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(54) **ELECTRONIC CIGARETTE**

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(57) **ABSTRACT**

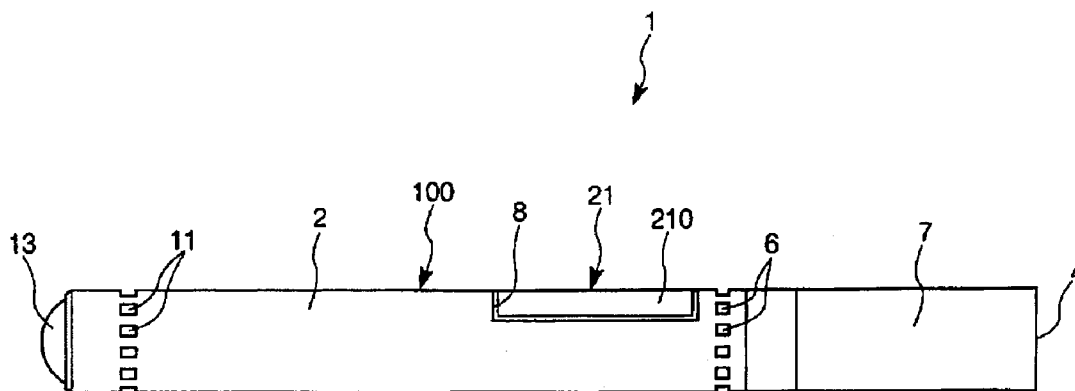
An electronic cigarette is provided. The electronic cigarette includes a casing having an inhalation hole and a substantially cylindrical configuration, ejection means (first ejection means) provided in the casing and at least one ejection head. Pressure in a cavity filled with a liquid flavor generating medium is changed by driving an actuator to eject the flavor generating medium as droplets from a nozzle in communication with the cavity. Control means provided in the casing controls the driving of the ejection means.

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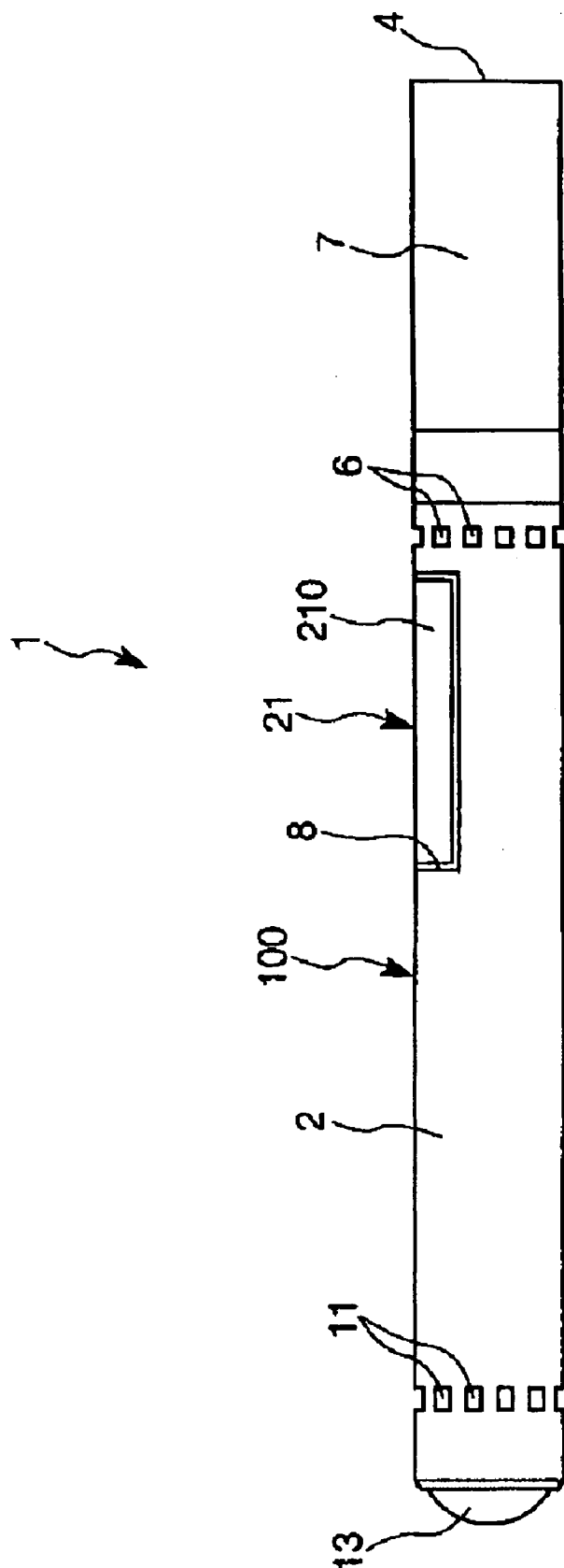
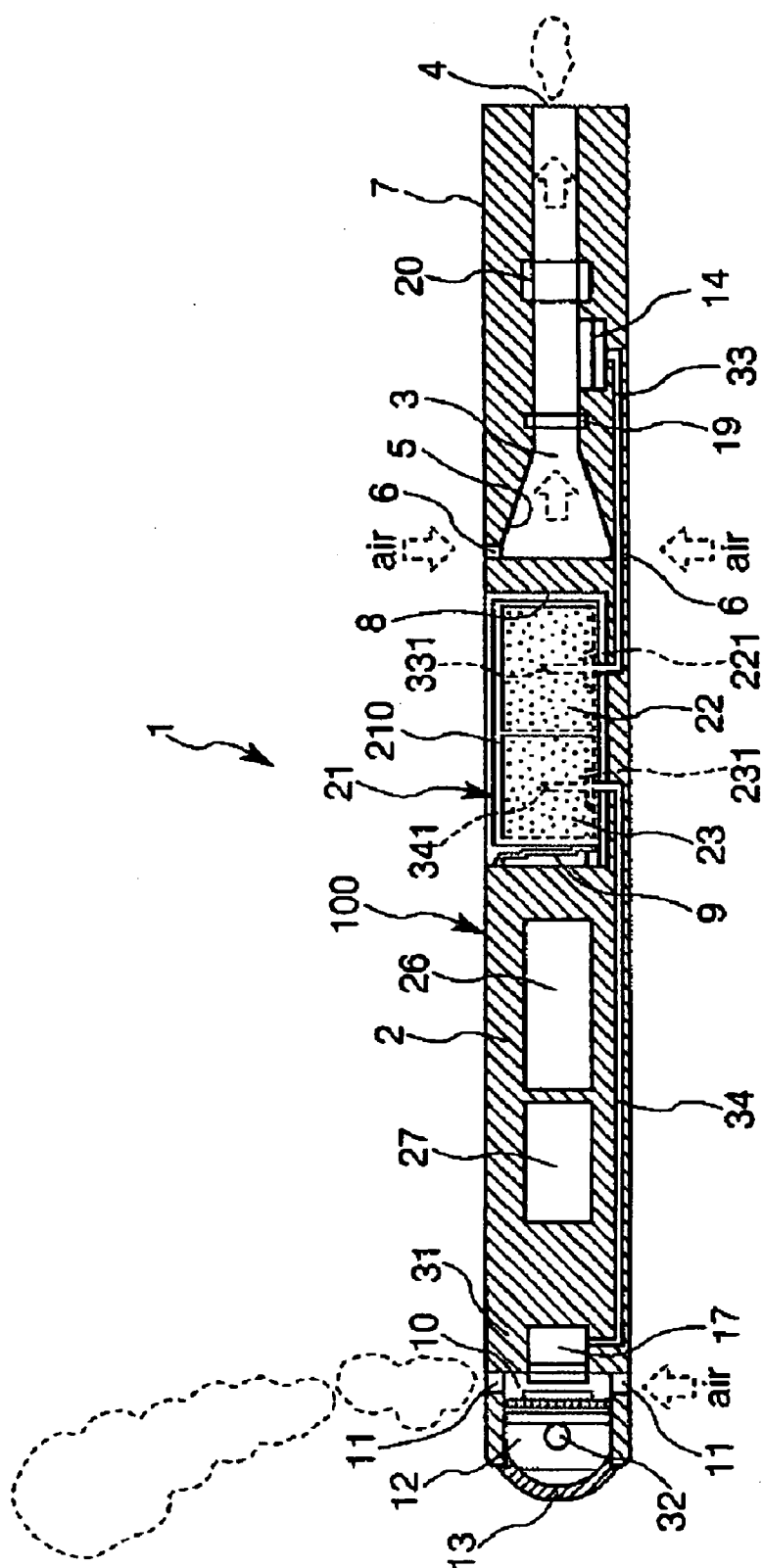


FIG. 1



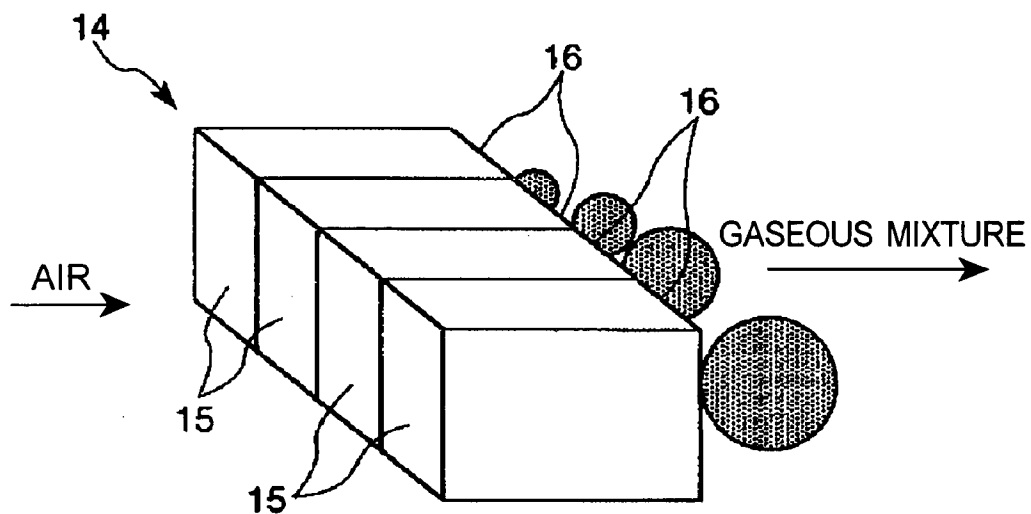


FIG. 3

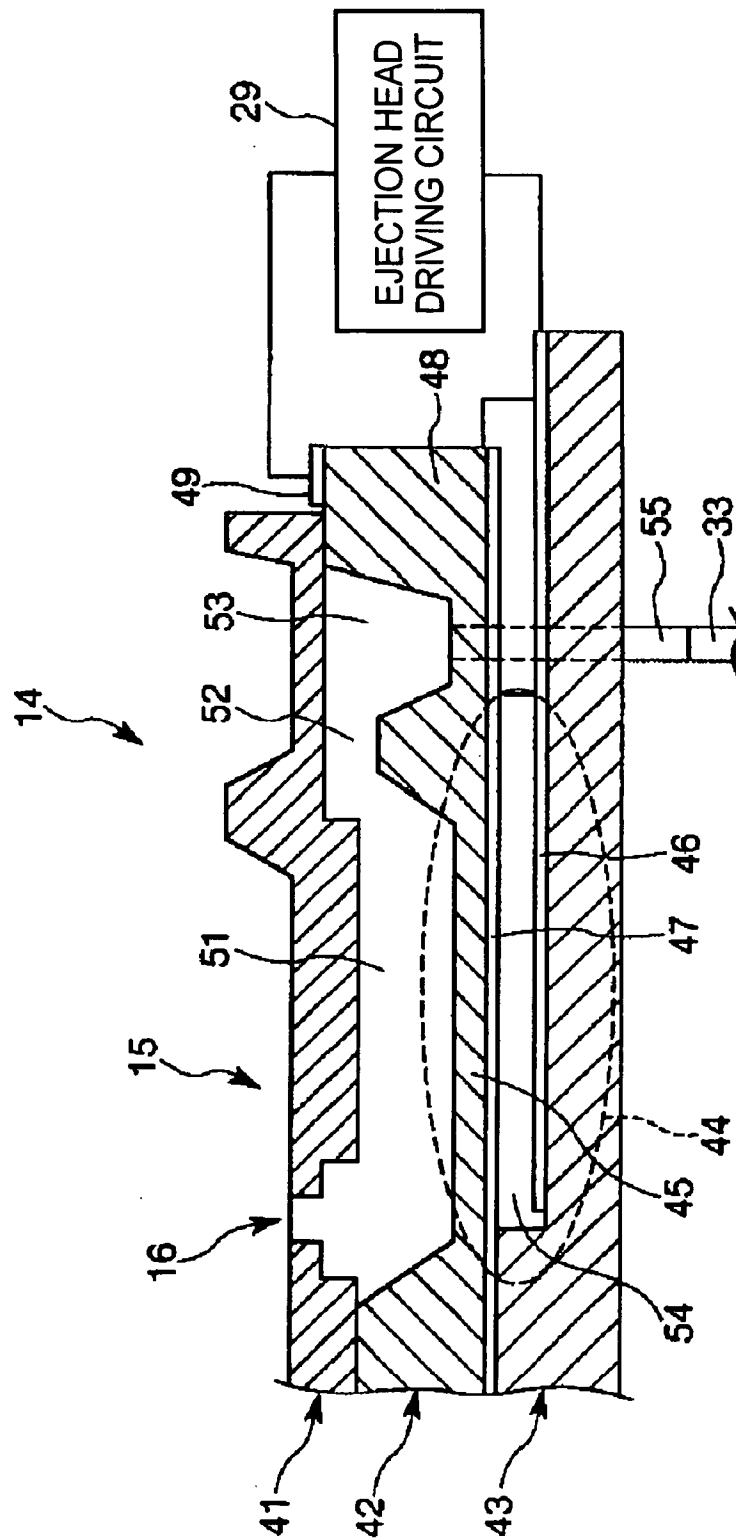


FIG. 4

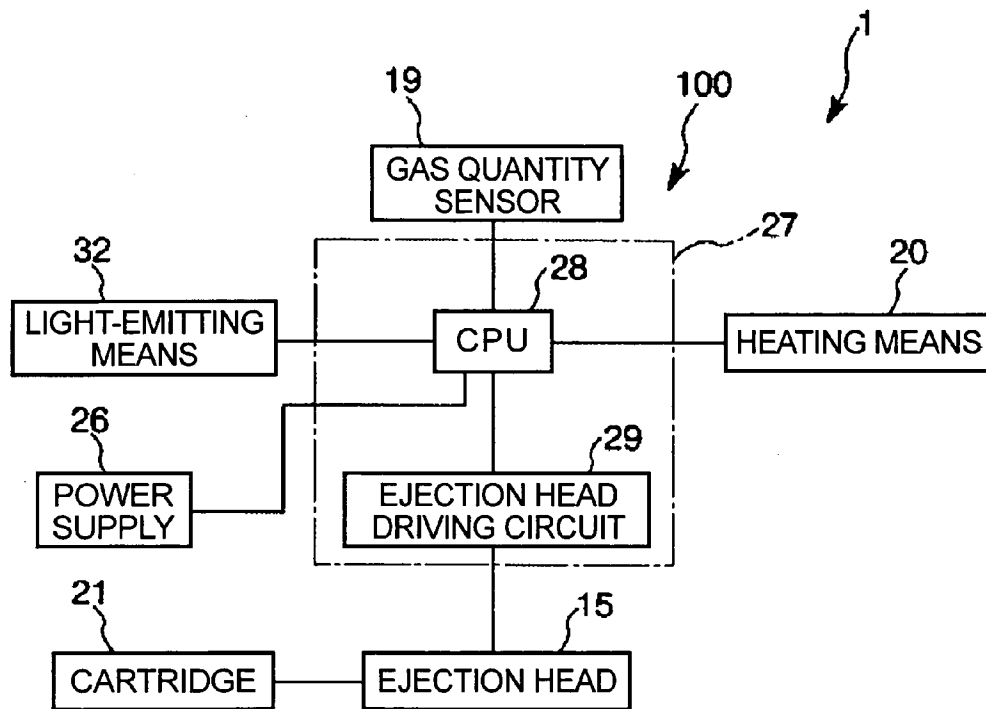


FIG. 5

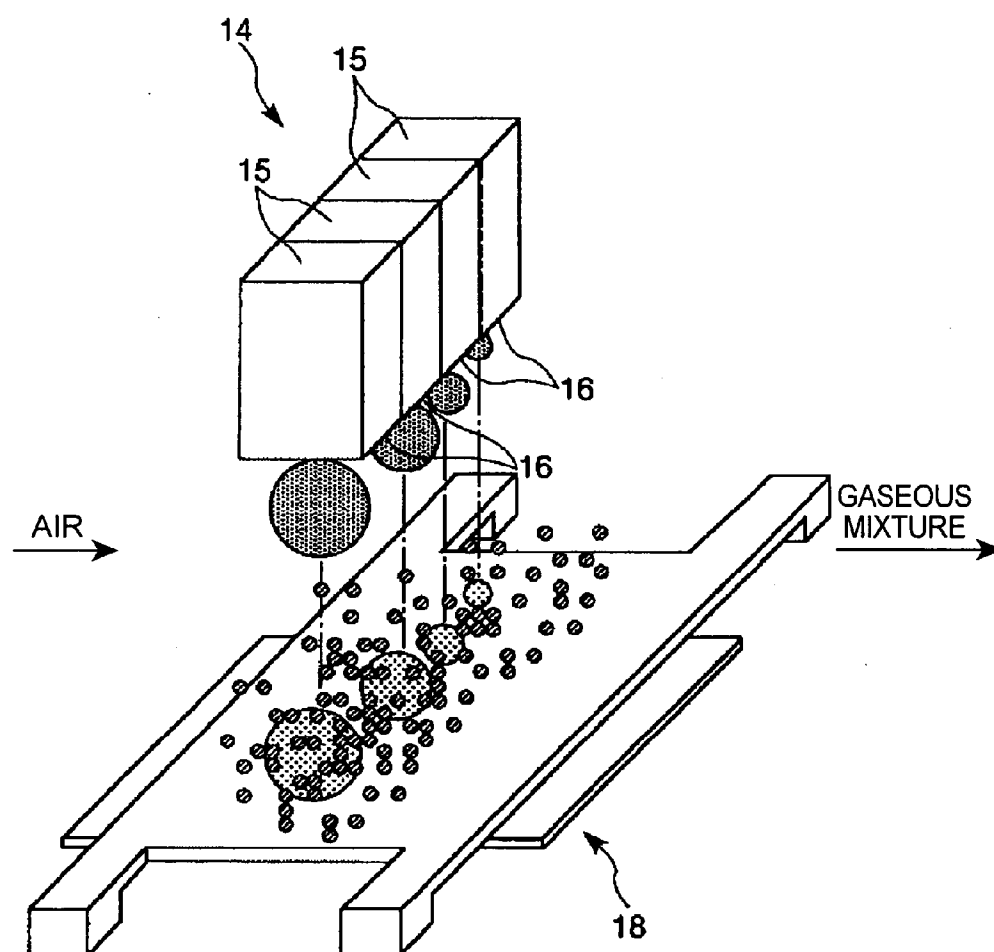


FIG. 6

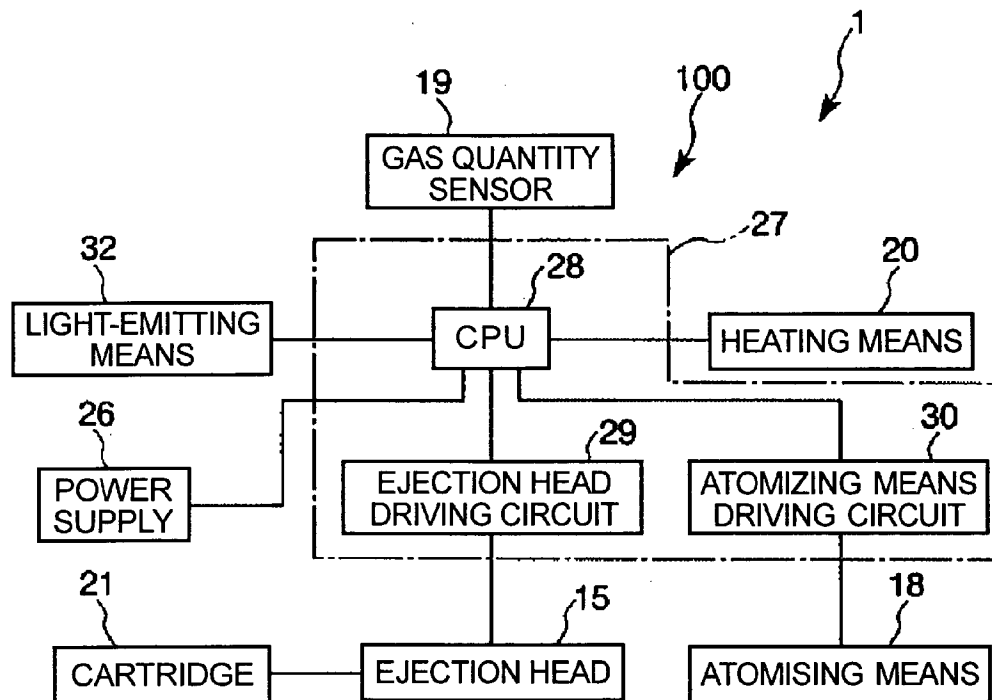


FIG. 7

ELECTRONIC CIGARETTE**RELATED APPLICATIONS**

[0001] This application claims priority to Japanese Patent Application No. 2003-198701 filed Jul. 17, 2003 which is hereby expressly incorporated by reference herein in its entirety.

BACKGROUND

[0002] 1. Technical Field to which the Invention Belongs

[0003] The present invention relates to an electronic cigarette.

[0004] 2. Related Art

[0005] Recently, various types of smoking simulators for tasting a flavor resembling that of a cigarette without burning a cigarette have been proposed.

[0006] For example, smoking simulators have been proposed, in which a heating element and solid flavor generating medium are provided in a heat-insulating tube and in which the heat-insulating tube and a power supply of the heating element are wrapped in fine quality wrapping paper and formed like a cigarette (for example, see Japanese Patent Laid-Open No. JP-A-3-232481).

[0007] In a smoking simulator having such a configuration, electrical energy is supplied from the power supply to the heating element to heat the flavor generating medium which in turn generates flavor components. A flavor resembling that of a cigarette can be tasted by inhaling a gaseous mixture of the flavor components and air which has been taken into the smoking simulator.

[0008] In a smoking simulator having such a configuration, however, since it takes time to increase the temperature of the flavor generating medium, a long time is required for the flavor generating medium to generate a sufficient amount of flavor components. Thus, a sufficient amount of flavor components can not be obtained at the beginning of simulated smoking, and a feeling similar to that of a cigarette cannot be provided from the beginning of simulated smoking.

[0009] Since the amount of flavor components generated by the flavor generating medium cannot be controlled with high accuracy, the amount of flavor components cannot be adjusted according to the amount of inhalation. As a result, a feeling similar to that of a cigarette cannot be provided.

[0010] Further, since there is no function of generating smoke similar to that of a cigarette and no function of generating a fire similar to that of a cigarette, a feeling similar to that of a cigarette cannot be provided.

[0011] It is an object of the invention to provide an electronic cigarette which provides a sufficient amount of flavor components from the beginning of smoking when a smoker inhales to smoke on a simulated basis which allows the smoker to have feelings similar to those a cigarette provides.

SUMMARY

[0012] The above and other objects are achieved by the invention as described below.

[0013] An electronic cigarette according to the invention comprising: a casing having an inhalation hole and having a substantially bar-like configuration as a whole; ejection means which is provided in the casing and has at least one ejection head and which changes a pressure in a cavity filled with a liquid flavor generating medium by driving an actuator to eject the flavor generating medium as droplets from a nozzle in communication with the cavity; and control means which is provided in the casing and which controls the driving of the ejection means.

[0014] Thus, droplets of the flavor generating medium are ejected into the casing by driving the ejection means with the control means, and flavor components are supplied into the casing. When the smoker inhales with the inhalation hole side of the casing held in the mouth, a gaseous mixture of air which has flowed into the casing and the flavor components in the casing flows into the mouth, and the flavor components spread in the mouth to allow the smoker to taste a flavor resembling that of a cigarette.

[0015] In this case, since a sufficient amount of droplets of the flavor generating medium are ejected into the casing from the beginning of the driving of the ejection means, a sufficient amount of flavor components can be provided from the beginning of inhalation to obtain a feeling similar to that of a cigarette.

[0016] By using a flavor generating medium which has no harmful substance, no uncomfortable smell, taste, and the like, it is possible to prevent people around the smoker and the smoker him or herself from being damaged or made uncomfortable by smoking.

[0017] The electronic cigarette according to the invention preferably has atomizing means which is provided in the casing and which atomizes droplets of the flavor generating medium ejected from the ejection means.

[0018] Thus, droplets of the flavor generating medium ejected into the casing by driving the ejection means are atomized (refined) by the atomizing means. When the smoker inhales with the inhalation hole side of the casing held in the mouth, a gaseous mixture of air which has flowed into the casing and the atomized flavor components in the casing flows into the mouth, and the flavor components spread in the mouth to allow the smoker to taste a flavor resembling that of a cigarette.

[0019] In this case, the flavor components which have been atomized by the atomizing means can be inhaled into the mouth, the smoker can feel as if he or she was inhaling smoke of a cigarette.

[0020] In the electronic cigarette according to the invention, the atomizing means is preferably heating means which heats droplets of the flavor generating medium ejected from the ejection means to atomize them.

[0021] Thus, since particles of flavor components atomized by being heated with the heating means of the atomizing means can be inhaled into the mouth, the flavor components can be efficiently spread in the mouth, and the smoker can feel as if he or she was inhaling smoke of a cigarette.

[0022] In the electronic cigarette according to the invention, the atomizing means is preferably vibration means

which vibrates droplets of the flavor generating medium ejected from the ejection means to atomize them.

[0023] Thus, since flavor components atomized by being vibrated with the vibration means of the atomizing means can be inhaled into the mouth, the flavor components can be efficiently spread in the mouth, and the smoker can feel as if he or she was inhaling smoke of a cigarette.

[0024] In the electronic cigarette according to the invention, the atomizing means is preferably mountable and removable in and from the casing.

[0025] Thus, the atomizing means can be easily attached in the casing as occasion demands.

[0026] The electronic cigarette according to the invention preferably has a mounting portion in which a cartridge having a containing portion containing the liquid flavor generating medium is removably mounted.

[0027] Thus, the flavor generating medium is supplied from the containing portion to the ejection means by attaching the cartridge in the mounting portion of the casing, and the supply of the flavor generating medium from the containing portion to the ejection means is stopped by detaching the cartridge from the mounting portion of the casing.

[0028] In the electronic cigarette according to the invention, the ejection means is preferably provided at the cartridge.

[0029] Thus, the ejection means is mounted and removed to and from the casing integrally with the cartridge by mounting and removing the cartridge in and from the mounting portion of the casing.

[0030] The electronic cigarette according to the invention preferably has a power supply switch which turns a power supply on/off when the cartridge is mounted and removed in and from the mounting portion.

[0031] Thus, the power supply is turned on through the power supply switch by attaching the cartridge to the mounting portion of the casing, and the power supply is turned off through the power supply switch by detaching the cartridge from the mounting portion of the casing.

[0032] In the electronic cigarette according to the invention, the power supply is preferably provided in the casing.

[0033] The electronic cigarette according to the invention preferably has detection means which detects the quantity of a gas flowing through the casing.

[0034] Thus, the quantity of air or a gaseous mixture of air and flavor components flowing through the casing is detected by the detection means, and various types of control can be performed with control means based on the result of the detection with the detection means (according to a signal from the detection means).

[0035] The electronic cigarette according to the invention is preferably configured such that the driving of the ejection means is controlled by the control means based on the result of the detection with the detection means.

[0036] Thus, the quantity of air or a gaseous mixture of air and flavor components flowing through the casing is detected by the detection means, and the driving of the ejection means is controlled by the control means based on

the result of the detection with the detection means (according to a signal from the detection means) to control turning on/off of the ejection means and the ejection amount of droplets of the flavor generating medium ejected from the ejection means.

[0037] Since smokers can therefore take flavor components into the mouth in an amount according to the inhalation capacity of the smoker, the smoker can feel as if he or she was inhaling smoke of a cigarette.

[0038] The electronic cigarette according to the invention preferably has light-emitting means provided at a tip end of the casing and has a configuration in which the driving of the light-emitting means is controlled by the control means based on the result of the detection with the detection means.

[0039] Thus, the quantity of air or a gaseous mixture of air and flavor components flowing through the casing is detected by the detection means, and the driving of the light-emitting means is controlled by the control means based on the result of the detection with the detection means (according to a signal from the detection means) to control the turning on/off of the light emitting means and the quantity of light of the same.

[0040] Since this makes it possible to increase or decrease the quantity of light of the light-emitting means according to the inhalation capacity of a smoker, the smoker can feel as if he or she was inhaling smoke of a cigarette.

[0041] The electronic cigarette according to the invention preferably has smoke generating means which generates simulated smoke from a tip end of the casing and has a configuration in which the driving of the smoke generating means is controlled by the control means based on the result of the detection with the detection means.

[0042] Thus, the quantity of air or a gaseous mixture of air and flavor components flowing through the casing is detected by the detection means, and the driving of the smoke generating means is controlled by the control means based on the result of the detection with the detection means (according to a signal from the detection means) to control the turning on/off of the smoke generating means and the amount of smoke.

[0043] Since this makes it possible to generate simulated smoke from the smoke generating means, to stop the generating of smoke, and to adjust the amount of smoke generated according to the inhalation capacity of a smoker, the smoker can feel as if he or she was inhaling smoke of a cigarette.

[0044] The electronic cigarette according to the invention preferably has heating means which heats air or a gaseous mixture including air and flavor components flowing through the casing.

[0045] Thus, since the air or the gaseous mixture of air and flavor components flowing through the casing is heated by the heating means, the smoker can feel as if he or she was inhaling smoke of a cigarette.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] FIG. 1 is a plan view of a first embodiment of an electronic cigarette according to the invention.

[0047] FIG. 2 is a sectional view of FIG. 1.

[0048] FIG. 3 is an enlarged view of a part of FIG. 2

[0049] FIG. 4 is a sectional view showing an example of a configuration of ejection means.

[0050] FIG. 5 is a block diagram of the electronic cigarette according to the first embodiment.

[0051] FIG. 6 is a partial enlarged view of an electronic cigarette according to a second embodiment.

[0052] FIG. 7 is a block diagram of the electronic cigarette according to the second embodiment.

DETAILED DESCRIPTION

[0053] An electronic cigarette (smoking simulator) according to the invention will now be described in detail based on a preferred embodiment shown in the accompanying drawings.

[0054] FIGS. 1 to 5 show a first embodiment of an electronic cigarette according to the invention. FIG. 1 is a plan view showing the electronic cigarette as a whole; FIG. 2 is a sectional view of FIG. 1; FIG. 3 is an enlarged view of a part of FIG. 2; FIG. 4 is a sectional view showing an example of a configuration of ejection means; and FIG. 5 is a block diagram of the electronic cigarette.

[0055] For convenience in description, the left side and the right side in FIGS. 1 and 2 will be described as "tip end" and "base end", respectively.

[0056] As shown in FIGS. 1 and 2, an electronic cigarette 1 has a cigarette main body 100 having a round bar-like (bar-like) or cylindrical configuration as a whole and a cartridge 21 having a containing portion containing a liquid flavor generating medium.

[0057] The cigarette main body 100 has a casing 2, first ejection means (ejection means) 14 which ejects droplets of the flavor generating medium into the casing 2 and second ejection means (smoke generating means) 17, and control means 27 which controls the driving and the like of the first ejection means 14 and the second ejection means 17.

[0058] The configuration as a whole of the casing 2 is in the form of a round bar (in the form of a bar) or substantially cylindrical. A mouthpiece portion 7 is provided at a base end of the casing 2 (one end in the longitudinal direction) which corresponds to a filter of a cigarette. A channel 3 with a predetermined length allowing air, a gaseous mixture including air and flavor components, or the like to flow through is provided along the longitudinal direction in the central part of the mouthpiece portion 7.

[0059] The channel 3 has a circular cross section in the present embodiment. A base end of the same opens (is exposed) in the central part of an end face on the base end side of the mouthpiece portion 7, and the opening is formed in a inhalation hole 4 for inhaling flavor components (a gaseous mixture including air and flavor components) into the mouth.

[0060] A tip end portion of the channel 3 is formed with a tapered surface 5 whose diameter gradually increases toward the tip end, and a plurality of intake holes (side holes) 6 penetrating through the casing 2 in the radial direction thereof are provided at the portion of the tapered surface 5 having the maximum diameter, the intake holes being pro-

vided at predetermined intervals in the circumferential direction. The channel 3 is exposed to the outer surface side of the casing 2 through the intake holes 6. Referring to the shape of the intake holes 6, for example, they may have a square sectional shape, a circular sectional shape, or the like (they have a square sectional shape in the present embodiment). When the smoker inhales with the mouth piece portion 7 held in the mouth, air is taken into the channel 3 through the intake holes 6, and the air flows through the channel 3 toward the inhalation hole 4 and flows into the mouth through the inhalation hole 4.

[0061] The first ejection means 14 which is ejection means is provided in a part of the casing 2 corresponding to a central part of the channel 3 in the longitudinal direction thereof such that it faces the channel 3, and microscopic droplets of the flavor generating medium are ejected into the channel 3 by driving the first ejection means 14. The droplets of the flavor generating medium ejected into the channel 3 by the first ejection means 14 are mixed with air flowing through the channel 3 and flow in the channel 3, and a resultant gaseous mixture flows into the mouth through the inhalation hole 4.

[0062] There is no particular limitation on the configuration material of the casing 2, and various resins, various metals, various ceramics, wood, paper, and the like may be listed by way of example.

[0063] The flavor generating medium is a medium which can be ejected as droplets to generate a flavor instead of burning the same and is appropriately chosen depending on usage or the like. For example, the flavor generating medium includes substances extracted from various natural substances or predetermined ones among components constituting them. For example, as flavoring substances included in the flavor generating medium, menthol, caffeine, precursors such as glycosides which generate a flavor when thermally decomposed, components of tobacco such as components extracted from tobacco and components that are condensates of tobacco smoke, and the like may be used. In this case, it is preferable to make the flavor generating medium harmless and to eliminate harmful components.

[0064] For example, the flavor generating medium may include a substance which generates aerosol when heated in order to add smoke to the flavor. As the substance for generating aerosol, for example, glycerin, polyols such as propylene glycol, lower alcohols, sugars, mixtures of them, and the like may be used.

[0065] The first ejection means 14 employs a fluid jet method (e.g., an ink jet method). A fluid jet method is a method in which a pressure in a cavity (pressure chamber) filled with a fluid such as a liquid is changed by driving an actuator to eject the fluid as droplets from a nozzle that is in communication with the cavity. For example, such fluid jet methods include film boiling fluid jet methods such as the thermal jet method (bubble jet method ("bubble jet" is a registered trademark), piezoelectric methods, and electrostatic methods. The invention is not limited to those methods, and any method having the same function may be employed.

[0066] An ejection head according to a film boiling fluid jet method such as the thermal jet method (bubble jet method ("bubble jet" is a registered trademark")) is equipped with a

film boiling type actuator having a heating body (heater) which generates heat when energized. According to the film boiling fluid jet method, for example, the heating body is heated by energizing to generate bubbles, and droplets are ejected by the pressure of the bubbles (a change in a liquid pressure caused by the bubbles).

[0067] An ejection head according to a piezoelectric method has a piezoelectric element and a piezoelectric actuator which utilizes a piezoelectric effect of the piezoelectric element. According to the piezoelectric method, for example, a voltage is applied to the piezoelectric element to displace (deform) the piezoelectric element and to thereby change the volumetric capacity of the cavity (pressure chamber), and droplets are ejected by a resultant change in the pressure in the cavity 51.

[0068] An ejection head according to an electrostatic method has an electrostatic actuator. According to the electrostatic method, for example, a voltage is applied between counter electrodes of the electrostatic actuator to generate a Coulomb force; a diaphragm is thereby displaced (deformed) to change the volumetric capacity of the cavity (pressure chamber); and droplets are ejected by a resultant change in the pressure in the cavity 51.

[0069] In the present embodiment, as shown in FIG. 3, the first ejection means 14 has a plurality of (four in the illustrated example) ejection heads 15 according to a fluid jet method having a nozzle 16 for ejecting droplets of a flavor generating medium. That is, the first ejection means 14 has a head unit having a plurality of ejection heads 15 according to a fluid jet method. The number of the ejection heads 15 is not limited to four, and it may be one, two, three, or five or more.

[0070] The nozzle 16 of each ejection head 15 is formed with a different diameter, and the amount of the flavor generating medium ejected can be adjusted to a predetermined amount by turning on/off those ejection heads 15 in a certain combination, for example.

[0071] A typical example of a configuration of the ejection heads 15 when an electrostatic method is adapted will now be described based on FIG. 4. FIG. 4 shows only one of the plurality of ejection heads 15.

[0072] As shown in FIG. 4, the ejection head 15 has a three-layer structure in which a nozzle plate 41 made of silicon is stacked on top of a silicon substrate 42 and a glass substrate 43 is stacked on the underside of the same.

[0073] Between the silicon substrate 42 and the nozzle plate 41, there is provided a cavity (pressure chamber) 51 filled with a flavor generating medium, a reservoir 53, and an orifice (supply hole) 52 which communicates the reservoir 53 and the cavity 51 with each other. A nozzle (outlet) 16 which establishes communication between the inside and outside of the cavity 51 is provided in a part of the nozzle plate 41 associated with the cavity 51. A part of the silicon substrate 42 that faces the cavity 51 is formed as a diaphragm (bottom wall) 45 which is smaller in thickness than other parts.

[0074] The diaphragm 45 is configured such that it can be elastically deformed (elastically displaced) in out-of-plane directions thereof (the direction of the thickness thereof) that is, upward and downward.

[0075] A major part of an electrostatic actuator (actuator) 44 is constituted by the diaphragm 45, a segment electrode 46 provided on top of the glass substrate 43, and an insulation layer 47 and a gap (recess) 54 between them.

[0076] An ejection head driving circuit (voltage application means) 29 including a driving circuit for applying a driving voltage between the segment electrode 46 and a common electrode 48 facing the segment electrode 46 (between counter electrodes) performs charging and discharging between the each counter electrodes according to signals (data for ejection) input from a CPU 28 which will be described later. One output terminal of the ejection head driving circuit 29 is connected to individual segment electrode 46 and another output terminal is connected to an input terminal 49 of the common electrode 48 formed on the silicon substrate 42. An impurity is doped in the silicon substrate 42 which thus has conductivity in itself, a voltage can therefore be applied (supplied) from the input terminal 49 to the diaphragm 45 (the common electrode 48 as a whole).

[0077] When a driving voltage is applied between the counter electrodes from the ejection head driving circuit 29, a Coulomb force is generated between the counter electrodes, and the diaphragm 45 deflects toward the segment electrode 46 from the initial state shown in FIG. 4 to increase (expand) the volumetric capacity of the cavity 51. When electrical charge between the counter electrodes is abruptly discharged in this state under control of the ejection head driving circuit 29, the diaphragm 45 returns upward because of its elastic restoring force and moves upward beyond the position of the diaphragm 45 in the initial state shown in FIG. 4, which abruptly decreases (contracts) the volumetric capacity of the cavity 51. As a result, the pressure in the cavity 51 increases, and the compression pressure generated in the cavity 51 ejects a part of the flavor generating medium filling the cavity 51 as microscopic droplets from the nozzle 16 that is in communication with the cavity 51.

[0078] An intake hole 55 in communication with the reservoir 53 is provided in a part of the glass substrate 43 that is associated with the reservoir 53. A base end side of a first supply pipe 33 to be described later is connected to the intake hole 55, and the flavor generating medium is supplied into the reservoir 53 from a cartridge 21 to be described later through the first supply pipe 33 and the intake hole 55.

[0079] As shown in FIG. 2, a gas quantity sensor 19 that is detection means is provided on the way of the channel 3 (at the base of the tapered surface 5 of the channel 3) on the base end side (left side in the figure) of the first ejection means 14, and the flow rate of a fluid (air or a gaseous mixture of air and flavor components) flowing through the channel 3 is detected by the gas quantity sensor 19.

[0080] Heating means 20 is provided on the way of the channel 3 on the tip end side (right side in the figure) of the first ejection means 14, and the fluid (air or a gaseous mixture including air and flavor components) flowing through the channel 3 is heated by driving the heating means 20. Thus, the fluid heated to a predetermined temperature flows out from the inhalation hole 4. There is no particular limitation on the heating means 20 as long as it has the function of allowing a fluid to be heated, and it may be a micro-heater or the like, for example. A micro-heater con-

verts electricity into thermal energy, and its configuration and type may be arbitrarily chosen. Normally, a heater thin film is formed, and a current is passed through such a resistor to generate heat.

[0081] The heating means **20** may be made mountable and removable to and from the mouthpiece portion **7** and may be attached to the mouthpiece portion **7** as occasion demands.

[0082] A configuration may be employed in which the heating means **20** is provided upstream of the first ejection means **14**, i.e., on the tip end side of the same (left side in **FIG. 2**) and in which the heating means **20** is driven to heat air which flows through the channel **3** and has not reached the first ejection means **14** yet (air which has not been mixed with droplets of the flavor generating medium yet).

[0083] In a central part of the casing **2** in the longitudinal direction thereof (a part of the same on the left side of the channel **3** in the figure), there is provided a cartridge chamber (mounting portion) **8** having a predetermined depth whose top side opens outwardly of the casing **2**, and a cartridge **21** containing (filled with) a liquid flavor generating medium is removably mounted in the cartridge chamber **8**. A cartridge detection/power supply switch **9** is provided on one end face of the cartridge chamber **8** in the axial direction thereof (left side in **FIG. 2**).

[0084] When the cartridge **21** is mounted in (attached to) the cartridge chamber **8**, the cartridge detection/power supply switch **9** is turned on. Thus, the state in which the cartridge **21** is mounted is detected, and a power supply **26** is turned on. When the cartridge **21** is removed (detached) from the cartridge chamber **8**, the cartridge detection/power supply switch **9** is turned off. Thus, the state in which the cartridge **21** is not mounted is detected, and the power supply **26** is turned off.

[0085] The cartridge **21** has a cartridge main body (casing) **210** having a box-like configuration as a whole. The interior of the cartridge main body **210** is partitioned into two chambers, i.e., a first chamber **22** and a second chamber **23**, and a predetermined amount of a liquid flavor generating medium is contained (filled) in each of the first chamber **22** and the second chamber **23**. The flavor generating medium contained in the first chamber **22** and the flavor generating medium contained in the second chamber **23** may be identical to or different from each other.

[0086] There is no particular limitation on the configuration material of the cartridge main body (casing) **210**, and various resins or the like may be listed by way of example.

[0087] There may be only one chamber in the cartridge main body **210**. A configuration may be employed in which the above-described first ejection means **14** may be provided at the cartridge **21** (the cartridge **21** and the first ejection means **14** may be integrated) and are integrally removably mounted in the cartridge chamber (mounting portion) **8** of the casing **2** (cigarette main body **100**).

[0088] A lancable or stuck portion **221** is formed on the bottom side of the first chamber **22** of the cartridge main body **210**, the stuck portion being lanced or stuck by a sharp end **331** at a tip end side of a first supply pipe **33** to be described later. Similarly, a lancable or stuck portion **231** is formed on the bottom side of the second chamber **23**, the stuck portion being lanced or stuck by a sharp end **341** at a

base end side of a second supply pipe **34** to be described later. When the cartridge **21** is mounted in the cartridge chamber **8**, the sharp end **331** of the first supply pipe **33** and the sharp end **341** of the second supply pipe **34** stick in and penetrate through the stuck portion **221** and the stuck portion **231** of the cartridge main body **210**, respectively. Thus, communication is established between the first chamber **22** and the first supply pipe **33**, and communication is established between the second chamber **23** and the second supply pipe **34**.

[0089] In an outer peripheral portion of the casing **2**, there is embedded the first supply pipe **33** which establishes mutual communication between a part of the cartridge chamber **8** associated with the first chamber **22** and the above-described first ejection means **14** in the axial direction and the second supply pipe **34** which establishes mutual communication between a part of the cartridge chamber **8** associated with the second chamber **23** and second ejection means **17** to be described later in the axial direction. The sharp end (sticking needle) **331** is formed at the tip end side of the first supply pipe **33**, and the sharp end (sticking needle) **341** is formed at the base end side of the second supply pipe **34**. The flavor generating media are supplied from the first chamber **22** of the cartridge **21** to the first ejection means **14** and from the second chamber **23** to the second ejection means **17** through the first supply pipe **33** and the second supply pipe **34**, respectively.

[0090] In a central part of the casing **2** in the longitudinal direction thereof (a part of the same on the left of the cartridge chamber **8**), the power supply (power supply portion) **26** and control means **27** are incorporated on the base end side and tip end side, respectively, the control means controlling the driving of the first ejection means **14**, the second ejection means **17**, the gas quantity sensor **19**, the heating means **20**, the power supply **26**, light-emitting means **32** to be described later, and the like. A configuration may be employed in which the power supply **26** can be removably mounted in the casing **2**.

[0091] For example, a battery such as a primary battery or a secondary battery may be used as the power supply **26**. In this case, compactness and a reduction of weight can be achieved by using a fuel battery which has a high energy density. The fuel battery may be provided in the form of a cartridge to facilitate replacement.

[0092] At the tip end of the casing **2** (the other end in the longitudinal direction thereof), a predetermined space **10** is provided, and a plurality of intake/discharge holes (side holes) **11** are provided at predetermined intervals in the circumferential direction of a part of the casing **2** facing the space **10**, the intake/discharge holes **11** penetrating through the casing **2** in the radial direction thereof. The space **10** is exposed to the outside of the casing **2** through the intake/discharge holes **11**. Referring to the shape of the intake/discharge holes **11**, for example, it may have a square sectional shape, a circular sectional shape, or the like (it has a square sectional shape in the present embodiment).

[0093] The second ejection means **17** which is smoke generating means is provided in a part of the casing **2** that is adjacent to the space **10** on the right side of the same in **FIG. 2** so as to face the space **10**, and microscopic droplets of the flavor generating media are ejected into the space **10** by driving the second ejection means **17**. In this case, for

example, simulated smoke (sidestream smoke) that resembles smoke (sidestream smoke) of a cigarette can be generated through selection, combination, or the like of the flavor generating media.

[0094] The configuration of the second ejection means 17 is not be illustrated and described because it is similar to that of the above-described first ejection means 14.

[0095] Droplets of the flavor generating media are ejected into the space 10 by driving of the second ejection means 17, and simulated smoke (sidestream smoke) resembling smoke (sidestream smoke) of a cigarette is thus generated in the space 10 and discharged from the intake/discharge holes 11. In this case, the generated (discharged) simulated smoke is preferably harmless. The simulated smoke thus generated may be odorless, or it may have an odor. When simulated smoke with an odor is to be generated, for example, the odor is preferably a pleasant odor rather than an odor like that of sidestream smoke of a cigarette.

[0096] At the tip end of the casing 2 (the part adjacent to the space 10), there is provided a recess 12 having a predetermined depth which opens at the tip end face of the casing 2. The opening of the recess 12 is closed by a diffusing lens 13 having a curved shape.

[0097] Light-emitting means 32 is provided on the bottom surface side of the recess 12, and the light-emitting means 32 can be driven for emission to generate a simulated safe fire that resembles the fire of a cigarette, which provides a visual effect that resembles the fire of a cigarette.

[0098] The amount of light emitted by the light-emitting means 32 is adjusted according to a signal from the gas quantity sensor 19 (based on the result of detection by the gas quantity sensor 19). For example, the light-emitting means 32 may be a red LED (light-emitting diode), an organic EL (Electro Luminescence), or the like. However, the invention is not limited to them, and any device having a similar function may be used.

[0099] As shown in FIG. 5, the control means 27 has a CPU (Central Processing Unit) 28 for controlling the driving of the first ejection means 14, the second ejection means 17, the heating means 20, the gas quantity sensor 19, the light-emitting means 32, the power supply 26, and the like and the ejection head driving circuit 29 incorporating a circuit for driving the first ejection means 14 and the second ejection means 17.

[0100] The provision of the control means 27 as described above allows the electronic cigarette 1 according to the present embodiment to perform various types of control.

[0101] For example, controlling of the turning on/off of the generation of simulated smoke resembling smoke (sidestream smoke) of a cigarette by controlling the turning on/off of the second ejection means 17, controlling of the turning on/off of the emission of the light-emitting means 32 or the like may be possible. Therefore, the generation of simulated smoke can be turned off and the emission of the light-emitting means may be turned off in places where smoking is prohibited (e.g., public places, railway stations, restaurants, and so on).

[0102] The heating of air or a gaseous mixture including air and flavor components with the heating means 20 can be

controlled such that it is turned off in summer and turned on in winter when a warm feel is desired.

[0103] In order to improve resemblance to a cigarette, control can be performed to reproduce states that resemble a weak odor and a low temperature at the beginning of smoking attributable to the long channel through which the smoke of the cigarette flows and to reproduce states that resemble a strong odor and a high temperature at the end of smoking attributable to the short channel through which the smoke flows.

[0104] By branding electronic cigarettes 1 and switching simulated smoking programming data depending on the brands; such control can be varied for each of the brands. Further, customization can be made depending on the preference of individual. For example, a mild odor provided by a long filter can be reproduced, and the number of times of inhalation to smoke one virtual cigarette may be set.

[0105] Such programs for simulated smoking may be written in a ROM, and the ROM may be attached to the cartridge 21 or a separate cartridge (not shown) to allow the ROM to be removably mounted in the casing 2 (cigarette main body 100) through the cartridge 21 or the separate cartridge. Another mode is possible, in which a RAM is provided in the cartridge 21 or a separate cartridge (not shown) that can be removably mounted in the casing 2 (cigarette main body 100) and in which the program for simulated smoking is downloaded using, for example, a radio interface such as Bluetooth or transmitted on an infrared basis to the RAM.

[0106] Alternatively, a memory having predetermined programs for simulated smoking written therein may be incorporated in the casing 2 (cigarette main body 100), and any of the patterns of preference may be selected using a dial or the like. In this case, for example, the storage of the programs for simulated smoking and the selection of the patterns of preference may be performed using a separate unit resembling a lighter to be paired.

[0107] For example, an RFID (radio tag) or the like may be attached to the casing 2 (cigarette main body 100), the cartridge 21, the separate cartridge (not shown), or the separate unit to allow the programs for simulated smoking to be switched or to allow parameters in the programs for simulated smoking to be changed.

[0108] When the smoker inhales with the mouthpiece portion 7 of the electronic cigarette 1 according to the present embodiment having the above-described configuration held in the mouth, air flows into the channel 3 through the intake holes 6; the quantity of the gas flowing through the channel 3 is detected by the gas quantity sensor 19; the first ejection means 14 is driven by the control means 27 according to a signal from the gas quantity sensor 19 (based on the result of detection by the gas quantity sensor 19); a predetermined amount of droplets of the flavor generating media is ejected into the channel 3 from the nozzles 16 of the ejection heads 15; the air and flavor components flowing through the channel 3 are mixed; and a gaseous mixture of them flows into the mouth through the inhalation hole 4; and the flavor components spread in the mouth to allow a flavor resembling that of a cigarette to be tasted.

[0109] In this case, since a sufficient amount of droplets of the flavor generating media is ejected into the casing 2 from

the beginning of driving of the first ejection means **14**, a sufficient amount of flavor components can be obtained from the beginning of simulated smoking (the beginning of inhalation) to provide a feeling similar to that of a cigarette.

[0110] The second ejection means **17** is driven by the control means **27** according to a signal from the gas quantity sensor **19** (based on the result of detection by the gas quantity sensor **19**), and a predetermined amount of droplets of the flavor generating media is ejected from the nozzles of the ejection heads of the second ejection means **17** into the space **10**. As a result, simulated smoke resembling smoke (sidestream smoke) of a cigarette is generated in the space **10**; the smoke flows out the space **10** through the intake/discharge holes **11**; and the smoke resembling sidestream smoke of a cigarette spreads.

[0111] Further, the light-emitting means **32** emits light according to a signal from the gas quantity sensor **19** (based on the result of detection by the gas quantity sensor **19**), which provides a visual effect that seems similar to the fire of a cigarette.

[0112] A second embodiment will now be described.

[0113] FIGS. 6 and 7 show a second embodiment of an electronic cigarette according to the invention. FIG. 6 is an enlarged illustration of a part of the same, and FIG. 7 is a block diagram of the electronic cigarette.

[0114] An electronic cigarette **1** according to the second embodiment will now be described, the description being focused on differences from the above-described first embodiment and omitting items that are identical between them.

[0115] As shown in FIG. 6, atomizing means **18** for atomizing (refining) droplets of a flavor generating medium ejected from the nozzle **16** of each ejection head **15** of the first ejection means **14** is provided facing the nozzles **16**. Although not shown, atomizing means **18** for atomizing (refining) droplets of a flavor generating medium ejected from the nozzle **16** of each ejection head **15** of the second ejection means **17** is similarly provided facing the nozzles **16**. As shown in FIG. 7, the control means **27** has an atomizing means driving circuit **30** incorporating a circuit for driving the atomizing means **18**. The configuration is otherwise similar to that shown in the first embodiment.

[0116] In this case, for example, the atomizing means **18** may be heating means which receives and heats droplets of the flavor generating medium ejected by the nozzles **16** of the ejection heads **15** to atomize them or vibration means which receives and vibrates droplets of the flavor generating medium to atomize them. For example, the heating means may be a micro-heater or the like, and the vibration means may be an ultrasonic vibration generator or the like.

[0117] Either of the atomizing means **18** of the first ejection means **14** and the atomizing means **18** of the second ejection means **17** may be omitted.

[0118] A configuration may be employed in which the atomizing means **18** are removably mounted in the casing **2** (cigarette main body **100**).

[0119] A configuration may be employed in which the atomizing means **18** is provided in the cartridge **21** (the cartridge **21** and the atomizing means **18** may be integrated)

and in which they are integrally removably mounted in the cartridge chamber (mounting portion) **8** of the casing **2** (cigarette main body **100**).

[0120] In the present embodiment, droplets of the flavor generating medium ejected by the nozzles **16** of the first ejection means **14** and the second ejection means **17** are atomized by the respective atomizing means **18** associated therewith.

[0121] Specifically, droplets of the flavor generating medium ejected from the nozzles **16** of the first ejection means **14** are atomized by the atomizing means **18** associated therewith. Therefore, when the smoker inhales with a mouthpiece portion **7** of the casing **2** held in the mouth, a gaseous mixture of air which has entered the casing **2** through the intake holes **6** and atomized flavor components in the casing **2** flows into the mouth; the flavor components spread in the mouth to allow a flavor resembling that of a cigarette to be tasted. In this case, since the flavor components can be inhaled into the mouth after being atomized by the atomizing means **18**, the smoker can feel as if he or she was inhaling smoke of a cigarette.

[0122] When the atomizing means **18** is constituted by a micro-heater, particles of the flavor generating medium which have been atomized through heating flow into the mouth. Thus, flavor components can be efficiently spread in the mouth, and the smoker can feel as if he or she was inhaling smoke of a cigarette.

[0123] When the atomizing means **18** is constituted by an ultrasonic vibration generator, particles of the flavor generating medium which have been atomized by vibration flow into the mouth. Thus, flavor components can be efficiently spread in the mouth, and the smoker can feel as if he or she was inhaling smoke of a cigarette.

[0124] Similarly, when the smoker inhales with the mouthpiece portion **7** of the casing **2** held in the mouth, droplets of the flavor generating medium ejected from the nozzles **16** of the second ejection means **17** are atomized by the atomizing means **18** associated therewith. Thus, simulated smoke resembling smoke (sidestream smoke) of a cigarette is generated in the space **10**, and it flows outside through the intake/discharge holes **11**. The smoke resembling sidestream smoke of a cigarette then spreads. In this case, droplets of the flavor generating medium ejected by the second ejection means **17** is atomized by the atomizing means **18**, simulated smoke that is very similar to sidestream smoke of a cigarette can be generated.

[0125] The electronic cigarette **1** can provide advantages similar to those of the above-described first embodiment.

[0126] While the invention has been described based on the illustrated embodiments, the invention is not limited to them, and the configuration of each part may be replaced with any other configuration having the same function. The invention may also be configured with other constituents.

What is claimed is:

1. An electronic cigarette comprising:

a casing having an inhalation hole;

an ejector provided in the casing, the ejector having at least one ejection head and which changes a pressure in a cavity filled with a liquid flavor generating medium

by driving an actuator to eject the flavor generating medium as droplets from a nozzle in communication with the cavity; and

a controller provided in the casing, the controller controlling driving of the ejector.

2. The electronic cigarette according to claim 1, comprising an atomizer provided in the casing, the atomizer atomizing droplets of the flavor generating medium ejected from the ejector.

3. The electronic cigarette according to claim 2, wherein the atomizer comprises a heater, the heater heating droplets of the flavor generating medium ejected from the ejector to atomize them.

4. The electronic cigarette according to claim 2, wherein the atomizer comprises a vibrator, the vibrator vibrating droplets of the flavor generating medium ejected from the ejector to atomize them.

5. The electronic cigarette according to claim 2, wherein the atomizer is removably mounted to the casing.

6. The electronic cigarette according to claim 1, comprising a mounting portion to which a cartridge having a containing portion containing the liquid flavor generating medium is removably mounted.

7. The electronic cigarette according to claim 6, wherein the ejector is provided at the cartridge.

8. The electronic cigarette according to claim 7, comprising a power supply switch which turns a power supply on/off when the cartridge is mounted and removed in and from the mounting portion.

9. The electronic cigarette according to claim 1, wherein the power supply is provided in the casing.

10. The electronic cigarette according to claim 1, comprising a detector which detects a quantity of a gas flowing through the casing.

11. The electronic cigarette according to claim 10, wherein the controller controls the driving of the ejector based on a result of the detection by the detector.

12. The electronic cigarette according to claim 10, wherein a light-emitter is provided at a tip end of the casing, the controller controlling the driving of the light-emitter based on a result of the detection by the detector.

13. The electronic cigarette according to claim 10, comprising a smoke generator, the smoke generator generating simulated smoke from a tip end of the casing, the controller controlling the driving of the smoke generator based on a result of the detection with the detector.

14. The electronic cigarette according to claim 1, comprising a heater which heats at least one of air and a gaseous mixture including air and flavor components flowing through the casing.

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