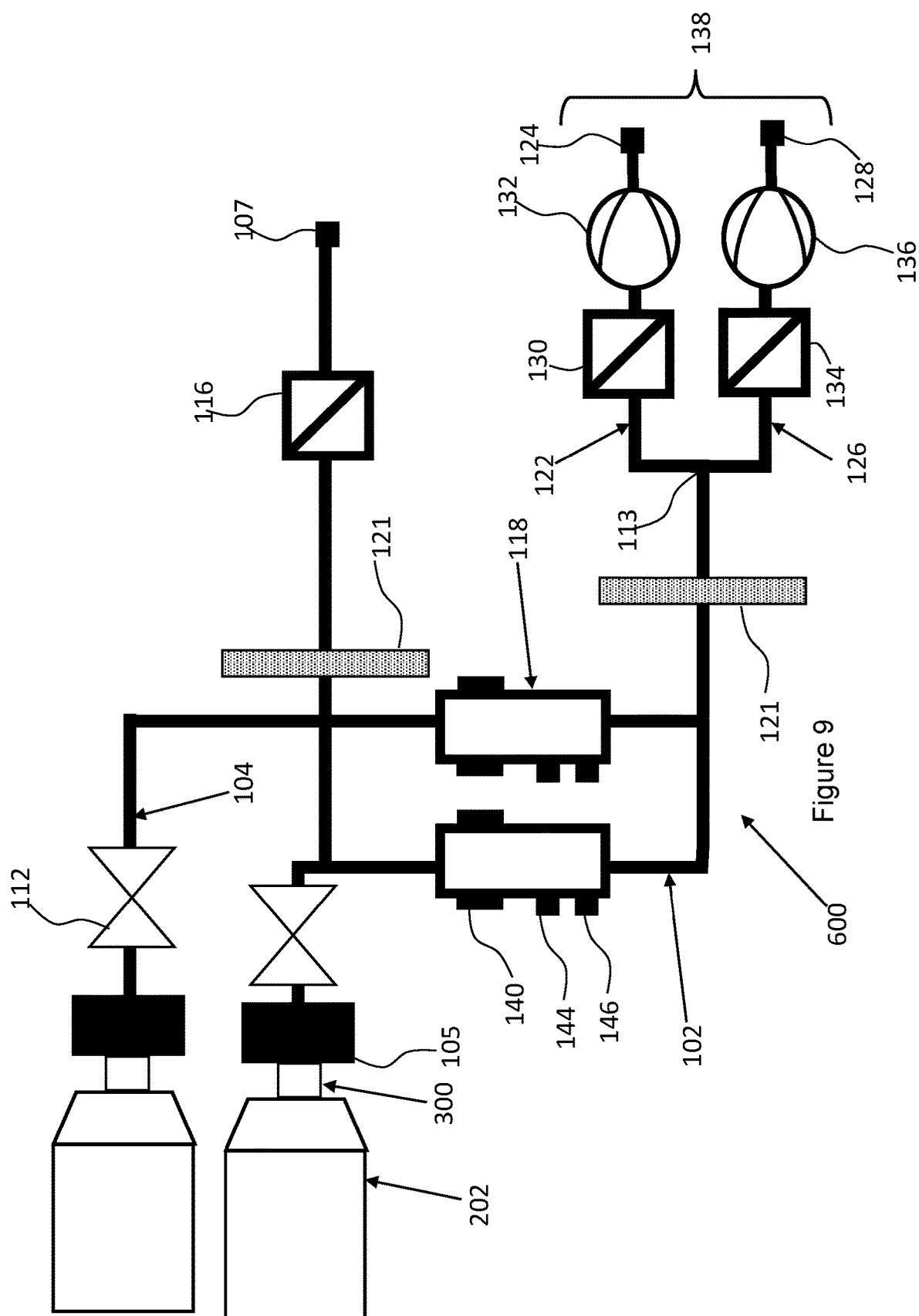
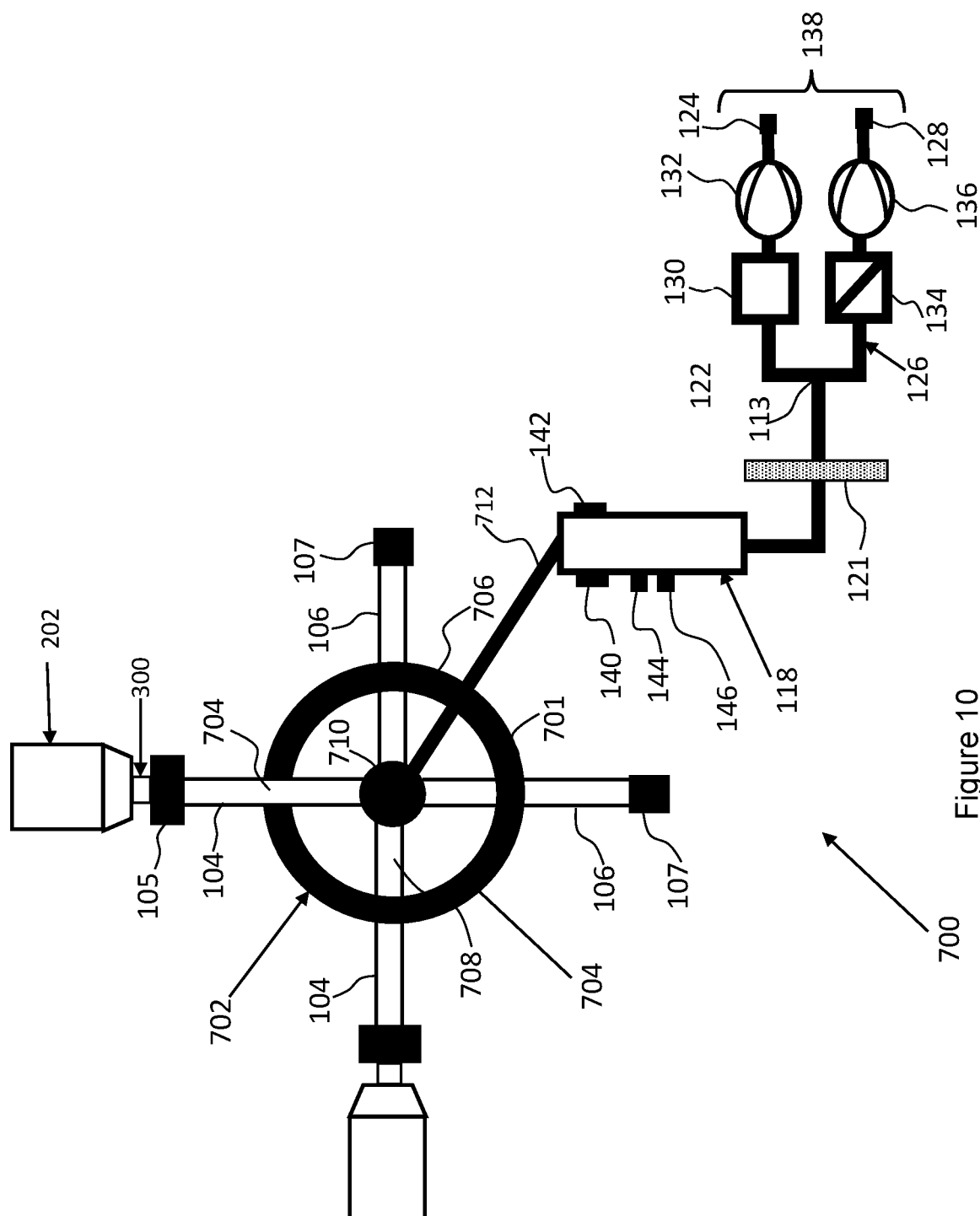
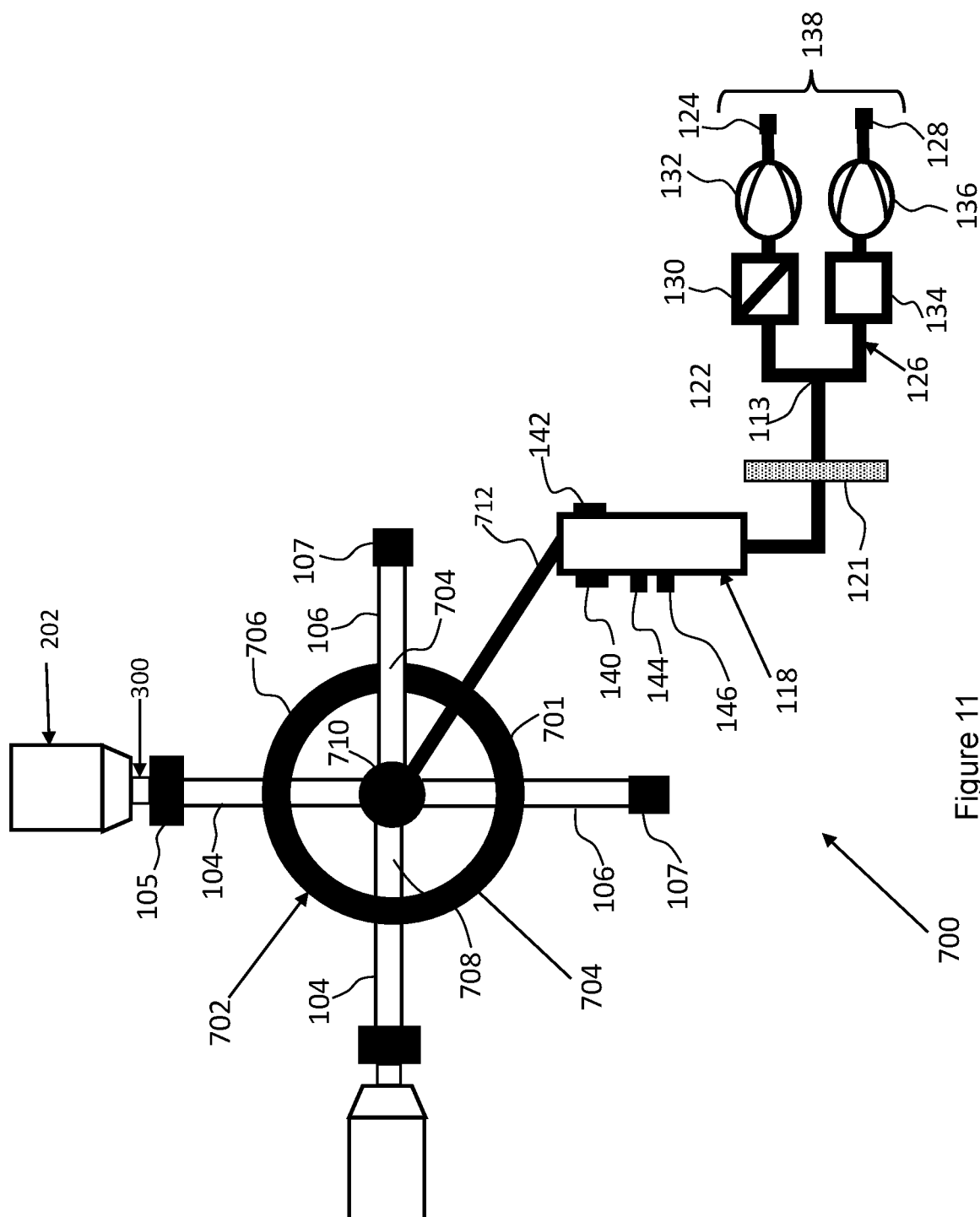


Figure 8







**MEASUREMENT DEVICE AND PROCESS
FOR AN AEROSOL GENERATING DEVICE
LIFECYCLE TESTING ARRANGEMENT**

[0001] The present disclosure relates to a testing apparatus for analysing an aerosol generated by an aerosol-generating system comprising an aerosol-forming substrate and a mouthpiece. The present disclosure also relates to methods of analysing an aerosol generated by such an aerosol-generating system using said testing apparatus and methods of detecting a defect in such an aerosol-generating system.

[0002] Aerosol-generating systems that comprise an aerosol-forming substrate, such as a tobacco containing substrate, and a mouthpiece are known. In such systems, heat is typically applied to the aerosol-forming substrate in order to generate an aerosol which can be inhaled by a user of the system by inhaling through the mouthpiece. Heat may be transferred from a heat source, for example a chemical, electrical or combustible heat source, to the aerosol-forming substrate. The aerosol-forming substrate is not, itself, combusted in such systems.

[0003] Many aerosol-generating systems electrically heat the aerosol-forming substrate. Such aerosol-generating systems may comprise an aerosol-generating device comprising a power supply and a heater assembly. The aerosol-forming substrate is contained in a separate aerosol-generating article which typically takes the forms of a rod and contains a plug of aerosol-forming substrate at or towards a distal end. In use, the aerosol-generating article is received in the aerosol-generating device and the heater assembly is used to heat the aerosol-forming substrate. The heating may be a result of resistive heating of a heater element of the aerosol-generating device that is in thermal contact with the aerosol-forming substrate or inductive heating of a susceptor element of the aerosol-generating device or aerosol-generating article, the susceptor element being in thermal contact with the aerosol-forming substrate.

[0004] Alternatively, an electrically heated aerosol-generating system may comprise an aerosol-generating device comprising a power supply and a heater assembly and the aerosol-forming substrate may be a liquid or a gel contained in reservoir. The reservoir is often formed by a housing of a separate cartridge that is receivable in the aerosol-generating device. In use, the cartridge is received in the aerosol-generating device and the heater assembly is used to heat the aerosol-forming substrate. The heater assembly comprises a heater element that may be part of the cartridge.

[0005] Other aerosol-generating systems are not electrically heated. One such system consists of an aerosol-generating article in which an aerosol is generated by the transfer of heat from a combustible carbonaceous heat source to a physically separate aerosol-forming substrate comprising tobacco material that is located downstream of the combustible carbonaceous heat source. In use, volatile compounds are released from the tobacco material by heat transfer to the aerosol-forming substrate from the combustible carbonaceous heat source and entrained in air drawn through the aerosol-generating article. As the released compounds cool, they condense to form an aerosol that is inhaled by the user. Heat may be transferred from the combustible carbonaceous heat source to the aerosol-forming substrate by one or both of forced convection and conduction.

[0006] All of the above aerosol-generating systems comprise or consist of a consumable component comprising an aerosol-forming substrate. There is a need to be able to

analyse the aerosol that is generated by the aerosol-generating system in use. This may be for quality and assurance testing of the consumable. When the consumable is consumed in combination with an aerosol-generating device, the analysis of the aerosol can also be used for quality and assurance testing of the device. For example, the quantity or quality of the generated aerosol may be determined in testing.

[0007] It is known to use chromatography, for example a high performance liquid chromatography (HPLC) column, to analyse an aerosol generated by an aerosol-generating system. However, chromatography equipment is expensive and complex. Furthermore, it is not possible to perform puff-by-puff analysis of the generated aerosol using chromatography in real time. Puff-by-puff analysis advantageously allows improved analysis of the generated aerosol as it provides information as to the performance of the aerosol-generating system throughout a use cycle or during a product lifecycle. For example, certain properties of the generated aerosol may be expected to change throughout a use cycle such as decrease or increase during sequential puffs. A puff-by-puff analysis may advantageously allow deviations from an expected pattern to be detected.

[0008] It would be advantageous to provide a low cost and simple testing apparatus suitable for analysing an aerosol generated by an aerosol-generating system. It would also be advantages to provide a testing apparatus that is capable of performing a puff-by-puff analysis of the generated aerosol.

[0009] Both consumables, such as aerosol-generating articles, and aerosol-generating devices are typically mass-produced. For quality assurance reasons, it is typically necessary to test a proportion of the articles or devices produced in a batch. This can cause problems such as downtime of the production line and require individual batches to be stored until the testing has been carried. These problems are particularly acute in the production of aerosol-generating articles having the form of a rod that are typically manufactured using very high speed and continuous rod forming techniques.

[0010] It would be advantageous to provide a testing apparatus that is particularly suitable for use in combination with a production line and which does not cause downtime of the production line or complicate the production process.

[0011] In a first aspect of the disclosure there is provided a testing apparatus for analysing an aerosol generated by an aerosol-forming substrate. The testing apparatus may be for analysing an aerosol generated by an aerosol-generating system comprising an aerosol-forming substrate and a mouthpiece.

[0012] The testing apparatus may comprise an airflow channel. The airflow channel may extend from a first channel opening. The first channel opening may be configured to receive a mouthpiece of the aerosol-generating system.

[0013] The testing apparatus may comprise a sensing assembly. The sensing assembly may comprise an emitter. The emitter may be configured to emit electromagnetic radiation. The emitter may be configured to emit electromagnetic radiation into the airflow channel.

[0014] The sensing assembly may further comprise a receiver. The receiver may be configured to receive electromagnetic radiation. The receiver may be configured to receive at least some of the electromagnetic radiation from the airflow channel. In particular, the receiver may be configured to receive at least some of the electromagnetic

radiation from the airflow channel emitted by the emitter. Preferably, the receiver may be configured to measure an intensity of the received electromagnetic radiation.

[0015] The testing apparatus may comprise a pump assembly. In a first configuration of the testing apparatus, the pump assembly may be configured to draw air through the airflow channel in a first direction. The pump assembly may be configured to draw air through the airflow channel in a first direction such that an aerosol-generating system in use is drawn from the mouthpiece received in the first channel opening and through the airflow channel. In this way, the pump assembly may advantageously mimic a user inhaling on the mouthpiece of the aerosol-generating system in a way that corresponds to real-world usage of the system. Preferably, the pump assembly may draw air through the airflow channel in the first direction for a predetermined time and then may stop drawing air through the airflow channel in the first direction. This may be referred to as a puff. The pump assembly may be configured to perform a plurality of successive puffs. The pump assembly may advantageously draw air through the airflow channel in a repeatable way. In this way, repeatable results may be achieved for the different aerosol-generating systems or different puffs of the same aerosol-generating system.

[0016] The pump assembly may also be configured to change characteristics of the air drawn through the airflow channel between different puffs, for example to correspond to a particular usage pattern of an aerosol-generating system or according to specific test conditions.

[0017] The testing apparatus may comprise a controller. The controller may be configured to determine at least one characteristic of the aerosol drawn through the airflow channel. The controller may be configured to determine at least one characteristic of the aerosol drawn through the airflow channel based on signals received from the sensing assembly.

[0018] For example, the controller may be configured to determine at least one characteristic of the aerosol drawn through the airflow channel based on signals received from the receiver. The electromagnetic radiation that is emitted by the emitter may pass through the aerosol drawn through the airflow channel. At least some of the electromagnetic radiation may interact with aerosol. For example, the electromagnetic radiation may be absorbed by the aerosol. The amount of absorption may depend on the quantity of the aerosol present in the flow channel. The amount of absorption may depend on other characteristics of the aerosol, for example the chemical composition of the aerosol. Using this relationship, the controller may advantageously be configured to determine at least one characteristic of the aerosol. Advantageously, the determined characteristic may be used to identify whether the aerosol-generating system is defective or is working correctly.

[0019] The amount of electromagnetic radiation transmitted through the aerosol may be related to the amount of electromagnetic radiation that is absorbed by the aerosol. The more radiation that is absorbed by the aerosol, the less radiation that will be transmitted through the aerosol.

[0020] One of the advantages of such a testing apparatus is that it is relatively inexpensive and straightforward to use, particularly when compared to chromatography equipment that is conventionally used to analyse an aerosol. Furthermore, data may be collected using the testing apparatus in

near real-time. This may be because measurements from the sensing assembly may advantageously be updated continuously as the aerosol is drawn through the airflow channel. Similarly, a puff-by-puff analysis of the generated aerosol may advantageously be possible using the testing apparatus.

[0021] The above described testing apparatus is particularly advantageous in the context of a production line for producing aerosol-generating systems or components of aerosol-generating systems such as aerosol-generating devices or, preferably, consumables comprising the aerosol-forming substrate. Near real-time generation of data may ensure that quality assurance testing performed using the testing apparatus is fast. A defective aerosol-generating system or component of an aerosol-generating system may be determined quickly without the need for quality assurance testing taking place separately to the manufacturing process. For example, a quality assurance test may require one or more components in a batch of components be tested. The components to be tested may be removed from the production line. The components may be tested for defects using the testing apparatus which, advantageously, may be positioned adjacent to the production line. In the meantime, the rest of the batch may continue through the production line, perhaps to be packaged. If a defect is detected, the respective batch may be identified and removed from the production line. If a defect is not detected, the respective batch may proceed, for example to be shipped. There may advantageously be no need to stop the production line to allow for the quality and assurance testing. There is no need to transport the components to be tested to a dedicated testing laboratory, for gas chromatography mass spectrometry analysis to be performed, for sample conditioning, or to store the batch while quality and assurance testing is carried out.

[0022] Preferably, the testing apparatus may be for analysing an aerosol generated by an electrically heated aerosol-generating system for electrically heating an aerosol-forming substrate. For example, the electrically heated aerosol-generating system may comprise an aerosol-generating device for receiving a consumable comprising the aerosol-forming substrate. The consumable may be an aerosol-generating article in the form of a rod receivable in the device.

[0023] Alternatively, the consumable may be a cartridge comprising a housing defining a reservoir for containing the aerosol-forming substrate. The cartridge may be receivable in a corresponding aerosol-generating device.

[0024] Either the consumable or the device may comprise the mouthpiece that is receivable by the first channel opening of the testing apparatus.

[0025] When the consumable is an aerosol-generating article, a distal end of the aerosol-generating article received in the device may protrude from the device. The distal end of the article may form a mouthpiece that is receivable by the first channel opening of the testing apparatus.

[0026] When the consumable is a cartridge, a housing of the cartridge may define a mouthpiece that is receivable by the first channel opening of the testing apparatus. Alternatively, a housing of the device may form a mouthpiece that is receivable by the first channel opening of the testing apparatus.

[0027] Additionally or alternatively, the testing apparatus may be for analysing an aerosol generated by an aerosol-generating system consisting of a heated aerosol-generating

article comprising a combustible heat source such as a carbonaceous combustible heat source, an aerosol-forming substrate downstream of the combustible heat source and a mouthpiece downstream of the heat source. The mouthpiece may be receivable by the first channel opening of the testing apparatus

[0028] As used herein, a “defect” may be any problem with the aerosol-generating system which may be identified based on characteristics of the aerosol that can be detected using the sensing assembly. This may include defects in at least one of the aerosol-forming substrate or an aerosol-generating device, if present.

[0029] In one example, the testing apparatus may be configured to identify defects in an aerosol-forming substrate. The defect may relate to the physical or chemical properties of the aerosol-forming substrate. An aerosol-forming substrate may comprise an aerosol former such as glycerine or propylene glycol. An example of a defect relating to chemical properties of the aerosol-forming substrate may include the concentration or amount of the aerosol former being incorrect such that an unexpected amount of aerosol may be generated. For example, if the amount of aerosol former is too low then less aerosol may be generated which may increase the amount of electromagnetic radiation received at the receiver.

[0030] Alternatively or additionally, the aerosol-generating system may comprise an aerosol-generating device for heating the aerosol-forming substrate and the testing apparatus may be configured to identify defects in the aerosol-generating device. This may include the device heating the aerosol-forming substrate to the incorrect temperature. If the device underheats the aerosol-forming substrate then less aerosol may be generated. If the device overheats the aerosol-forming substrate then more aerosol may be generated. As the amount of electromagnetic radiation received at the receiver may be dependent on the amount of aerosol generated, such defects may be identified based on measurements made by the receiver.

[0031] The sensing assembly may be positioned between the first channel opening and the pump assembly. In this way, the pump assembly may be configured to draw air through the airflow channel and past any sensors of the sensing assembly. This may advantageously ensure that the sensing assembly can measure properties of the aerosol drawn through the airflow channel. For example, at least some of the electromagnetic radiation emitted by the emitter may pass through the aerosol drawn through the airflow channel to then be received by the receiver.

[0032] The controller may be configured to compare the at least one determined characteristic to one or more predetermined values for the or each determined characteristic or one or more predetermined range of values for the or each determined characteristic. For example, the controller may be configured to compare a determined first characteristic to a first predetermined value or a first predetermined range of values. Additionally or alternatively, the controller may be configured to compare a determined second characteristic to a second predetermined value or second predetermined range of values. Additionally or alternatively, the controller may be configured to compare a determined third characteristic to a third predetermined value or a third predetermined range of values.

[0033] The one or more predetermined values or one or more predetermined range of values may correspond to

values for the respective determined characteristic that are acceptable. In particular, the one or more predetermined values or one or more predetermined range of values may correspond to values for the respective determined characteristic that is indicative of the aerosol-generating operating correctly.

[0034] The controller may be configured to determine that the aerosol-generating system is defective if at least one of the determined characteristics is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic.

[0035] The determination of a defective system based on a comparison of the determined characteristic to the predetermined values may advantageously mean that it is not necessary for the controller to perform a detailed analysis of the generated aerosol to determine a defective system. For example, a first characteristic may be the transmittance of the aerosol as measured using the sensing assembly. The generated aerosol of a normally operating aerosol-generating system may have a transmittance corresponding to a predetermined value or range of values. Therefore, the controller may advantageously determine a defective system if the transmittance is not equal to the predetermined value or does not fall within the range of values. Although the transmittance of the aerosol may depend on at least the quantity of the generated aerosol and the chemical composition of the generated aerosol, there is advantageously no need for the controller to determine the actual quantity or chemical composition of the generated aerosol in order to determine a defective device.

[0036] The one or more predetermined values or one or more predetermined range of values may advantageously be values that have been determined by prior experimentation in which thresholds for the expected values between a normally operating aerosol-generating system and a defective aerosol-generating system have been determined.

[0037] The one or more predetermined values or one or more predetermined range of values may be stored in a memory of the controller. These predetermined values may be input into the memory on manufacture of the testing apparatus, for example. Alternatively, the predetermined values may be input into the memory of the controller prior to performing an analysis operation using the testing apparatus. For example, a user may input the values into a user interface of the testing apparatus or the values may be uploaded from a separate database. Alternatively, the values may be determined by determining the respective one or more characteristics of an aerosol of an aerosol-generating system that is known to operate correctly in a separate routine. Values for the characteristics may be used as the predetermined values.

[0038] As used herein, references to “the predetermined values” are intended to include “predetermined range of values” unless explicitly stated otherwise. For example, the statement above that predetermined values are input into the memory of the controller also covers a predetermined range of values being input into the memory of the controller.

[0039] The testing apparatus may comprise a user interface. If an aerosol-generating system is found to be defective, the testing apparatus may be configured to indicate this using the user interface. If an aerosol-generating system is not found to be defective, the testing may be configured to indicate this using the user interface. The user interface may

comprise a display for indicating if an aerosol-generating system is defective or not defective.

[0040] The testing apparatus may preferably be suitable for analysing an aerosol generated by more than one type of aerosol-generating system or aerosol-generating systems comprising different aerosol-forming substrate.

[0041] The first channel opening may comprise a mouthpiece receiving portion. The mouthpiece receiving portion may be shaped to receive the mouthpiece of an aerosol-generating system in an opening of the mouthpiece receiving portion. The mouthpiece receiving portion may be shaped so as to provide a seal between the testing apparatus and the mouthpiece of the aerosol-generating system.

[0042] As used herein, the term “seal” means that interface between the mouthpiece receiving portion of the testing device and the received mouthpiece of the aerosol-generating system is sufficiently airtight to prevent substantial leakage of air through that interface. This may advantageously ensure that, when the pumping assembly draws air through the airflow channel in the first direction, that air is drawn into the airflow channel through the aerosol-generating system rather than through interface (and so bypassing the aerosol-generating system).

[0043] The mouthpiece receiving portion may be removable. The mouthpiece receiving portion may be replaceable. Therefore, if the testing apparatus is configured for use with different types of aerosol-generating system, the mouthpiece receiving portion may be replaced with a mouthpiece receiving portion specifically shaped for a particular aerosol-generating system to be tested.

[0044] The aerosol generated by different types of aerosol-generating system or different aerosol-forming substrates may be different and so the one or more predetermined values or one or more predetermined ranges of values may also be different. The memory of the controller may advantageously store values for a number of different types of aerosol-generating system or aerosol-forming substrate. Alternatively or additionally, the appropriate values may be input into the memory of the controller prior to performing an analysis operation using the testing apparatus as described as above.

[0045] A first characteristic of the aerosol determined by the controller may be related to an intensity of electromagnetic radiation received by the receiver. The controller may be configured to compare a first intensity of electromagnetic radiation to a second intensity of electromagnetic radiation.

[0046] The first intensity may correspond to the intensity of the electromagnetic radiation as received by the receiver after passing through aerosol generated by the aerosol-generating system that is drawn through the airflow channel. The controller may be configured to measure the first intensity based on signals received from the receiver.

[0047] The second intensity may correspond to the intensity of the electromagnetic radiation when aerosol generated by the aerosol-generating is not drawn through the airflow channel. The controller may be configured to measure the second intensity as a separate routine to determining the transmittance of aerosol drawn through the airflow channel. For example, the second intensity may be measured by measuring the intensity of electromagnetic radiation received at the receiver from the emitter when aerosol is not drawn through the airflow channel by the pump assembly. Measuring the second intensity may advantageously provide a means of calibrating the testing apparatus.

[0048] Alternatively, the second intensity may be a predetermined value stored in a memory of the controller.

[0049] The comparison of the first and second intensity may comprise the controller determining a ratio of the first intensity to the second intensity. The comparison of the first and second intensity may comprise the controller determining the transmittance of electromagnetic radiation through the aerosol. In other words, a first characteristic of the aerosol determined by the controller may be the transmittance of the aerosol.

[0050] The absorbance of electromagnetic radiation by the aerosol is related to the transmittance. In particular, the absorbance is equal to the negative base ten logarithm of the transmittance. Thus, the controller may be configured to determine the absorbance in addition to or instead of the transmittance as the first characteristic.

[0051] In other words, the first characteristic of the aerosol determined by the controller may be described as being related to the transmittance of the aerosol.

[0052] The sensing assembly may comprise a temperature sensor. The temperature sensor may be configured to measure a temperature of a portion of the airflow channel. The temperature sensor may comprise or consist of a thermocouple. The controller may be configured to determine the temperature of the aerosol drawn through the airflow channel based on signals received from the temperature sensor. In other words, a second characteristic of the aerosol determined by the controller may be temperature.

[0053] The generated aerosol drawn through the airflow channel may rapidly cool to ambient temperature. Measuring the temperature of the generated aerosol after it has cooled may have limited value as all temperature measurements may be substantially the same, irrespective of whether the aerosol-generating system is defective. It may therefore be advantageous to position the temperature sensor towards the first channel opening. This may advantageously reduce the risk of the generated aerosol cooling to ambient temperature before the temperature before being drawn past the temperature sensor.

[0054] Preferably, the temperature sensor may be positioned closer to the first channel opening than any other component of the sensing assembly. For example, the temperature sensor may be positioned closer to the first channel opening than the emitter and the receiver.

[0055] Preferably, the separation between the first channel opening and the temperature sensor, as measured along the airflow channel, may be less than 10 centimetres, preferably less than 5 centimetres, preferably less than 2 centimetres, even more preferably less than 1.5 centimetres.

[0056] The controller may be configured to determine that the aerosol-generating system is defective if the second characteristic is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic. The temperature of the generated aerosol may be dependent on the temperature to which the substrate is heated. Overheating or underheating of the aerosol-forming substrate may cause the temperature of the generated aerosol to be not equal to or fall within the range of the predetermined values. Overheating or underheating of the aerosol-forming substrate may indicate a defect with the aerosol-generating system.

[0057] The controller may advantageously be configured to compare the second characteristic to different predeter-

mined values or predetermined ranges of values for successive puffs. This may be the case when it is known that the aerosol-generating system produces an aerosol temperature, preferably an average aerosol temperature, that changes with increasing puff number. For example, it may be known that the aerosol temperature decreases with increasing puff number. In that case, the controller may advantageously be configured to compare the second characteristic to predetermined values or predetermined range of values that decrease for increasing puff number. In this way, the controller may advantageously be configured to determine a defect with aerosol-generating device if the temperature for successive puffs does not follow the expected pattern.

[0058] The sensing assembly may further comprise a pressure sensor. The pressure sensor may be configured to measure a pressure drop in a portion of the airflow channel. The controller may be configured to determine the pressure drop of the aerosol drawn through the airflow channel based on signals received from the pressure sensor. In other words, a third characteristic of the aerosol determined by the controller may be pressure.

[0059] The controller may advantageously be configured to compare the third characteristic to different predetermined values or predetermined ranges of values for successive puffs. This may be the case when it is known that the pressure drop of an aerosol-generating system changes with increasing puff number. For example, it may be known from prior experimentation that the pressure drop decreases with increasing puff number. In that case, the controller may advantageously be configured to compare the third characteristic to predetermined values or predetermined range of values that decrease for increasing puff number. In this way, the controller may advantageously be configured to determine a defect with aerosol-generating device if the pressure drop for successive puffs does not follow the expected pattern.

[0060] The emitter may comprise one or more LEDs. The emitter may comprise LEDs emitting different wavelengths of electromagnetic radiation. The emitter may be configured to emit electromagnetic radiation having a wavelength of between 200 nanometres and 15,000 nanometres. Preferably, the emitter may be configured to emit electromagnetic radiation in the visible part of the electromagnetic spectrum. The emitter may be configured to emit electromagnetic radiation having a wavelength of between 200 nanometres and 750 nanometres, preferably between 380 nanometres and 750 nanometres, preferably between 300 nanometres and 700 nanometres, even more preferably between 350 nanometres and 650 nanometres.

[0061] The receiver may comprise a fibre sensor. The receiver may be configured to receive electromagnetic radiation having a frequency corresponding to the frequency of the electromagnetic radiation emitted by the emitter.

[0062] The emitter may be configured to emit electromagnetic radiation into the airflow channel in a direction perpendicular to a direction of flow of air drawn through the airflow channel when the testing apparatus is in the first configuration. Preferably, the emitter and receiver are positioned at opposite sides of the airflow channel.

[0063] The pump assembly, in a second configuration of the testing apparatus, may be configured to draw air through the airflow channel in a second direction that is opposite to the first direction. Airflow in the second configuration may advantageously flush any remnants of generated aerosol, or

other contaminants, from the airflow channel. This may advantageously prepare the testing apparatus for determining at least one characteristic of aerosol drawn through the airflow channel when the testing apparatus is in the first configuration (in other words, preparing the testing apparatus for the next puff). The air drawn through the airflow channel in the second configuration may be referred to as a purge air flow.

[0064] The airflow channel may further comprise a second channel opening. Air drawn through the airflow channel in the second direction may advantageously exit the airflow channel through the second channel opening. Thus, the air, which may carry previously generated aerosol and other contaminants, advantageously does not need to pass back through the aerosol-generating system which might otherwise affect results from later puffs. The second channel opening may be referred to as the exhaust for the airflow channel.

[0065] The airflow channel may extend from the second channel opening. A first branch of the airflow channel may extend from the first channel opening and a second branch of the airflow channel may extend from the second channel opening. The first branch of the airflow channel may merge with the second branch of the airflow channel. The first branch of the airflow channel may merge with the second branch of the airflow channel upstream of the sensing assembly. Advantageously, air flowing through the airflow channel to or from either the first channel opening or the second channel opening passes the sensing assembly.

[0066] As used herein, the terms 'upstream' and 'downstream' are used to describe the relative positions of components, or portions of components, of the testing apparatus in relation to the first direction, in other words, in the direction in which the pump assembly draws air through the airflow channel when the testing apparatus is in the first configuration.

[0067] The testing apparatus may further comprise a valve assembly.

[0068] The valve assembly may be configured such that when the testing apparatus is in the first configuration the first channel opening is open and the second channel opening is closed. Therefore, aerosol generated by the aerosol-generating system may not exit the airflow channel through the second channel opening in the first configuration. This may advantageously mean that the generated aerosol must be drawn past the sensing assembly when the testing apparatus is in the first configuration. The generated aerosol may not bypass the sensing assembly by escaping out of the second channel opening when second channel opening is closed.

[0069] The valve assembly may be configured such that when the testing apparatus is in the second configuration the first channel opening is closed and the second channel opening is open. Therefore, air drawn through the airflow channel in the second direction by the pump assembly may not exit the airflow channel through the first channel opening in the first configuration. As described above, this may mean that previously generated aerosol and any contaminants do not pass through the first channel opening in which the aerosol-generating system is received. Thus, the purge air flow may advantageously not pass through the aerosol-generating system that is received by the first channel opening.

[0070] The controller may be configured to control the valve assembly. The controller may be configured to control the pump assembly. The controller may be configured to control the valve assembly and the pump assembly to operate the testing apparatus between the first configuration and the second configuration. For example, in the first configuration, the controller may be configured to control the pump assembly to draw air through the airflow channel in the first direction while also controlling the valve assembly to opening the first channel opening and to close the second channel opening.

[0071] The controller may be configured to operate the testing apparatus from the first configuration to the second configuration at the end of each individual puff. Alternatively, the controller may be configured to operate the testing apparatus from the first configuration to the second position after a plurality of successive puffs, for example, four or more, five or more, six or more puffs, seven or more, eight or more, nine or more, ten or more, fifteen or more or twenty or more. This may correspond to a usage session of the aerosol-generating system.

[0072] The valve assembly may comprise a first valve positioned between the first channel opening and the sensing assembly. When the airflow channel comprises first and second branches that merge upstream of the sensing assembly, the valve may be positioned upstream of portion of the airflow channel where the first and second branches merge. The first valve may be positioned in a portion of the first branch.

[0073] The first valve may be configured to open or close the first channel opening. The controller may be configured to control the first valve. The controller may be configured to open the first valve, at least initially, when the testing apparatus is in the first configuration. The controller may be configured to control the first valve at the end of the predetermined time corresponding to the length of a puff. In this way, the first valve may advantageously be used to control when individual puffs begin and end while the testing apparatus is in the first position.

[0074] The first valve may be a pinch valve. A pinch valve may advantageously have relatively fast opening and closing times and be simple to operate. A pinch valve may advantageously be particularly suitable for the first valve because the first valve may need to open and close frequently. A pinch valve may also be advantageous because a pinch valve does not comprise metal or mechanical internal parts on which the generated aerosol might otherwise be deposited.

[0075] The valve assembly may comprise a second valve positioned between the second channel opening and the sensing assembly. The controller may control the opening and closing of the second valve. When the airflow channel comprises first and second branches that merge upstream of the sensing assembly, the second valve may be positioned upstream of the portion of the airflow channel where the first and second branches merge. The second valve may be positioned in a portion of the second branch.

[0076] The second valve may be configured to open or close the second channel opening.

[0077] The second valve may be an electromechanically operated valve. The use of an electromechanical valve may be advantageous as there is no need to supply compressed air to operate the valve, as is the case for pinch valves.

[0078] The first or second channel opening may be considered open when air is able to flow through the airflow

channel, past the sensing assembly, and into or out of the respective channel opening. The first or second channel opening may be considered closed when air is not able to flow through the airflow channel, past the sensing assembly, and into or out of the respective channel opening. Thus, the first and second valves may be considered to open or close the first and second channel openings respectively even if the valves themselves are not positioned at the channel openings.

[0079] The pump assembly, in a third configuration of the testing assembly, may be configured to draw air through the airflow channel in the first direction. When the testing apparatus is in the third configuration, the valve assembly may be configured to close the first channel opening. The valve assembly may be configured to open the second channel opening.

[0080] In the third configuration, air may be drawn through the airflow channel from the second opening, past the sensing assembly, and towards the pump assembly. Air may not be drawn from the aerosol-generating system into the airflow channel through the first opening. As in the second configuration, airflow in the third configuration may advantageously flush any lingering generated aerosol, or other contaminants, from the airflow channel. This may advantageously prepare the testing apparatus for determining at least one characteristic of aerosol drawn through the airflow channel when the testing apparatus is in the first configuration (in other words, preparing the testing apparatus for the next puff). The air drawn through the airflow channel in the third configuration may be referred to as a purge air flow.

[0081] The testing apparatus may be configurable between the first configuration and at least one of the second or third configuration. As both the second and third configuration provide a purge air flow, configuring the testing apparatus to be in only one of these configurations may be enough to flush the airflow channel of previous generated aerosol and contaminants after a testing operation has been carried out with the testing apparatus in the first configuration. However, it may be preferable for the testing apparatus to be configured in one of the second and third configurations and then, afterwards, be configured in the other configuration. In this way, purge air flow may be provided in both the first and second directions which may advantageously more effectively flush the airflow channel.

[0082] The controller may be configured to control the valve assembly and the pump assembly to operate the testing apparatus between the first configuration and the third configuration or between the second configuration and the third configuration.

[0083] The testing apparatus may comprise a first filter. The first filter may be configured to filter aerosol or contaminants in the air drawn through the airflow channel when the testing apparatus is in the second configuration. Preferably, the first filter may be configured to filter aerosol or contaminants in the air drawn through the airflow channel before that air passes through the second channel opening. The first filter may be positioned between the sensing assembly and second channel opening. The advantage of providing such a first filter may be that aerosol or contaminants in the purge air flow do not pass through the second channel opening. This is particularly advantageous if the second channel is open to the atmosphere. With the provision of a filter, the testing apparatus may be positioned

adjacent to a production line without emitting the aerosol or contaminants into the atmosphere surrounding the production line.

[0084] Alternatively or additionally, the second channel opening may be connectable with a ventilation system or a waste container. Again, this may advantageously prevent aerosol or contaminants from being emitted into the atmosphere.

[0085] The airflow channel may further comprise a third channel opening. The airflow channel may extend from the first channel opening to the third channel opening. When the airflow channel further comprises a second airflow channel opening, the airflow channel may also extend from the second channel opening to the third channel opening. As described above, this may be the case when the airflow channel comprises first and second branches that merge together.

[0086] The third channel opening may be downstream of sensing assembly. The third channel opening may be positioned such that air drawn through the airflow channel in a first direction by the pump assembly exits the airflow channel.

[0087] The pump assembly may comprise a first pump. The first pump may be positioned at or towards the third channel opening. The first pump may be configurable to draw air through the airflow channel in the first direction when the testing apparatus is in the first configuration. The first pump may be a suction pump.

[0088] The testing apparatus may comprise a second filter. The second filter may be configured to filter aerosol or contaminants in the air drawn through the airflow channel when the testing apparatus is in the first configuration. Preferably, the second filter may be configured to filter aerosol or contaminants in the air drawn through the airflow channel before that air passes through the third channel opening. The second filter may be positioned between the sensing assembly and third channel opening. The advantage of providing such a second filter may be that aerosol or contaminants do not pass through the third channel opening. This is particularly advantageous if the third channel is open to the atmosphere. With the provision of a filter, the testing apparatus may be positioned adjacent to a production line without emitting the aerosol or contaminants into the atmosphere surrounding the production line.

[0089] Alternatively or additionally, the third channel opening may be connectable with a further ventilation system or a waste container. Again, this may advantageously prevent aerosol or contaminants from being emitted into the atmosphere.

[0090] In the second configuration, air drawn through the airflow channel in a second direction by the pump assembly may enter the airflow channel through the third channel opening. This may be preferable if the third channel opening is open to the atmosphere. In that case, the first pump may also be configurable to draw air through the airflow channel in the second direction when the testing apparatus is in the second configuration.

[0091] Alternatively, the airflow channel may comprise a fourth channel opening. Similarly to the third channel opening, the fourth channel opening may be positioned downstream of sensing assembly. The fourth channel opening may be positioned such that air drawn through the airflow channel in a second direction by the pump assembly exits the airflow channel through the fourth channel opening. The

pump assembly may comprise a second pump that is positioned at or towards the fourth channel opening. The second pump may be configurable to draw air through the airflow channel in the second direction when the testing apparatus is in the second configuration.

[0092] The valve assembly may be configured such that when the testing apparatus is in the first configuration the third channel opening is open and the fourth channel opening is closed. Therefore, aerosol generated by the aerosol-generating system may exit the airflow channel through the third channel opening in the first configuration. Said aerosol may not exit the airflow channel through the fourth channel opening in the first configuration. If the third channel opening is connectable with a further ventilation system or a waste container, this may advantageously ensure that any generated aerosol enters the ventilation system or waste container rather than exiting into the atmosphere. This is particularly when the testing apparatus is positioned adjacent a production line.

[0093] The valve assembly may be configured such that when the testing apparatus is in the second configuration, the third channel opening is closed and the fourth channel opening is open. Therefore, air drawn through the airflow channel in the second direction by the pump assembly may enter the airflow channel through the fourth channel opening in the third configuration. Air may not enter the airflow channel through the third channel opening in the second configuration. This may be particularly advantageous if the third channel opening is connectable to ventilation system or waste container.

[0094] The valve assembly may be configured such that when the testing apparatus is in the third configuration, the third channel opening is closed and the fourth channel opening is open. Therefore, air drawn through the airflow channel in the first direction by the pump assembly may enter the airflow channel through the second channel opening in the second configuration and exit the airflow channel through the fourth channel opening. Air may not enter the airflow channel through the third channel opening in the second configuration.

[0095] The airflow channel may extend from the third and fourth channel openings. A third branch of the airflow channel may extend from the third channel opening and a fourth branch of the airflow channel may extend from the fourth channel opening. The third branch of the airflow channel may merge with the fourth branch of the airflow channel. The third branch of the airflow channel may merge with the fourth branch of the airflow channel downstream of the sensing assembly.

[0096] When the airflow channel comprises a fourth channel opening, the valve assembly may comprise a third valve positioned between the sensing assembly and the third channel opening. When the airflow channel comprises third and fourth branches that merge downstream of the pump assembly, the third valve may be positioned downstream of the portion of the airflow channel where the third and fourth branches merge. The third valve may be positioned in a portion of the third branch.

[0097] The valve assembly may comprise a fourth valve positioned between the sensing assembly and the fourth channel opening. When the airflow channel comprises third and fourth branches that merge downstream of the pump assembly, the fourth valve may be positioned downstream of

the portion of the airflow channel where the third and fourth branches merge. The fourth valve may be positioned in a portion of the fourth branch.

[0098] The third valve may be configured to open or close the third channel opening.

[0099] The fourth valve may be configured to open or close the fourth channel opening.

[0100] The controller may be configured to operate the third and fourth valves to open or close.

[0101] The testing apparatus may be for analysing the aerosol generated by a plurality of aerosol-generating systems. This may advantageously allow multiple systems to be tested at once. This may be particularly preferable when the testing apparatus is used adjacent to a production line for manufacturing aerosol-generating systems, or consumables for aerosol-generating systems. This may be because a plurality of aerosol-generating systems or consumables may need to be tested per batch in a quality assurance routine. A testing apparatus for analysing the aerosol generated by a plurality of aerosol-generating systems may advantageously speed up the quality assurance routine. For example, the testing apparatus may advantageously be able to analyse the aerosol generated from each of the plurality aerosol-generating systems or consumables, as required for a quality assurance routine, at once.

[0102] The testing apparatus may comprise a first channel opening and a sensing assembly for each of the plurality of aerosol-generating systems to be tested. For example, if the testing apparatus is suitable for analysing an aerosol generated by five different aerosol-generating systems, the testing apparatus may comprise five first channel openings, each of the channel openings being configured to receive a mouthpiece of one of the aerosol-generating systems. The testing apparatus may further comprise five sensing assemblies comprising an emitter and a receiver. Such a testing apparatus may advantageously allow for the plurality of aerosol-generating systems to be tested simultaneously.

[0103] The testing apparatus may comprise a first channel opening for each of the plurality of aerosol-generating systems and a single sensor assembly. The airflow channel may comprise a first branch associated with each of the first channel openings. Each of the first branches of the airflow channel may be connectable to the sensor assembly.

[0104] The testing apparatus may comprise an actuation mechanism configured to connect and disconnect each of the first branches of the airflow channel to the sensor assembly. In this way, a single sensor assembly may advantageously be used to analyse aerosol generated by aerosol-generating systems received in each of the first channel openings. This may advantageously reduce the cost, complexity and size of the testing apparatus.

[0105] The actuation mechanism may be configured to connect and disconnect each of the first branches of the airflow channel to the sensor assembly in turn. The actuation mechanism may comprise a rotatory valve mechanism. The rotatory valve mechanism may be configured to connect each of the first branches to the sensor assembly in turn.

[0106] The rotatory valve mechanism may comprise a single opening. The single opening may be formed in a rotatable element such as a rotating disk. A first branch may be connected to the sensory assembly through the single opening. The rotatable element may otherwise prevent connection of the other branches to the sensor assembly. In this

way, the rotatable element may advantageously be used to sequentially connect individual branches to the sensor assembly.

[0107] The pump assembly in first configuration may be configured to draw air through the airflow channel in the first direction when a first branch is connected to the sensor assembly. In this way, any aerosol generated by the aerosol-generating system may be drawn past the sensor assembly, as described above.

[0108] The testing apparatus may further comprise a second channel opening. Preferably, the testing apparatus may further comprise a second channel opening for each of the plurality of aerosol-generating systems or for each of the first channel openings. The airflow channel may comprise a second branch associated with each of the second channel openings. The actuation mechanism may be configured to connect and disconnect the or each of the second branches of the airflow channel to the sensor assembly in turn. Preferably, the actuation mechanism may be configured to connect the or a second branch of the airflow channel after disconnecting from one of the first sub-branches.

[0109] The pump assembly in second configuration may be configured to draw air through the airflow channel in the second direction when a second branch is connected to the sensor assembly. In this way, a purge air flow may advantageously be drawn through the sensor assembly.

[0110] The testing apparatus may comprise a single second channel opening

[0111] 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 is part of an aerosol-generating article.

[0112] 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 by the user drawing or puffing on a mouthpiece at a proximal or user-end of the system. An aerosol-generating article may be disposable. An article comprising an aerosol-forming substrate comprising tobacco is referred to as a tobacco stick. The aerosol-generating article may be insertable into the cavity of the aerosol-generating device.

[0113] As used herein, the term “aerosol-generating device” refers to a device that interacts with an aerosol-generating article to generate an aerosol.

[0114] As used herein, the term “aerosol-generating system” refers to the combination of an aerosol-generating article, as further described and illustrated herein, with an aerosol-generating device. In the system, the aerosol-generating article and the aerosol-generating device cooperate to generate a respirable aerosol. Alternatively, when the aerosol-generating article itself comprises a heat source such as a carbonaceous combustible heat source, the term “aerosol-generating system” refers to the aerosol-generating article on its own.

[0115] The aerosol-forming substrate may comprise nicotine. The nicotine-containing aerosol-forming substrate may be a nicotine salt matrix. The aerosol-forming substrate may comprise plant-based material. The aerosol-forming substrate may comprise tobacco. The aerosol-forming substrate

may comprise a tobacco-containing material including volatile tobacco flavour compounds which are released from the aerosol-forming substrate upon heating. Alternatively, the aerosol-forming substrate may comprise a non-tobacco material. The aerosol-forming substrate may comprise homogenised plant-based material. The aerosol-forming substrate may comprise homogenised tobacco material. Homogenised tobacco material may be formed by agglomerating particulate tobacco. In a particularly preferred embodiment, the aerosol-forming substrate may comprise a gathered crimped sheet of homogenised tobacco material. As used herein, the term 'crimped sheet' denotes a sheet having a plurality of substantially parallel ridges or corrugations.

[0116] The aerosol-forming substrate may comprise at least one aerosol-former. An aerosol-former is any suitable known compound or mixture of compounds that, in use, facilitates formation of a dense and stable aerosol and that is substantially resistant to thermal degradation at the temperature of operation of the system. Suitable aerosol-formers are well known in the art and include, but are not limited to: polyhydric alcohols, such as triethylene glycol, 1,3-butanediol and glycerine; esters of polyhydric alcohols, such as glycerol mono-, di- or triacetate; and aliphatic esters of mono-, di- or polycarboxylic acids, such as dimethyl dodecanedioate and dimethyl tetradecanedioate. Preferred aerosol formers are polyhydric alcohols or mixtures thereof, such as triethylene glycol, 1,3-butanediol. Preferably, the aerosol former is glycerine. Where present, the homogenised tobacco material may have an aerosol-former content of equal to or greater than 5 percent by weight on a dry weight basis, and preferably from about 5 percent to about 30 percent by weight on a dry weight basis. The aerosol-forming substrate may comprise other additives and ingredients, such as flavourants.

[0117] 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 millimetres, but may be in the range of approximately 5 millimetres to approximately 25 millimetres.

[0118] In a second aspect of the disclosure there is provided a method of analysing an aerosol generated by an aerosol-generating system comprising an aerosol-forming substrate and a mouthpiece using the testing apparatus of the first aspect.

[0119] The method may comprise positioning the mouthpiece of the aerosol-generating system such that the mouthpiece is received in the first channel opening.

[0120] The method may comprise, when the testing apparatus is in the first configuration, using the pumping assembly to draw air through the airflow channel in a first direction such that an aerosol generated by the aerosol-generating system is drawn through the airflow channel.

[0121] The method may comprise determining at least one characteristic of the aerosol drawn through the airflow channel based on signals received from the sensing assembly.

[0122] The method may comprise comparing the at least one determined characteristic to one or more predetermined values for the at least one characteristic or one or more predetermined range of values for the at least one characteristic.

[0123] The method may comprise determining that the aerosol-generating system or the aerosol-forming substrate is defective if at least one of the determined characteristics is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic.

[0124] The step of determining at least one characteristic may comprise determining a first characteristic that is related to an intensity of electromagnetic radiation received by the receiver.

[0125] The step of determining the first characteristic may comprise comparing a first intensity of electromagnetic radiation to a second intensity of electromagnetic radiation.

[0126] The first intensity may correspond to the intensity of the electromagnetic radiation as received by the receiver after passing through aerosol generated by the aerosol-generating system that is drawn through the airflow channel. The method may comprise measuring the first intensity based on signals received from the receiver.

[0127] The second intensity may correspond to the intensity of the electromagnetic radiation when aerosol generated by the aerosol-generating system is not drawn through the airflow channel. The method may comprise measuring the second intensity as a separate routine to determining the transmittance of aerosol drawn through the airflow channel. For example, the second intensity may be measured by measuring the intensity of electromagnetic radiation received at the receiver from the emitter when aerosol is not drawn through the airflow channel by the pump assembly. Measuring the second intensity may advantageously provide a means of calibrating the testing apparatus. Alternatively, the second intensity may be a predetermined value stored in a memory of the controller.

[0128] The comparison of the first and second intensity may comprise determining a ratio of the first intensity to the second intensity.

[0129] The first characteristic may be the transmittance of electromagnetic radiation through the aerosol.

[0130] The step of determining at least one characteristic may comprise determining a second characteristic. The second characteristic may be the temperature of the aerosol. The step of determining the second characteristic may comprise measuring the temperature of aerosol using a temperature sensor of the sensing assembly.

[0131] The method may comprise determining that the aerosol-generating system is defective if the second characteristic is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic.

[0132] The method may advantageously comprise comparing the second characteristic to different predetermined values or predetermined ranges of values for successive puffs.

[0133] The step of determining at least one characteristic may comprise determining a third characteristic. The third characteristic may be the pressure drop of the aerosol. The step of determining the third characteristic may comprise measuring the pressure drop of aerosol using a pressure sensor of the sensing assembly. The pressure sensor may advantageously be a differential pressure sensor.

[0134] The method may comprise determining that the aerosol-generating system is defective if the third characteristic is not equal to one of the predetermined values for

that characteristic or does not fall within one of the predetermined ranges of values for that characteristic.

[0135] The method may advantageously comprise comparing the third characteristic to different predetermined values or predetermined ranges of values for successive puffs.

[0136] The method may comprise, when the testing apparatus is in a second configuration, using the pump assembly to draw air through the airflow channel in a second direction that is opposite to the first direction.

[0137] The testing apparatus may comprise a second channel opening. Air drawn through the airflow channel in the second direction may advantageously exit the airflow channel through the second channel opening.

[0138] The testing apparatus may further comprise a valve assembly.

[0139] The method may comprise configuring the testing apparatus to be in the first configuration by opening the first channel opening (or maintaining the first channel opening open) and closing the second channel opening using the valve assembly (or maintaining the second channel opening closed). The method may further comprise using the pump assembly to draw air through the airflow channel in the first direction.

[0140] The method may comprise configuring the testing apparatus to be in the second configuration by closing the first channel opening (or maintain the first channel opening closed) and opening the second channel opening using the valve assembly (or maintaining the second channel opening open). The method may further comprise using the pump assembly to draw air through the airflow channel in the second direction.

[0141] The method may comprise configuring the testing apparatus to be in the third configuration by closing the first channel opening (or maintaining the first channel opening closed) and opening the second channel opening (or maintaining the second channel opening open) using the valve assembly. The method may further comprise using the pump assembly to draw air through the airflow channel in the first direction.

[0142] The method may comprise reconfiguring the testing apparatus from the first configuration to the second position at the end of each individual puff, preferably at the end of the predetermined time.

[0143] Alternatively, the method may comprise reconfiguring the testing apparatus from the first configuration to the second configuration after a plurality of successive puffs, for example, four or more, five or more, six or more puffs, seven or more, eight or more, nine or more, ten or more, fifteen or more or twenty or more

[0144] Opening or closing the first channel opening may comprise controlling a first valve to open or close.

[0145] Opening or closing the second channel opening may comprise controlling a second valve to open or close.

[0146] The method may comprise controlling the first valve to close the first channel opening at the end of the predetermined time. In this way, the first valve may advantageously be used to control when individual puffs begin and end while the testing apparatus is in the first position.

[0147] The method may comprise reconfiguring the testing apparatus from the first configuration and at least one of the second or third configuration. As both the second and third configuration provide a purge air flow, reconfiguring the testing apparatus to be in only one of these configura-

tions may be enough to flush the airflow channel of previous generated aerosol and contaminants after a testing operation has been carried out with the testing apparatus in the first configuration. However, it may be preferable for the testing apparatus to be reconfigured from the first configuration to one of the second and third configurations and then, afterwards, to be reconfigured in the other configuration. In this way, purge air flow may be provided in both the first and second directions which may advantageously more effectively flush the airflow channel.

[0148] The method may comprise activating the aerosol-generating system prior to or simultaneously with performing the step of using the pump assembly to draw air through the airflow channel.

[0149] For electrically heated aerosol-generating systems comprising an aerosol-generating device for electrically heating an aerosol-forming substrate, the step of activating the aerosol-generating system may comprise activating the device. The aerosol-generating device may perform a pre-heating routine in which substantial quantities of aerosol are not generated. In that case, step of activating the aerosol-generating system may preferably be performed before carrying out the step of using the pump assembly.

[0150] The aerosol-generating device may comprise a button or other user interface element which may be pressed to activate the device. Thus, the step of activating the device may comprise pressing or interacting with the button or user interface element of the aerosol-generating device. The step of activating the device may comprise a user pressing or interacting with the button or user interface element of the aerosol-generating device manually. Alternatively, the step of activating the device may comprise an actuation assembly of the testing apparatus interacting with the button or user interface element of the aerosol-generating device automatically when the aerosol-generating device is to be activated. The actuation assembly may comprise a pneumatically actuatable element which is configured to move between at least a first position in which the actuatable element is not pressing or interacting with the button or user interface element and a second position in which the actuatable element is pressing or interacting with the button or user interface.

[0151] Alternatively or additionally, the aerosol-generating device may comprise a puff detection assembly. The puff detection assembly may be configured to activate the device upon detection a puff. For example, the puff detection assembly may comprise a pressure sensor and to detect a puff based on a change in pressure that is representative of a user taking a puff. Preferably, when the aerosol-generating device comprises a puff detection assembly, the method may comprise activating the aerosol-generating device simultaneously with step of using the pump assembly. The air drawn by the pump assembly may advantageously be detected by the puff detection assembly such that the aerosol-generating system is activated automatically.

[0152] The aerosol-generating system may consist of an aerosol-generating article comprising a combustible heat source and an aerosol-generating substrate. In such cases, activating the aerosol-generating system may comprise igniting the combustible heat source. The step of activating the aerosol-generating system may be carried out simultaneously to the step of using the pump assembly. In this way, air may be drawn through aerosol-generating system as the

carbonaceous heat source is ignited which may advantageously ensure proper ignition of the heat source.

[0153] In a third aspect of the disclosure, there is provided a method of detecting a defect in an aerosol-generating system comprising an aerosol-forming substrate and a mouthpiece.

[0154] The method may comprise positioning the mouthpiece of the aerosol-generating device such that the mouthpiece is received in a first channel opening of an airflow channel of a testing apparatus.

[0155] The method may comprise using a pump assembly of the testing apparatus to draw air through the airflow channel in a first direction such that an aerosol generated by the aerosol-generating system is drawn from the mouthpiece received in the first channel opening and through the airflow channel.

[0156] As described in relation to the first aspect, the pump assembly may advantageously mimic a user inhaling on the mouthpiece of the aerosol-generating system in a way that corresponds to real-world usage of the system. Preferably, the pump assembly may draw air through the airflow channel in the first direction for a predetermined time and then may stop drawing air through the airflow channel in the first direction. This may be referred to as a puff. The pump assembly may be configured to perform out successive puffs. The pump assembly may advantageously draw air through the airflow channel in a repeatable way such that each “inhalation” is the same for each puff. In this way, repeatable results may be achieved for the different aerosol-generating systems or different puffs of the same aerosol-generating system.

[0157] The method may comprise determining at least one characteristic of the aerosol drawn through the airflow channel.

[0158] The method may comprise comparing the at least one determined characteristic to one or more predetermined values for the or each characteristic or one or more predetermined range of values for the or each characteristic.

[0159] The method may comprise determining that the aerosol-generating system is defective if at least one of the determined characteristics is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic. The determination of a defective system based on a comparison of the determined characteristic to the predetermined values may advantageously mean that it is not necessary for the controller to perform a detailed analysis of the generated aerosol to determine a defective device. For example, a first characteristic may be the transmittance of the aerosol as measured using the sensing assembly. The generated aerosol of a normally operating aerosol-generating system may have a transmittance corresponding to a predetermined value or range of values. Therefore, the controller may advantageously determine a defective system if the transmittance is not equal to the predetermined value or does not fall within the range of values. Although the transmittance of the aerosol may depend on at least the quantity of the generated aerosol and the chemical composition of the generated aerosol, there is advantageously no need for the controller to determine the quantity or chemical composition of the generated aerosol.

[0160] The one or more predetermined values or one or more predetermined range of values may advantageously be values that have been determined by prior experimentation

in which thresholds for the expected values between a normally operating aerosol-generating system and a defective aerosol-generating system have been determined.

[0161] The method may further comprise determining the predetermined values or range of values. This may comprise determining the respective one or more characteristics of an aerosol of an aerosol-generating system that is known to operate correctly in a separate routine. Values for the characteristics may be used as the predetermined values.

[0162] The at least one characteristic may comprise a first characteristic. The first characteristic may be the transmittance of electromagnetic radiation through the aerosol.

[0163] The method may comprise determining the first characteristic. This may comprise comparing a first intensity of electromagnetic radiation to a second intensity of electromagnetic radiation.

[0164] The first intensity may correspond to the intensity of the electromagnetic radiation as received by the receiver after passing through aerosol generated by the aerosol-generating system that is drawn through the airflow channel. The method may comprise measuring the first intensity based on signals received from the receiver.

[0165] The second intensity may correspond to the intensity of the electromagnetic radiation when aerosol generated by the aerosol-generating is not drawn through the airflow channel. The method may comprise measuring the second intensity as a separate routine to determining the transmittance of aerosol drawn through the airflow channel. For example, the second intensity may be measured by measuring the intensity of electromagnetic radiation received at the receiver from the emitter when aerosol is not drawn through the airflow channel by the pump assembly. Measuring the second intensity may advantageously provide a means of calibrating the testing apparatus. Alternatively, the second intensity may be a predetermined value stored in a memory of a controller of the testing apparatus.

[0166] The comparison of the first and second intensity may comprise determining a ratio of the first intensity to the second intensity.

[0167] The first characteristic may be the transmittance of electromagnetic radiation through the aerosol.

[0168] The step of determining at least one characteristic may comprise determining a second characteristic. The second characteristic may be the temperature of the aerosol. The step of determining the second characteristic may comprise measuring the temperature of aerosol using a temperature sensor of the sensing assembly.

[0169] The method may comprise determining that the aerosol-generating system is defective if the second characteristic is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic.

[0170] The method may advantageously comprise comparing the second characteristic to different predetermined values or predetermined ranges of values for successive puffs.

[0171] The step of determining at least one characteristic may comprise determining a third characteristic. The third characteristic may be the pressure drop of the aerosol. The step of determining the third characteristic may comprise measuring the pressure drop of aerosol using a pressure sensor of the sensing assembly.

[0172] The method may comprise determining that the aerosol-generating system is defective if the third charac-

teristic is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic.

[0173] The method may advantageously comprise comparing the third characteristic to different predetermined values or predetermined ranges of values for successive puffs.

[0174] Features described in relation to one aspect, example or embodiment may also be applicable to other aspects, examples and embodiments. In particular, features of the testing apparatus of the first aspect may apply to the testing apparatus used in the method of the second and third aspects. Similarly, features described in relation to the method of the second aspect may also apply to the method of the third aspect and vice versa.

[0175] Below, there is provided a non-exhaustive list of non-limiting examples. Any one or more of the features of these examples may be combined with any one or more features of another example, embodiment, or aspect described herein.

[0176] EX1. A testing apparatus for analysing an aerosol generated by an aerosol-generating system comprising an aerosol-forming substrate and a mouthpiece, the testing apparatus comprising:

[0177] an airflow channel that extends from a first channel opening that is configured to receive a mouthpiece of an aerosol-generating system;

[0178] a sensing assembly comprising an emitter configured to emit electromagnetic radiation into the airflow channel and a receiver configured to receive at least some of the electromagnetic radiation from the airflow channel;

[0179] a pump assembly that, in a first configuration of the testing apparatus, is configured to draw air through the airflow channel in a first direction such that an aerosol generated by the aerosol-generating system in use is drawn from the mouthpiece received in the first channel opening and through the airflow channel; and

[0180] a controller configured to determine at least one characteristic of the aerosol drawn through the airflow channel based on signals received from the sensing assembly.

[0181] EX2. A testing apparatus according to example EX1, wherein the sensing assembly is positioned between the first channel opening and the pump assembly.

[0182] EX3. A testing apparatus according to example EX1 or EX2, wherein the controller is configured to compare the at least one determined characteristic to one or more predetermined values for the or each characteristic or one or more predetermined range of values for the or each characteristic.

[0183] EX4. A testing apparatus according to example EX3, wherein the controller is configured to determine that the aerosol-generating system is defective if at least one of the determined characteristics is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic.

[0184] EX5. A testing apparatus according to any one of the preceding examples, wherein a first characteristic of the aerosol determined by the controller is related to an intensity of electromagnetic radiation received by the receiver.

[0185] EX6. A testing apparatus according to example EX5, wherein the controller is configured to compare a first

intensity of electromagnetic radiation to a second intensity of electromagnetic radiation, the first intensity corresponding to the intensity of the electromagnetic radiation as received by the receiver after passing through aerosol generated by the aerosol-generating system that is drawn through the airflow channel and the second intensity corresponding to the intensity of the electromagnetic radiation when aerosol generated by the aerosol-generating system is not drawn through the airflow channel.

[0186] EX7. A testing apparatus according to example EX6, wherein the comparison of the first and second intensity comprises the controller determining a ratio of the first intensity to the second intensity.

[0187] EX8. A testing apparatus according to example EX6 or EX7, wherein the comparison of the first and second intensity comprises the controller determining the transmittance of electromagnetic radiation through the aerosol.

[0188] EX9. A testing apparatus according to any one of examples EX6 to EX8, wherein the controller is configured to measure the first intensity based on signals received from the receiver.

[0189] EX10. A testing apparatus according to any one of the preceding examples, wherein the sensing assembly further comprises a temperature sensor configured to measure a temperature of a portion of the airflow channel.

[0190] EX11. A testing apparatus according to example EX10, wherein the temperature sensor is a thermocouple.

[0191] EX12. A testing apparatus according to example EX10 or EX11, wherein a second characteristic of the aerosol determined by the controller is temperature.

[0192] EX13. A testing apparatus according to any one of the preceding examples, wherein the sensing assembly further comprises a pressure sensor configured to measure a pressure drop in a portion of the airflow channel, preferably a differential pressure sensor.

[0193] EX14. A testing apparatus according to example EX13, wherein a third characteristic of the aerosol determined by the controller is pressure drop.

[0194] EX15. A testing apparatus according to any one of the preceding examples, wherein the emitter comprises one or more LEDs.

[0195] EX16. A testing apparatus according to any one of the preceding examples, wherein the receiver comprises a fibre sensor.

[0196] EX17. A testing apparatus according to any one of the preceding examples, wherein the emitter is configured to emit electromagnetic radiation having a wavelength of between 200 nanometres and 15,000 nanometres.

[0197] EX18. A testing apparatus according to any one of the preceding examples, wherein the receiver is configured to receive electromagnetic radiation having a wavelength of between 200 nanometres and 15,000 nanometres

[0198] EX19. A testing apparatus according to any one of the preceding examples, wherein the emitter is configured to emit electromagnetic radiation into the airflow channel in a direction perpendicular to a direction of flow of air drawn through the airflow channel when the testing apparatus is in the first configuration.

[0199] EX20. A testing apparatus according to any one of the preceding examples, wherein the emitter and receiver are positioned at opposite sides of the airflow channel.

[0200] EX21. A testing apparatus according to any one of the preceding examples, wherein the pump assembly, in a second configuration of the testing apparatus, is configured

to draw air through the airflow channel in a second direction that is opposite to the first direction.

[0201] EX22. A testing apparatus according to example EX21, wherein the airflow channel further comprises a second channel opening.

[0202] EX23. A testing apparatus according to example EX22, wherein the testing apparatus further comprises a valve assembly.

[0203] EX24. A testing apparatus according to example EX23, wherein the valve assembly is configured such that, when the testing apparatus is in the first configuration, the first channel opening is open and the second channel opening is closed.

[0204] EX25. A testing apparatus according to example EX23 or EX24, wherein the valve assembly is configured such that when the testing apparatus is in the second configuration the first channel opening is closed and the second channel opening is open.

[0205] EX26. A testing apparatus according to example EX24 or EX25, wherein the valve assembly comprises a first valve positioned between the first channel opening and the sensing assembly, the first valve configured to open or close the first channel opening.

[0206] EX27. A testing apparatus according to example EX26, wherein the first valve is a pinch valve.

[0207] EX28. A testing apparatus according to any one of examples EX24 to EX27, wherein the valve assembly comprises a second valve positioned between the second channel opening and the sensing assembly, the second valve configured to open or close the second channel opening.

[0208] EX29. A testing apparatus according to example EX28, wherein the second valve is an electromechanically operated valve.

[0209] EX30. A testing apparatus according to any one of examples EX23 to EX29, wherein the pump assembly, in a third configuration of the testing assembly, is configured to draw air through the airflow channel in a second direction opposite to the first direction and wherein, when the testing apparatus is in the third configuration, the valve assembly is configured to close the first channel opening.

[0210] EX31. A method of analysing an aerosol generated by an aerosol-generating system comprising an aerosol-forming substrate and a mouthpiece using the testing apparatus of any one of the preceding claims, the method comprising:

[0211] positioning the mouthpiece of the aerosol-generating system such that the mouthpiece is received in the first channel opening;

[0212] when the testing apparatus is in the first configuration, using the pump assembly to draw air through the airflow channel in a first direction such that an aerosol generated by the aerosol-generating system is drawn from the mouthpiece received in the first channel opening and through the airflow channel;

[0213] determining at least one characteristic of the aerosol drawn through the airflow channel based on signals received from the sensing assembly.

[0214] EX32. A method according to example EX31, further comprising comparing the at least one determined characteristic to one or more predetermined values for the at least one characteristic or one or more predetermined range of values for the at least one characteristic.

[0215] EX33. A method according to example EX32, further comprising determining that the aerosol-generating

system or the aerosol-forming substrate is defective if at least one of the determined characteristics is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic.

[0216] EX34. A method according to any one of examples EX31 to EX33, wherein the step of determining at least one characteristic comprises determining a first characteristic that is related to an intensity of electromagnetic radiation received by the receiver.

[0217] EX35. A method according to example EX34, wherein the step of determining the first characteristic comprises comparing a first intensity of electromagnetic radiation to a second intensity of electromagnetic radiation, the first intensity corresponding to the intensity of electromagnetic radiation received by the receiver and the second intensity corresponding to the intensity of electromagnetic radiation emitted by the emitter.

[0218] EX36. A method according to example EX35, wherein the comparison of the first and second intensity comprises determining a ratio of the first intensity to the second intensity.

[0219] EX37. A method according to any one of examples EX34 to EX36, wherein the first characteristic is the transmittance of electromagnetic radiation through the aerosol.

[0220] EX38. A method according to any one of examples EX31 to EX37, wherein the step of determining at least one characteristic comprises determining a second characteristic and the second characteristic is the temperature of the aerosol.

[0221] EX39. A method according to any one of examples EX31 to EX38, wherein the step of determining at least one characteristic comprises determining a third characteristic and the third characteristic is the pressure drop of the aerosol.

[0222] EX40. A method according to any one of examples EX31 to EX39, wherein the method further comprises using the pump assembly in a second configuration of the testing apparatus to draw air through the airflow channel in a second direction that is opposite to the first direction.

[0223] EX41. A method according to example EX40, wherein the step of using the pump assembly in a second configuration occurs after the step of using the pump assembly in the first configuration.

[0224] EX42. A method according to example EX41, wherein the step of using the pump assembly in a second configuration comprises closing the first channel opening and opening the second channel opening.

[0225] EX43. A method of detecting a defect in an aerosol-generating system comprising an aerosol-forming substrate and a mouthpiece, the method comprising:

[0226] positioning the mouthpiece of the aerosol-generating device such that the mouthpiece is received in a first channel opening of an airflow channel of a testing apparatus;

[0227] using a pump assembly of the testing apparatus to draw air through the airflow channel in a first direction such that an aerosol generated by the aerosol-generating system is drawn from the mouthpiece received in the first channel opening and through the airflow channel; determining at least one characteristic of the aerosol drawn through the airflow channel;

[0228] comparing the at least one determined characteristic to one or more predetermined values for the or

each characteristic or one or more predetermined range of values for the or each characteristic; and

[0229] determining that the aerosol-generating system is defective if at least one of the determined characteristics is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic.

[0230] EX44. A method according to example EX43, wherein the at least one characteristic comprises a first characteristic that is the transmittance of electromagnetic radiation through the aerosol.

[0231] EX45. A method according to example EX43 or EX44, wherein the at least one characteristic comprises a second characteristic that is the temperature of the aerosol.

[0232] EX46. A method according to any one of examples EX43 to EX45, wherein the at least one characteristic comprises a third characteristic that is the pressure of the aerosol.

[0233] Examples will now be further described with reference to the figures in which:

[0234] FIG. 1 is a schematic of a testing apparatus according to a first embodiment in combination with a first aerosol-generating system;

[0235] FIG. 2 is a schematic cross-section of the first aerosol-generating system of FIG. 1;

[0236] FIG. 3 is a flow diagram of a method of analysing an aerosol generated by the first aerosol-generating system of FIG. 2 using the testing apparatus of FIG. 1;

[0237] FIG. 4 is a schematic of the testing apparatus of FIG. 1 in a first configuration;

[0238] FIG. 5 is a graph representing the transmittance of aerosol generated in use of the first aerosol-generating system of FIG. 1 for successive puffs;

[0239] FIG. 6 is a graph representing the temperature of aerosol generated in use of the aerosol-generating system of FIG. 1 for successive puffs;

[0240] FIG. 7 is a schematic of the testing apparatus of FIG. 1 in a second configuration;

[0241] FIG. 8 is a schematic of the testing apparatus of FIG. 1 in a third configuration;

[0242] FIG. 9 is a schematic of a second embodiment of a testing apparatus that is suitable for analysing the aerosol generated by two aerosol-generating systems;

[0243] FIG. 10 is a schematic of third embodiment of a testing apparatus that is suitable for analysing the aerosol generated by two aerosol-generating systems, the testing apparatus being in a first position; and

[0244] FIG. 11 is schematic of the third embodiment of the testing apparatus, the testing apparatus in a second position.

[0245] FIG. 1 is a schematic of a testing apparatus 100 in which a first aerosol-generating system 200 is received. The aerosol-generating system 200 is shown in more detail, separately from the testing apparatus 100, as a cross-sectional schematic view in FIG. 2.

[0246] The testing apparatus 100 comprises an airflow channel 102.

[0247] A first branch 104 of the airflow channel extends from a first channel opening 105 that is configured to receive a mouthpiece of the aerosol-generating system 200. The first channel opening 105 comprises a machined mouthpiece receiving portion (not shown in the figures) which is shaped to receive the mouthpiece of the aerosol-generating system 200 in an opening of the mouthpiece receiving portion and to provide a seal between the testing apparatus and the

mouthpiece of the aerosol-generating system 200. The mouthpiece of the aerosol-generating system 200 is not shown in FIG. 1 because it is received in the first channel opening 105 but is shown in FIG. 2 as feature 204.

[0248] A second branch 106 of the airflow channel extends from a second channel opening 107 that is open to the atmosphere. The first branch 104 and second branch 106 merge at a first junction 108.

[0249] Between the first channel opening 105 and the first junction 108 is a first valve 112. The first valve 112 is a pinch valve and is controllable to open or close. When the first valve 112 is open, air is able to flow from the first channel opening 105, through the first branch 104 and on through the airflow channel 102 (or vice versa). When the first valve 112 is closed, air is prevented from being able to flow from the first channel opening 105 and through the first branch 104 (or vice versa). When the first valve 112 is closed, the first channel opening 105 may be referred to as being closed.

[0250] Between the second channel opening 107 and the first junction 108 is a second valve 116. The second valve 116 is an electromechanically operated valve and is controllable to open or close. When the second valve 116 is open, air is able to flow from the second channel opening 107, through the second branch 106 and on through the airflow channel 102 (or vice versa). When the second valve 116 is closed, air is prevented from being able to flow from the second channel opening 107 and through the second branch 106 (or vice versa). When the second valve 116 is closed, the second channel opening 107 may be referred to as being closed.

[0251] Downstream of the first junction 108, the airflow channel 108 passes through a sensing assembly 118 and continues to a second junction 113. Between the second junction 113 and the second valve 116 is positioned a filter element 121.

[0252] The sensing assembly 118 comprises an emitter 140 comprising a plurality of LEDs configured to emit electromagnetic radiation into the airflow channel. The electromagnetic radiation has a wavelength in the visible range of the electromagnetic spectrum. In particular, the LEDs are configured to emit electromagnetic radiation at a single wavelength of 625 nanometres.

[0253] The sensing assembly 118 further comprises a receiver 142 in the form of a fibre sensor. The receiver 142 is configured to receive at least some of the electromagnetic radiation emitted into the airflow channel by the emitter 140. The emitter 140 and receiver 142 are positioned on opposite sides of the airflow channel 102. In this way, electromagnetic radiation received by the receiver 142 from the emitter 140 must have passed through the airflow channel 102. Thus, the electromagnetic radiation must have interacted with the air in the airflow channel.

[0254] The sensing assembly 118 further comprises a temperature sensor 144. The temperature sensor 144 is a thermocouple. The temperature sensor is suitable for measuring temperatures of between about -minus 50 degrees Celsius and 350 degrees Celsius. The temperature sensor 144 is configured to measure a temperature of a portion of the airflow channel 102. In this way, it is possible to determine the temperature of air flowing through the airflow channel 102.

[0255] The sensing assembly 118 further comprises a pressure sensor 146. The pressure sensor 146 is configured to measure a pressure drop of a portion of the airflow channel 102.

[0256] A third branch 122 of the airflow channel 102 extends from the second junction 113 to a third channel opening 124. The third channel opening 124 is open to the atmosphere.

[0257] A fourth branch 126 of the airflow channel 102 extends from the second junction 113 to a fourth channel opening 128. Again, the fourth channel opening 128 is open to the atmosphere.

[0258] Between the second junction 113 and the third channel opening 124 is positioned a third valve 130 and a first pump 132. The third valve 130 is an electromechanical valve and is controllable to open or close. When the third valve 130 is open, air is able to flow from the second junction 113, through the third branch 122 and on to the third channel opening 124 (or vice versa). When the third valve 130 is closed, air is prevented from being able to flow from the second junction 113, through the third branch 122 and on to the third channel opening 124 (or vice versa). When the third valve 130 is closed, the third channel opening 124 may be referred to as being closed.

[0259] The first pump 132 is a suction pump. The first pump 132 is controllable to be either on or off. When the first pump 132 is controlled to be switched on, the first pump 132 is configured to draw air through the airflow channel 102 in a first direction such that air is drawn through the airflow channel so as to flow from the first junction 108 towards the second junction 113.

[0260] Between the second junction 113 and the fourth channel opening 128 is positioned a fourth valve 134 and a second pump 136. The fourth valve 134 is an electromechanical valve and is controllable to open or close. When the fourth valve 134 is open, air is able to flow from the second junction 113, through the fourth branch 126 and on to the fourth channel opening 128 (or vice versa). When the fourth valve 134 is closed, air is prevented from being able to flow from the second junction 113, through the fourth branch 126 and on to the fourth channel opening 128 (or vice versa). When the fourth valve 134 is closed, the fourth channel opening 128 may be referred to as being closed.

[0261] The second pump 136 may be referred to as an exhaust pump. The second pump 136 is controllable to be off, on in a suction mode or on in a blowing mode. When the second pump 136 is controlled to be switched on in the suction mode, the second pump 136 is configured to draw air through the airflow channel 102 in the first direction such that air is drawn through the airflow channel so as to flow from the first junction 108 towards the second junction 113. When the second pump 136 is controlled to be switched on in the blowing mode, the second pump 136 is configured to draw air through the airflow channel 102 in a second direction such that air is drawn through the airflow channel so as to flow from the second junction 113 towards the first junction 108.

[0262] The first and second pumps 132, 136 together may together be referred to as a pump assembly 138. The pump assembly 138 and the first, second, third and fourth valves 112, 116, 130 and 134 are controlled by a controller of the testing assembly, not shown in the figures. The controller is configured to control the first and second pumps to be switched on or off, and in the case of the second pump, to

be in the suction or blowing modes when switched on. The controller is also configured to open or close the first, second, third and fourth valves, as required. In particular, the controller controls the pumping assembly and valves according to different configurations of the testing apparatus. This is described in more detail below.

[0263] Although the second, third and fourth channel openings have all been described as being open to the atmosphere, it is also possible for any or all of these openings to be connected to a ventilation system or a waste container that is separate to the testing apparatus. This would ensure that any exhausted air from the testing apparatus is contained. In such embodiments, it may not be necessary to include the filter elements 121 in the testing apparatus 100. However, the presence of the filter elements 121 would still provide the benefit of protecting the pump from the generated aerosol.

[0264] FIG. 2 is a cross-sectional schematic view of the first aerosol-generating system 200 that is shown in combination with the testing apparatus 100 in FIG. 1. The aerosol-generating system 200 comprises an aerosol-generating device 202 comprising a chamber 210 defined by a device housing. The chamber 210 is tubular, made of a stainless steel and has at an upstream end a base. The chamber 210 is configured for receiving an aerosol-generating article 300.

[0265] The aerosol-generating article 300 received in the chamber 210 contains an aerosol-forming substrate 306. The aerosol-forming substrate is a solid tobacco-containing substrate. In particular, the aerosol-forming substrate is a gathered sheet of homogenised tobacco. As shown in FIG. 2, the aerosol-generating article and chamber are configured such that a mouth end of the aerosol-generating article 300 protrudes out of the chamber 10 and out of the aerosol-generating device when the aerosol-generating article is received in the chamber. This mouth end forms a mouthpiece 304. In normal use of the aerosol-generating system 200, a user of the system may puff on the mouthpiece 304 in use. However, when the aerosol-generating system 200 is used with the testing apparatus 100 of FIG. 1, the mouthpiece 304 is instead received in the first channel opening 105 of the testing apparatus 100.

[0266] The aerosol-generating device 202 comprises a heater assembly comprising a heating element 211. The heating element 211 surrounds the chamber 10 along a portion of the chamber in which the aerosol-forming substrate 306 of the aerosol-generating article 202 is received. The heating element 211 is a resistive heating element.

[0267] An airflow channel 220 extends from an air inlet 222 of the aerosol-generating device 100. Upstream of the chamber, the airflow channel 220 is primarily defined by an airflow channel wall 224. Downstream of the airflow channel wall 224, the airflow channel 220 passes through an air inlet defined in the base of the chamber. The airflow channel 220 then extends through the chamber 210. In particular, air flowing through the airflow channel 220 passes into the aerosol-generating article 300 at its distal end.

[0268] The aerosol-generating device 202 further comprises a power supply 242 in the form of a rechargeable battery for powering the heating element 211 controllable by a controller of the device (not shown). The power supply is connected to the controller and the heating element 211 via electrical wires and connections that are not shown in the Figures. The aerosol-generating device may comprise fur-

ther elements, not shown in the Figures, such as a button for activating the aerosol-generating device.

[0269] In use of the aerosol-generating system 100, air is drawn through the mouthpiece 304 of the received aerosol-generating article 300 resulting in air being drawn through the airflow channel 220 towards the mouthpiece 304. Air will be drawn from outside of the aerosol-generating device into the airflow channel 220 through air inlet 222. Because the aerosol-generating article 300 is received in the chamber, the air drawn into the chamber will enter the aerosol-generating article 300 at its distal end. Thus, the air passes through the aerosol-forming substrate 306. In doing so, volatile compounds generated by the heating of the substrate 306 will become entrained in the air. As the air continues towards the mouthpiece 304 of the aerosol-generating article 300, the volatile compounds cool to form an aerosol. The air and entrained aerosol then exits the aerosol-generating article 300 through the mouthpiece 304.

[0270] In normal use of the aerosol-generating system 200, it is a user puffing on the mouthpiece 304 that results in air being drawn through the airflow channel 220, as described above. During a puff, a user inhales through the aerosol-generating system 100 and so draws air through the aerosol-generating system 200.

[0271] However, when the aerosol-generating system 200 is used with the testing apparatus 100, as shown in FIG. 1, it is the testing apparatus 100, and specifically the pump assembly 138 of the testing apparatus 100, that imitates a user puffing and draws air through the aerosol-generating system 200. The purpose of this is so that the generated aerosol enters the airflow channel 102 and past the sensing assembly 118 of the testing apparatus 100 to be analysed. Analysis of the generated aerosol allows defective aerosol-generating systems 200 to be detected and is particularly important in the context of quality assurance testing in relation to the production of the aerosol-generating system 200 or components of that system (particularly consumable components of that system).

[0272] FIG. 3 shows a flow diagram showing the steps analysing an aerosol generated by the aerosol-generating system of FIG. 2 using the testing apparatus shown in FIG. 1.

[0273] Step 402 of the method is to position the aerosol-generating system 200 in the testing apparatus 100. In particular, the mouthpiece 304 of the aerosol-generating system is inserted into the mouthpiece receiving portion of the first channel opening 105 of the testing apparatus 100.

[0274] Step 404 of the method is to draw generated aerosol into the testing apparatus 100 using the pump assembly 138. Step 404 first comprises configuring the testing apparatus 100 of FIG. 1 to be in a first configuration, as shown in FIG. 4. The controller of the testing apparatus is configured to open the first valve 112 and the third valve 130 and to close the second valve 116 and the fourth valve 134. If the valves are already in their respective open or closed state for the first configuration, the controller is configured to maintain the valves in that state. For example, if the first valve 112 is already open, the controller is maintains the first valve in that open position.

[0275] The controller is also configured to turn on the first pump 132 to draw air through the airflow channel in the first direction. Air is not able to enter the airflow channel 102 through the second or fourth channel openings 107, 128 because the second and fourth valves 116, 134 are closed.

Thus, when the first pump 132 draws air through the airflow channel 102 in the first direction, that air must be drawn into the airflow channel 102 through the first channel opening 105 and so also through the aerosol-generating system 200 whose mouthpiece 204 is received in the first channel opening 105. The pump assembly 138 mimics a user puffing on the aerosol-generating system 200. The air flow through the testing apparatus 100 in the first configuration is represented by the dotted arrows in FIG. 4.

[0276] The aerosol-generating system 200 is an electrically heated aerosol-generating system and so, for aerosol to be generated, the aerosol-generating device 202 should be activated to heat the aerosol. In some embodiments, the aerosol-generating device 202 comprises a button for activating the device which should be pressed by the user to activate the device. This may be before or during the step of the pump assembly drawing air through the airflow channel. Alternatively or additionally, in other embodiments, the aerosol-generating device 200 comprises a puff detector system that is configured to activate the device upon detecting a puff. In such embodiments, the aerosol-generating device 200 is activated automatically upon detection of a puff and so is activated by the pump assembly 138 drawing air through the airflow channel 102.

[0277] Once the aerosol-generating device 202 has been activated, the heater element 210 will heat up the aerosol-forming substrate 306 to generate an aerosol, as described above in relation to FIG. 2. This generated aerosol will then be entrained in the air drawn through the airflow channel 102 by the pump assembly 138.

[0278] Step 406 of the method is to determine a characteristic of the generated aerosol. This step is performed by the controller of the testing apparatus based on signals received from the sensing assembly 118.

[0279] Step 406 comprises determining a first characteristic of the generated aerosol which is the transmittance of the aerosol. The transmittance of a material is defined as the ratio of light energy transmitted through a body to the light energy falling on it. In this case, the body is the generated aerosol.

[0280] The light energy transmitted through the generated aerosol is determined by the controller based on signals received from the receiver 142 while generated aerosol is drawn through the airflow channel 102. This is because the generated aerosol will pass through the sensing assembly 118 such that electromagnetic radiation emitted by the emitter 140 will interact with (and be absorbed by) the aerosol. Thus, the intensity of electromagnetic radiation received by the receiver 142 is representative of the amount of energy transmitted through the generated aerosol. This intensity is a first intensity.

[0281] In some embodiments, the light energy falling on the generated aerosol is a predetermined value that is stored in a memory of the controller of the testing apparatus. In some embodiments, the light energy falling on the generated aerosol is alternatively or additionally measured prior to step 404. In particular, the controller of the testing apparatus is configured to measure the intensity of electromagnetic radiation received at the receiver 142 from the emitter 140 when no aerosol has yet been generated. This intensity is a second intensity.

[0282] The controller of the testing apparatus **100** is configured to determine the transmittance of the generated aerosol by calculating the ratio of the first intensity to the second intensity.

[0283] Step **408** of the method comprises comparing the first characteristic (i.e. the determined transmittance) to a predetermined range of values for the transmittance. The predetermined range of values represent values for the transmittance of an aerosol generated by an aerosol-generating system that is operating correctly.

[0284] The predetermined range of values are known values that are determined from prior experimentation. For example, such experimentation may comprise measuring the transmittance of an aerosol generated by a large number of aerosol-generating systems that are known to operate correctly (i.e. without a defect). The predetermined range of values may then be determined based on an average of the transmittance values and the spread or standard deviation of the transmittance values.

[0285] The predetermined range of values used in the comparison are specific to the type of aerosol-generating system being tested. The predetermined range of values are also specific to the type of aerosol-forming substrate of the aerosol-generating system being tested (if the aerosol-generating system is capable of operating with different aerosol-forming substrates).

[0286] The predetermined range of values are stored in a memory of the controller of the testing apparatus. In some embodiments, the method can additionally comprise inputting the predetermined range of values into the memory manually or by uploading the predetermined range of values to the memory from a central database, for example.

[0287] Step **408** comprises step **409** of checking if the characteristic is outside of a predetermined range.

[0288] Step **410** of the method is carried out if the determined characteristic is outside the predetermined range of values for that characteristic. Step **410** of the method is to determine that the aerosol-generating system **200** is defective. If the aerosol-generating system **200** is determined to be defective, the testing device **100** will inform a user. This may be via a user interface of the testing device **100** (not shown in the Figures), for example in the form of an error message on a screen of the user interface, by emitting a sound or by lighting an error LED on the user interface.

[0289] Step **412** of the method is carried out if the determined characteristic is within the predetermined range of values for that characteristic. Step **412** on FIG. **4** is to take no action. In some embodiments, however, the testing device will inform a user that the aerosol-generating system **200** being tested is not defective.

[0290] In some embodiments, step **412** is followed by repeating steps **406** and **408** for further characteristics of the generated aerosol and while generated aerosol is drawn into the testing apparatus **100**. In some embodiments, the controller performs steps **406** and **408** for further characteristics at the same time as for the first characteristics.

[0291] In some embodiments, the method may comprise comparing the or each characteristic to a respective single predetermined value rather than a range of predetermined values. The principle is the same. The single predetermined value is known from prior experimentation.

[0292] Steps **406** and **408** are repeated by determining a second and third characteristic of the generated aerosol and comparing the second and third characteristics to respective

predetermined ranges of values. The second characteristic is the temperature of generated aerosol. The third characteristic is the pressure drop when aerosol is generated compared to an ambient pressure.

[0293] The second characteristic is determined by the controller of the testing apparatus based on signals received at the controller from the temperature sensor **144**.

[0294] The third characteristic is determined by the controller of the testing apparatus based on signals received at the controller from the pressure sensor **146**. The pressure sensor **146** is a differential pressure sensor and so the pressure drop in the airflow channel can be determined directly.

[0295] Again, the predetermined range of values for the second and third characteristics are known values derived from prior experimentation in relation to the specific type of aerosol-generating system and aerosol-forming substrate being tested.

[0296] In some embodiments, the controller is configured to determine that the aerosol-generating device is defective if any of one the first to third characteristics is outside of the respective predetermined range. In some embodiments, the controller is configured to determine that the aerosol-generating device is defective only if two or three of the first to third characteristics is outside of the respective predetermined range.

[0297] Steps **406** and **408** are performed (and repeated) simultaneously to step **404**. Step **404** continues for a predetermined time that is representative a typical user puff. The predetermined time is 2 seconds. At the end of the predetermined time, step **404** comes to end and the controller of the testing apparatus **100** is configured to switch the first pump **132** off.

[0298] In some embodiments, the method comprises repeating steps **404** onwards of FIG. **3** for a number of subsequent puffs. In one embodiment, steps **404** onwards of FIG. **3** are repeated nine times (i.e. for nine further puffs). Optionally, there is a delay of about 30 seconds between each repetition of steps **404** onwards. This repetition is intended to mimic a real-world usage session of the aerosol-generating system **200**.

[0299] The characteristics of an aerosol generated by a normally operating aerosol-generating system (i.e. one that is not defective) will typically vary for subsequent puffs.

[0300] FIG. **5** is a graph representing how the transmittance of an aerosol generated by a particular aerosol-generating system varies for subsequent puffs. y axis **502** represents transmittance, x axis **504** represents puff number. As the number of puffs progresses, the transmittance initially falls and then rises again towards the end of the usage session. The change in transmittance will depend on how the quantity of generated aerosol and chemical composition of that aerosol changes for subsequent puffs. Different aerosol-generating systems and different aerosol-forming substrates will have a different pattern.

[0301] FIG. **6** is a graph representing how the temperature of the aerosol generated by the aerosol-generating system of FIG. **5** varies for subsequent puffs. y axis **602** represents temperature, x axis **604** represent puff number. The general trend of aerosol temperature is to decrease as the number of puffs increases. This may be because of the heating profile employed by the aerosol-generating device of the particular

aerosol-generating system. It may also result from a changing chemistry of the aerosol-forming substrate as the substrate is depleted.

[0302] The pressure drop can follow a similar pattern to the temperature wherein the pressure drop decreases for increasing puff number.

[0303] To account for the changing characteristics of an aerosol generated by a normally operating aerosol-generating system for subsequent puffs, the method comprises comparing the determined characteristics to different predetermined ranges of values for subsequent puffs. For example, the predetermined range of values for the transmittance follows a decreasing and then increasing pattern for subsequent puffs, similar to the trend shown in the graph of FIG. 5. The predetermined range of values for the temperature and the pressure drop follows a decreasing pattern similar to the trend shown in the graph of FIG. 6.

[0304] The method further comprises applying a purge air flow through the air flow channel to remove generated aerosol and other contaminants from the airflow channel which might impact future results. In some embodiments, the purge air flow is applied between each individual puff, at the end of the predetermined time of step 404 as described above. In other embodiments, the purge air flow is applied at the end of a usage session (i.e. after 10 subsequent puffs have been carried out). The step of applying a purge air flow comprises applying that purge air flow for 28 seconds.

[0305] Applying a purge air flow comprises configuring the testing apparatus 100 to be in a second configuration, as shown in FIG. 7. To do this, the controller of the testing apparatus 100 closes the first valve 112 and the third valve 130 and opens the second valve 116 and the fourth valve 134. If the valves are already in their respective closed or open state for the second configuration, the controller is configured to maintain the valves in that state. For example, if the first valve 112 is already closed, the controller maintains the first valve in that closed position.

[0306] The controller is also configured to turn on the second pump 136 into its blowing mode to draw air through the airflow channel in a second direction which is opposite to the first direction such that air is drawn through the airflow channel 102 so as to flow from the second junction 113 towards the first junction 108. The flow of air is represented by dotted arrows in FIG. 7.

[0307] Air is not able to enter the airflow channel 102 through the first or third channel openings 105, 124 because the first and third valves 112, 130 are closed. Thus, when the second pump 136 draws air through the airflow channel 102 in the second direction, that air must be drawn into the airflow channel 102 through the fourth channel opening 128. The air that is drawn into the airflow channel 102 is fresh air that passes through the airflow channel 102, including through the sensing assembly 118. This fresh air flushes out any lingering aerosol or contaminants in the airflow channel 102. Any lingering aerosol or contaminants are entrained in the airflow and carried out of the airflow channel 102 through the second channel opening 107.

[0308] Applying a purge airflow further comprises configuring the testing apparatus 100 to be in a third configuration, as shown in FIG. 8. To do this, the controller of the testing apparatus 100 closes the first valve 112 and the third valve 130 and opens the second valve 116 and the fourth valve 134. As the valves are already in their respective closed or open state for the third configuration, when starting

in the second configuration, the controller is configured to maintain the valves in that state. For example, the first valve 112 is already closed, so the controller maintains the first valve in that closed position.

[0309] The controller is also configured to turn on the second pump 136 into its suction mode to draw air through the airflow channel in the first direction such that air is drawn through the airflow channel 102 so as to flow from the first junction 108 towards the second junction 113. The flow of air is represented by the dotted lines in FIG. 8.

[0310] Air is not able to enter the airflow channel 102 through the first or third channel openings 105, 124 because the first and third valves 112, 130 are closed. Thus, when the second pump 136 draws air through the airflow channel 102 in the first direction, that air must be drawn into the airflow channel 102 through the second channel opening 107. The air that is drawn into the airflow channel 102 is fresh air that passes through the airflow channel 102, including through the sensing assembly 118. This fresh air flushes out any lingering aerosol or contaminants in the airflow channel 102. Any lingering aerosol or contaminants are entrained in the airflow and carried out of the airflow channel 102 through the second channel opening 107.

[0311] In the above described embodiment, a purge air flow is applied in two different directions in two different configurations of the testing apparatus. In some embodiments, applying a purge airflow only comprises applying the air flow in a single direction and in a single configuration of the testing apparatus.

[0312] The testing apparatus 100 has been described in combination with a first aerosol-generating system 200 of the type that receives and electrically heats an aerosol-generating article comprising an aerosol-forming substrate. However, it will be appreciated that the testing apparatus 100, or a similar testing apparatus 100, can be used with other types of aerosol-generating system provided that the aerosol-generating system comprises a mouthpiece through which, in normal use of the aerosol-generating system, a user of the system inhales.

[0313] For example, in some embodiments, the aerosol-generating system is of the type comprising an aerosol-generating device and a cartridge containing an aerosol-forming substrate. The aerosol-generating device may receive the cartridge in a cavity. Either the aerosol-generating device or the cartridge comprises a mouthpiece and that mouthpiece is received in the mouthpiece receiving portion of the testing apparatus 100. The aerosol-generating system is activated either by a user or automatically in response to detecting a user puff. The aerosol generated by the aerosol-generating device is then carried out in the same way as described above.

[0314] In other embodiments, the aerosol-generating system consists of an aerosol-generating article. The aerosol-generating article comprises a mouthpiece, an aerosol-forming substrate and a combustible carbonaceous heat source. The mouthpiece of the article is received in the mouthpiece receiving portion of the first channel opening 105. The aerosol-generating system is activated by igniting the combustible carbonaceous heat source. The aerosol generated by the aerosol-generating device is then carried out in the same way as described above. Because the pump assembly 138 mimics user puffs in the first configuration, the aerosol-generating article will combust (and so operate) in the same way as when used in a normal usage session.

[0315] In embodiments where the same testing apparatus 100 is used for different types of aerosol-generating system, the mouthpiece receiving portion of the first channel opening 105 is removable. In this way, the mouthpiece receiving portion can, if necessary, be removed and replaced with a mouthpiece receiving portion that is specifically shaped for the aerosol-generating system to be analysed.

[0316] A second embodiment of a testing apparatus 600 is shown in FIG. 9. The testing apparatus 600 of the second embodiment operates similarly to the testing apparatus of the first embodiment, as shown in FIG. 1. Like components are numbered accordingly. The testing apparatus 600 of the second embodiment differs in that it is suitable for testing more than one aerosol-generating system 200 at once. Therefore, the testing apparatus 600 comprises two first channel openings 105, two first valves 112, two first branches 104 of air flow channel and two sensing assemblies 118. The airflow channel 102 and the above mentioned components are positioned and configured such that a single pump assembly 138 is used to draw air through the airflow channel in both the first and second directions. The first valves are controlled in unison. So, in the first configuration of the testing apparatus 600, both the first valves 112 are open and the single second valve 116 is closed. Air drawn in the first direction by the first pump 132 will therefore draw aerosol generated by both of the aerosol-generating systems into the airflow channel. As shown in FIG. 9, the airflow channel 102 is configured such that the aerosol from one of the aerosol-generating systems is drawn past one of the sensing assemblies 118 and the aerosol from the other of the aerosol-generating systems is drawn past the other of the sensing assemblies 118. In this way, aerosol generated by multiple aerosol-generating systems can be analysed separately and simultaneously.

[0317] The analysis of characteristics of the generated aerosol is as described above in relation to the testing apparatus 100.

[0318] In the second and third configurations of the testing apparatus 600, both of the first valves 112 are closed and the second valve 116 is opened. Therefore, purge air can be drawn through the airflow channel by the single pump assembly 138 in the same way as described in relation to the testing apparatus 100. As shown in FIG. 9, the airflow channel 102 is configured such that the purge airflow will pass through both sensor assemblies.

[0319] The testing apparatus 600 is designed for testing two aerosol-generating systems 200 simultaneously. However, it will be appreciated that the testing apparatus can be adapted for testing any number of aerosol-generating system 200 according in a similar way to testing the two aerosol-generating systems 200 as shown in FIG. 9.

[0320] A third embodiment of a testing apparatus 700 is shown in FIG. 10. The testing apparatus 700 of the third embodiment operates similarly to the testing apparatus of the first embodiment, as shown in FIG. 1. Like components are numbered accordingly.

[0321] The third embodiment of the testing apparatus 700 is another embodiment that is suitable for testing more than one aerosol-generating system at once, in particular two aerosol-generating systems. The testing apparatus 600 comprises two first channel openings 105 and two first branches 104 of air flow channel. The testing apparatus 700 also comprises two second channel openings 107 and two second branches 106 of airflow channel. Unlike the testing apparatus

600 of the second embodiment, the testing apparatus 700 of the third embodiment comprises a single sensor assembly 118.

[0322] The first and second branches 104 and 106 are connected to the sensor assembly through a rotatory valve mechanism 702. The rotatory valve mechanism 702 comprises a single opening 704 which is formed in a rotating disk 706, the rotating disk 706 being rotatable by an electrical motor of the rotatory valve mechanism, not shown in the Figures.

[0323] The rotatory valve mechanism 702 further comprises an airflow channel portion 708 for each of the first and second branches 104, 106. Each airflow channel portion 708 is connected to a central column 710. An airflow channel portion 712 connects the central column 710 to the sensor assembly 118.

[0324] In FIG. 10, the rotating disk 706 is positioned such that the single opening 704 is aligned with one of the first branches 104. In this way, the aerosol-generating system received in one of the first channel openings 105 can be tested by drawing generated aerosol through the sensor assembly 118 using the pump assembly 138, as described in relation to the first embodiment. The generated aerosol will be drawn through the first branch 104, into the central column 710 and then through airflow channel 712 before passing the sensor assembly 118 and on towards the pump assembly 138.

[0325] Because the rotating disk 706 only comprises a single opening 704, when the disk is positioned as shown in FIG. 10, the other branches are not engaged to the sensor assembly. In other words, only one of the first channel openings is “open” in FIG. 10, and both of the second channel opening are “closed”.

[0326] The rotating disk 706 can be controlled to be rotated by the electrical motor to connect different first or second branches (and associated first or second openings) to the sensor assembly and pump assembly.

[0327] FIG. 11 shows the rotating disk 706 in a second position in which the single opening 704 is aligned with one of the second branches 106 to connect one of the second channel openings to the sensor assembly 118 and pump assembly 138. In this position, a purge airflow can be applied through the sensor assembly, as described in relation to the first embodiment.

[0328] During operation of the testing apparatus 700, the rotating disk 706 is rotated so that the single opening 704 engages each of the first and second branches sequentially so as to draw aerosol from each aerosol-generating system past the sensor assembly and then perform a purge routine between drawing aerosol from an aerosol-generating system.

[0329] Unlike the testing apparatus 600 of the second embodiment, the testing apparatus 700 of third embodiment is not capable of simultaneous analysis of the aerosol generated by multiple aerosol-generating systems. Instead, the rotating disk 706 is rotated stepwise.

[0330] Of course, it is possible for the testing apparatus 700 to be configured to analyse more than two aerosol-generating systems. In that case, additional first and second channel openings and related features would be provided.

1-15. (canceled)

16. A testing apparatus for analysing an aerosol generated by an aerosol-generating system comprising an aerosol-forming substrate and a mouthpiece, the testing apparatus comprising:

- an airflow channel that extends from a first channel opening that is configured to receive a mouthpiece of an aerosol-generating system;
- a sensing assembly comprising an emitter configured to emit electromagnetic radiation into the airflow channel and a receiver configured to receive at least some of the electromagnetic radiation from the airflow channel;
- a pump assembly that, in a first configuration of the testing apparatus, is configured to draw air through the airflow channel in a first direction such that an aerosol generated by the aerosol-generating system in use is drawn from the mouthpiece received in the first channel opening and through the airflow channel; and
- a controller configured to determine at least one characteristic of the aerosol drawn through the airflow channel based on signals received from the sensing assembly;

the airflow channel further comprising a second channel opening and the testing apparatus further comprising a valve assembly;

wherein the pump assembly, in a second configuration of the testing apparatus, is configured to draw purge air through the airflow channel in a second direction that is opposite to the first direction; and

wherein the pump assembly, in a third configuration of the testing apparatus, is configured to draw purge air through the airflow channel in the first direction;

wherein the valve assembly is configured such that when the testing apparatus is in the first configuration, the first channel opening is open and the second channel opening is closed;

wherein the valve assembly is further configured such that when the testing apparatus is in the second and third configurations, the first channel opening is closed and the second channel opening is open.

17. A testing apparatus according to claim 16, wherein the controller is configured to compare the at least one determined characteristic to one or more predetermined values for the or each characteristic or one or more predetermined range of values for the or each characteristic.

18. A testing apparatus according to claim 17, wherein the controller is configured to determine that the aerosol-generating system is defective if at least one of the determined characteristics is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic.

19. A testing apparatus according to claim 16, wherein a first characteristic of the aerosol determined by the controller is related to the transmittance of the aerosol.

20. A testing apparatus according to claim 16, wherein the sensing assembly further comprises a temperature sensor configured to measure a temperature of a portion of the airflow channel.

21. A testing apparatus according to claim 20, wherein a second characteristic of the aerosol determined by the controller is temperature.

22. A testing apparatus according to claim 16, wherein the sensing assembly further comprises a pressure sensor configured to measure a pressure in a portion of the airflow channel.

23. A testing apparatus according to claim 22, wherein a third characteristic determined by the controller is a pressure drop.

24. A testing apparatus according to claim 16, wherein the emitter comprises one or more LEDs.

25. A method of analysing an aerosol generated by an aerosol-generating system comprising an aerosol-forming substrate and a mouthpiece using the testing apparatus of claim 16, the method comprising:

positioning the mouthpiece of the aerosol-generating system such that the mouthpiece is received in the first channel opening;

when the testing apparatus is in the first configuration, using the pump assembly to draw air through the airflow channel in a first direction such that an aerosol generated by the aerosol-generating system is drawn from the mouthpiece received in the first channel opening and through the airflow channel;

determining at least one characteristic of the aerosol drawn through the airflow channel based on signals received from the sensing assembly;

using the pump assembly, in a second configuration of the testing apparatus, to draw purge air through the airflow channel in a second direction that is opposite to the first direction; and

using the pump assembly, in a third configuration of the testing apparatus, to draw purge air through the airflow channel in the first direction;

wherein when the testing apparatus is in the first configuration, the first channel opening is open and the second channel opening is closed;

wherein when the testing apparatus is in the second and third configurations, the first channel opening is closed and the second channel opening is open.

26. A method according to claim 25, further comprising comparing the at least one determined characteristic to one or more predetermined values for the at least one characteristic or one or more predetermined range of values for the at least one characteristic.

27. A method according to claim 26, further comprising determining that the aerosol-generating system or the aerosol-forming substrate is defective if at least one of the determined characteristics is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic.

28. A method of detecting a defect in an aerosol-generating system comprising an aerosol-forming substrate and a mouthpiece, the method comprising:

positioning the mouthpiece of the aerosol-generating device such that the mouthpiece is received in a first channel opening of an airflow channel of a testing apparatus according to claim 16;

using the pump assembly of the testing apparatus, in a first configuration of the testing apparatus, to draw air through the airflow channel in a first direction such that an aerosol generated by the aerosol-generating system is drawn from the mouthpiece received in the first channel opening and through the airflow channel;

determining at least one characteristic of the aerosol drawn through the airflow channel using the sensing assembly;

comparing the at least one determined characteristic to one or more predetermined values for the or each characteristic or one or more predetermined range of values for the or each characteristic; and

determining that the aerosol-generating system is defective if at least one of the determined characteristics is not equal to one of the predetermined values for that characteristic or does not fall within one of the predetermined ranges of values for that characteristic;

using the pump assembly, in a second configuration of the testing apparatus, to draw purge air through the airflow channel in a second direction that is opposite to the first direction; and

using the pump assembly, in a third configuration of the testing apparatus, to draw purge air through the airflow channel in the first direction;

wherein when the testing apparatus is in the first configuration, the first channel opening is open and the second channel opening is closed;

wherein when the testing apparatus is in the second and third configurations, the first channel opening is closed and the second channel opening is open.

29. A method according to claim **28**, wherein the at least one characteristic comprises a first characteristic that is the transmittance of electromagnetic radiation through the aerosol.

30. A method according to claim **28**, wherein the at least one characteristic comprises a second characteristic that is the temperature of the aerosol.

31. A method according to claim **29**, wherein the at least one characteristic comprises a second characteristic that is the temperature of the aerosol.

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