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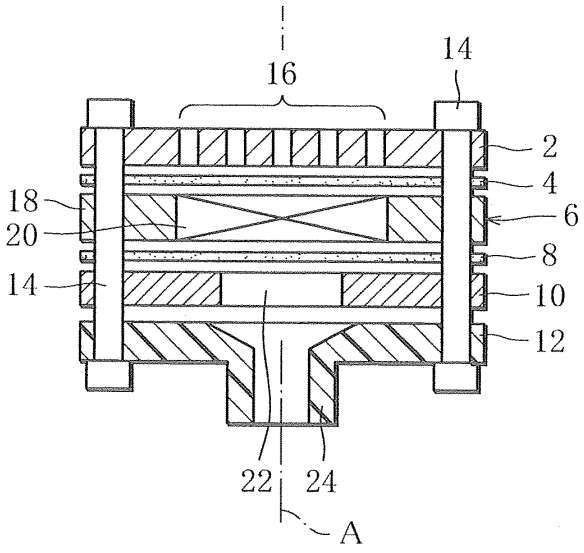
(54) NON-COMBUSTION SUCTION TYPE TOBACCO PRODUCT

(57) A non-combustion suction type tobacco product has tobacco particles (20) made of tobacco material such as leaf tobacco, and at least one kind of stabilizer for stabilizing the delivery of nicotine from the tobacco particles (20), and the stabilizer has a characteristic where solubility parameter distance with respect to nicotine is 17 or less, and that vapor pressure at a temperature of 25 degrees centigrade is 1 mmHg or less.

FIG. 1



EP 2 647 299 A1

Description

Technical Field

[0001] The invention relates to a non-combustion suction type tobacco product that does not lighted to generate smoke from the tobacco product.

Background Art

[0002] A non-combustion suction type tobacco product of this type includes a hollow suction holder and a filler disposed inside the suction holder and made of tobacco particles obtained by granulating tobacco material, and provides an airflow resistance of about 40 to about 80 mmHg (Patent Document 1).
According to the Patent Document 1, when the tobacco product is used, or sucked by a user, nicotine that is one of ingredients specific to tobacco is delivered with sucked air into the user's mouth.

Prior Art Document

Patent Document

[0003] Patent Document 1: WO2010/095659

Disclosure of the Invention

Problems to be Solved by the Invention

[0004] According to the Patent Document 1, the amount of nicotine discharged from tobacco particles, namely, the amount of nicotine delivered into the user's mouth, is relatively quickly reduced in proportion as the number of puffing is increased. In other words, the amount of nicotine sucked by the user is greatly changed along with the increase of puffing number. The user therefore not only is aware of an uncomfortable feeling during the use of the tobacco product but also has the impression that the estimated usable period of the tobacco product (the puff number) is shorter (less) than anticipated.

[0005] The invention has been made in light of the foregoing circumstances. It is an object of the invention to provide a non-combustion suction type tobacco product in which a delivery amount of nicotine that is one of ingredients specific to tobacco is stabilized for long periods, and the puff number sufficient to satisfy the user is greatly increased.

Means for Solving the Problem

[0006] The above object is accomplished by a non-combustion suction type tobacco product of the present invention. The tobacco comprises tobacco particles obtained by shredding or pulverizing tobacco material, and at least one kind of stabilizer for stabilizing nicotine delivery from the particles. The stabilizer has a characteristic where solubility parameter distance with respect to nicotine is 17 or less and vapor pressure at a temperature of 25 degrees centigrade is 1 mmHg or less.

[0007] Because of its high nicotine solubility and low vapor pressure, the stabilizer stably maintains nicotine and stabilizes the amount of nicotine delivered to the user for long periods.
For example, the stabilizer is selected from among compounds containing propylene glycol, benzyl alcohol or an ester group. The compounds are selected from among medium-chain triglyceride, triester citrate (triethyl citrate, tributyl citrate, etc.), benzyl benzoate, and ethyl laurate.

[0008] Preferably, in light of more stabilization of the nicotine delivery amount, the stabilizer is characterized by having a 12 or less solubility parameter distance and a 0.1 mmHg or less vapor pressure at a temperature of 25 degrees centigrade.
The tobacco particles may further contain an additive having at least either one of carbonate and hydrogen carbonate both commonly used in snuff products such as snus.

[0009] The non-combustion suction type tobacco product may further comprise a heat source for heating the tobacco particles. In this case, the stabilizer has a characteristic where the solubility parameter distance is 17 or less, and the vapor pressure is 1 mmHg or less at a heating temperature of the tobacco particles.
Preferably, the stabilizer has a content of 5 to 20 percent by weight relative to dry weight of the tobacco particles. If the stabilizer content is less than 5 percent by weight, the nicotine required is not stabilized, whereas if the stabilizer content is over 20 percent by weight, the stabilizer cause lumping of the particles. In these cases, the handling, namely the

fabrication, of the tobacco particles becomes difficult.

Technical Advantage of the Invention

[0010] Since the non-combustion suction type tobacco product of the present invention comprises the stabilizer in the tobacco particles, it is possible to stabilize for long periods the delivery amount of nicotine that is one of ingredients specific to tobacco, which are discharged from the tobacco particles.

Brief Description of the Drawings

[0011]

FIG. 1 is a cross-sectional view of a non-combustion suction type tobacco product according to one embodiment.
FIG. 2 is a schematic view of a measuring device for testing the effectiveness of stabilizers.
FIG. 3 is a graph showing a relationship between the puff number and nicotine delivery amount, using different kinds of stabilizers as parameters.
FIG. 4 is a graph showing a relationship between the puff number and nicotine delivery amount, using kinds of other stabilizers as parameters.
FIG. 5 is a graph showing a relationship between the puff number and nicotine delivery amount, using stabilizer contents as parameters.
FIG. 6 is a cross-sectional view of the non-combustion suction type tobacco product according to a modification example.

Best Mode of Carrying out the Invention

[0012] A non-combustion suction type tobacco product 1 of one embodiment shown in FIG. 1 comprises an axis A thereof, an upstream member 2, a tobacco cartridge 6, a downstream member 10 and a mouthpiece member 12, which are aligned along the axis A. These members 2, 6, 10 and 12 are integrally joined together with a plurality of connecting bolts and nuts 14.
For example, the upstream member 2 is a stainless steel sheet with a thickness of 1 mm, and includes an open area 16 in the center thereof. The open area 16 has an aperture ratio of 23 percent. Specifically, the open area 16 is formed of small apertures with a diameter of 1 mm, and the small apertures are uniformly distributed.
[0013] The tobacco cartridge 6 includes a frame member 18 made of stainless steel and having a thickness of 2 mm. The frame member 18 has an open portion with an internal diameter of 26 mm in the center thereof. The open portion contains tobacco particles 20. The tobacco particles 20 have air permeability.
As is apparent from FIG. 1, the tobacco cartridge 6 further has air permeable non-woven cloths 4 and 8. The non-woven cloths 4 and 8 sandwich the frame member 18 therebetween and thus prevent the tobacco particles 20 from falling off the frame member 18.
The tobacco particles 20 will be described later.
[0014] Like the upstream member 2, the downstream member 10 is a stainless steel sheet with a thickness of 1 mm, and includes an open portion 22 with an internal diameter of 18 mm in the center thereof.
The mouthpiece member 12 is made of Teflon (trademark) and includes a mouthpiece end 24. The mouthpiece end 24 is protruding from the face of the mouthpiece member 12 remote from the downstream member 10, and has an internal diameter of 6 mm. An open portion of the mouthpiece member 12, which is located on the side of the downstream member 10, has an internal diameter of 20 mm.
[0015] In the tobacco product 1, when a user sucks air from the mouthpiece end 24 of the mouthpiece member 12, outside air enters from the open area 16 of the upstream member 2 into the user's mouth through the non-woven cloth 4, the tobacco particles 20, the non-woven cloth 8, the open portion 22 of the downstream member 10 and the mouthpiece member 12. When the air passes through the tobacco particles 20, nicotine released from the tobacco particles 20 is mixed into the air, so that the user inhales the air containing the nicotine.
[0016] The tobacco particles 20 will be described below in detail.
The tobacco particles 20 are made of a mixture containing particles obtained by shredding or pulverizing, moisturizing and heating tobacco material made of domestic burley leaf tobacco; and an additive made, for example, of at least either one of carbonate and hydrogen carbonate, or more specifically, potassium carbonate. The tobacco particles 20 include particles of 300 mg on a dry weight basis.
[0017] According to the present embodiment, the mixture contains the additive of 12 percent by weight relative to dry weight of tobacco material. The mixture is so prepared that nicotine that is one of ingredients specific to tobacco, which is included in the particles, is 2.3 percent by weight relative to the dry weight, and that a volatile element included in the

particles is 12 percent by weight relative to the weight of the particles.
The content of nicotine is obtained by steps of mixing 7.5 ml of 11 percent by weight aqueous sodium hydroxide and 10 ml of hexane into the particles of 200 mg with a range of plus or minus 2.5 mg; shaking this mixture at room temperature for 60 minutes while shielding lights with aluminum foil, to thereby conduct an extraction treatment; and analyzing a hexane phase by means of a gas chromatograph-mass spectrometer.

[0018] The content of the volatile element can be found by a reduction in weight of the particles of 200 mg with a range of plus or minus 2 mg, which have been subjected to a drying treatment at a temperature of 80 degrees centigrade for three hours.
The dry weight is shown as a value obtained by subtracting the content of the volatile element found as described above from the weight of the particles.

[0019] In the case of the present embodiment, the tobacco particles 20 contain not only the foregoing mixture but also at least one kind of stabilizer for stabilizing the amount of the nicotine delivered to the user. The stabilizer has a characteristic where solubility parameter distance between nicotine and the stabilizer is 17 or less, or preferably 12 or less, and vapor pressure of the stabilizer at a temperature of 25 degrees centigrade is 1 mmHg or less, or preferably 0.1 mmHg or less.

[0020] More specifically, the solubility parameter distance is an index indicative of the solubility of a solute relative to a solvent, and is generally shown by Ra ($MPa^{1/2}$). Ra can be found by a formula below.

$$Ra=[4\times(\delta d,2-\delta d,1)\hat{}2+(\delta p,2-\delta p,1)\hat{}2+(\delta h,2-\delta h,1)\hat{}2]\hat{}(1/2)$$

where δd, δp and δh are defined as a dispersion force, dipolar interaction, and hydrogen bonding, respectively, of a solubility parameter.

[0021] To be specific, the stabilizer is selected from among compounds containing propylene glycol, benzyl alcohol or an ester group. The compounds include medium-chain triglyceride, triester citrate (triethyl citrate, tributyl citrate, etc.), benzyl benzoate, and ethyl laurate.

[0022] TABLE 1 below shows solubility parameter distances Ra and vapor pressures at a temperature of 25 degrees centigrade with respect to the above-mentioned stabilizers, together with those with respect to glycerin (A).

[0023]

[TABLE 1]

Stabilizer	Ra ($MPa^{1/2}$ at 25°C)	Vapor Pressure (mmHg at 25°C)
A (Glycerin)	23.0	0.0002
B (Propylene glycol)	16.4	0.2
C (Medium-chain triglyceride)	11.7	0.0000000002
D (Triethyl citrate)	5.7	0.0002
E (Benzyl benzoate)	1.3	0.0003
F (Benzyl alcohol)	6.6	0.2
G (Ethyl laurate)	9.0	0.00744
H (Tributyl citrate)	8.6	0.0000001

[0024] Stabilizer C is a medium-chain triglyceride consisting primarily of triglyceride caprylate, or more specifically, Coconard MT made by Kao Corporation.
The solubility parameter distance Ra in TABLE 1 is a result of calculation using Molecular Modeling Pro Version 6.01.

[0025] A measuring device shown in FIG. 2 is used to test the effectiveness of stabilizers B to H. The measuring device

measures the delivery amount of nicotine specific to tobacco, which is fed from the tobacco product 1 to the user when the user sucks the tobacco product 1.

[0026] The measuring device has an impinger 26 containing 20 ml of ethanol. Used as the impinger 26 is a Kinoshita-type gas washing bottle (standard type, 50 ml) made by Kinoshita Rika Kogyo Co., Ltd. The impinger 26 contains filter particles (100 to 200 μm) inside, and is provided with a suction pipe 28 and a delivery pipe 30 extending from the inside thereof.

[0027] The tobacco product 1 to be tested is connectable to the suction pipe 28. The delivery pipe 30 is connected to a suction pump 36 via an electromagnetic valve 32 and a mass flow controller (MFC) 34. A valve controller (VC) 38 is electrically connected to the electromagnetic valve 32. The valve controller 38 controls an opening/closing operation of the electromagnetic valve 32.

[0028] Due to the opening/closing operation controlled by the valve controller 38, the electromagnetic valve 32 can repeat 1-suction cycle in which the suction pump 36 and the impinger 26 are connected for 4 seconds, and then the impinger 26 is exposed to atmosphere for 11 seconds. A flow rate of the mass flow controller 34 is set at 3300 cc/min.

[0029] As the tobacco product 1 to be tested, there are prepared a tobacco product of comparative example 1, which contains neither the glycerin (A) nor the stabilizers B to H in the tobacco particle 20; a tobacco product of comparative example 2, which contains the glycerin (A) in the tobacco particles 20; and tobacco products of embodiments, which contain the stabilizers B to H in the tobacco particles 20, respectively.

[0030] In the tobacco products of the comparative example 2 and the embodiments, contents of the glycerin (A) and the stabilizers B to F are each 15 percent by weight (45 mg) relative to dry weight of the tobacco particles 20. After one of the tobacco products according to the comparative examples 1 and 2 and the embodiments is connected to the suction pipe 28 of the impinger 26, the above-described suction cycle is repeated for 50 times under environment with a room temperature of 22 degrees centigrade and a humidity of 60 percent. The nicotine delivered from the tobacco product is trapped in the ethanol contained in the impinger 26.

[0031] Subsequently, the ethanol in which the nicotine has been trapped is removed from the impinger 26. The removed ethanol is analyzed with the gas chromatograph- mass spectrometer, to thereby measure the nicotine specific to tobacco per 1- suction cycle (one puff), which is delivered from the tobacco product.

The trapping and the analysis measurement are repeatedly conducted until the total of suction cycles reaches a given number of times. This way, a measurement process with respect to a single tobacco product is completed.

This measurement process is conducted with respect to each tobacco product. Results of the measurement are shown in FIGS. 3 and 4.

[0032] The tobacco products of the embodiments including the stabilizers G and H differ from those of the other embodiments in the following points. In the case of the embodiments including the stabilizers G and H, the nicotine contained in the particles is 1.6 percent by weight relative to dry weight of tobacco material, and the volatile element contained in the particles is 10 percent by weight relative to the weight of the particles.

[0033] As is evident from FIGS. 3 and 4, in comparison with the tobacco product (containing no stabilizer) of the comparative example 1, the tobacco products of the embodiments including the stabilizers B to H prevent a reduction in nicotine delivery amount, which is caused by increase of puff number. This demonstrates that the stabilizers B to H are effective in stabilizing the nicotine delivery amount for long periods of time.

The tobacco product (glycerin A) of the comparative example 2 does not significantly differ from the tobacco product (no stabilizer) of the comparative example 1 in terms of the reduction of nicotine delivery amount, which is caused by the increase of puff number. In this view, the glycerin A is not effective in stabilizing the nicotine delivery amount.

[0034] A possible reason for the foregoing result is that the solubility parameter distance Ra of the glycerin A is as large as 23.0 although the stabilizers B to H have a solubility parameter distance Ra of 17 or less, and a vapor pressure of 1 mmHg or less at a temperature of 25 degrees centigrade.

[0035] The tobacco product containing the stabilizer F is lower in the nicotine delivery amount than the tobacco product of the comparative example 1, regardless of the puff number. This is because of a higher nicotine-trap effect of the stabilizer F (benzyl alcohol) as compared to the other stabilizers B to E, G and H.

It can be therefore considered that, in the case where the stabilizer F is used, if the content of the stabilizer F is set less than the contents of the stabilizers B to E, G and H, the tobacco product containing the stabilizer F can deliver nicotine as well as the tobacco products of the other embodiments do. This will be clarified by descriptions below which explain measurement results shown in FIG. 5.

[0036] As is clear from FIG. 3, in the case of the tobacco product of the embodiment including the stabilizer F, the nicotine delivery amount tends to increase in proportion to the increase of puff number. If such a tendency gives an uncomfortable feeling to the user and is therefore undesirable to the user, it can be considered that, as to a stabilizer like the stabilizer F which has a 12 or less solubility parameter distance Ra, its vapor pressure at a temperature of 25 degrees centigrade is too high. On this account, it is preferable to select a stabilizer that has a vapor pressure of 0.1 mmHg or less at a temperature of 25 degrees centigrade.

[0037] Focusing on the stabilizer D, there were prepared tobacco products of embodiments, which differ from the

above-described embodiments in terms of content of the stabilizer D, and the measurement process was conducted in the same manner with respect to these tobacco products. Results of the measurement are shown together with a measurement result associated with the tobacco product containing no stabilizer.

As is obvious from FIG. 5, as the content of the stabilizer D is increased from 5 percent by weight (15 mg) to 10 percent by weight (30 mg) to 15 percent by weight (45 mg), the nicotine delivery amount is decreased and shows only a little change over a long period of time.

[0038] It is can be thought that the same results are also applicable to the other stabilizers B, C, E and F to H, so that the contents of the stabilizers B to H may be set in a range of from 5 to 20 percent by weight. If the content is less than 5 percent by weight, a desired stabilization effect is not achieved with respect to the nicotine delivery amount. If the content is over 20 percent by weight, the stabilizer causes lumping of the tobacco particles 20, making it difficult to handle, namely fabricate, the tobacco particles 20.

[0039] In the case that the stabilizer F is used, if the content of the stabilizer F is set less than the contents of the stabilizers B to E, G and H, the tobacco product containing the stabilizer F is expected to be able to generate as much nicotine delivery amount as the tobacco products containing the stabilizers B to E, G and H do.

[0040] The non-combustion suction type tobacco product may further include a heat source for heating the tobacco particles 20. For example, as illustrated in FIG. 6, the upstream member 2 of the tobacco product has an electric heater 40 embedded therein. While the tobacco product is being used, the heater 40 heats the tobacco particles 20 to a desired temperature through the upstream member 2, the non-woven cloth 4 and the frame member 18.

In this case, the stabilizer contained in the tobacco particles 20 has a 1 mmHg or less vapor pressure at a heating temperature of the tobacco particles 20 and a 17 or less solubility parameter distance Ra with respect to nicotine. Preferably, the stabilizer is selected from among stabilizers characterized by having a 0.1 mmHg or less vapor pressure at the heating temperature of the tobacco particle 20 and a 12 or less solubility parameter distance Ra.

[0041] TABLE 2 below shows vapor pressures of the glycerin (A) and the above-mentioned stabilizers at temperatures of 25 degrees centigrade, 70 degrees centigrade and 100 degrees centigrade, respectively.

[0042]

[TABLE 2]

Stabilizer	Vapor Pressure (mmHg at 25°C)	Vapor Pressure (mmHg at 70°C)	Vapor Pressure (mmHg at 100°C)
A (Glycerin)	0.0002	0.00517	0.0292
B (Propylene glycol)	0.2	2.7	10.0
C (Medium-chain triglyceride)	0.0000000002	0.00000001	0.0000001
D (Triethyl citrate)	0.0002	0.005	0.03
E (Benzyl benzoate)	0.0003	0.006	0.03
F (Benzyl alcohol)	0.2	1.9	6.9
G (Ethyl laurate)	0.00744	0.103	0.429
H (Tributyl citrate)	0.0000001	0.000005	0.00004

In TABLE 2, the vapor pressures at temperatures 70 degrees centigrade and 100 degrees centigrade are calculated by a Clausius-Clapeyron equation below.

$$P=PO\times e^{\wedge}(L/R)\times(1/TO-1/T)$$

wherein P is vapor pressure [mmHg] at temperature T; PO is vapor pressure [mmHg] at a temperature of 25 degrees centigrade; L is the heat of vaporization [J/mol]; R is a gas constant [J/mol×K]; TO is 298[K] (25 degrees centigrade); and T is temperature [K].

As is evident from TABLE 2, for example, if the heating temperature of the tobacco particles 20 is 70 or 100 degrees centigrade, it is possible to select the stabilizer C, D, E, G or H as a stabilizer.

[0043] The invention is not limited to the one embodiment described above, but may be modified in various ways. For example, the stabilizer is not limited to B to H as long as the stabilizer has a 17 or less solubility parameter distance Ra and a 1 mmHg or less vapor pressure. Alternatively, it is possible to combine the stabilizers B to H in an arbitrary

way. Furthermore, a configuration of the tobacco product is not limited to the one shown in FIG. 1, either.

[0044] If a selected stabilizer has a 1 mmHg vapor pressure at the heating temperature of the tobacco particles 20 and a 17 or less solubility parameter distance Ra with respect to nicotine, the tobacco particles 20 can be heated to not only the heating temperature shown in TABLE 2, but also any arbitrary temperature. Likewise, the method of heating the tobacco particles 20 is not limited to the one shown in FIG. 6.

Reference Marks

[0045] 1: tobacco product, 2: upstream member, 4: non-woven cloth, 6: tobacco cartridge, 8: non-woven cloth, 10: downstream member, 12: mouthpiece member, 18: frame member, 20: tobacco particles, 20: open portion, 22: heater 40 (heat source)

Claims

1. A non-combustion suction type tobacco product comprising tobacco particles obtained by shredding or pulverizing tobacco material, the tobacco product mixing nicotine specific to tobacco, which is generated from the tobacco particles, into suction air, and delivering the nicotine with the suction air into a user's mouth, wherein
the tobacco particles further contains at least one kind of stabilizer for stabilizing the nicotine delivery to the user; and
said stabilizer has a characteristic where solubility parameter distance with respect to the nicotine is 17 or less, and vapor pressure at a temperature of 25 degrees centigrade is 1 mmHg or less.

2. The non-combustion suction type tobacco product according to claim 1, wherein said stabilizer is selected from among compounds containing propylene glycol, benzyl alcohol or an ester group.

3. The non-combustion suction type tobacco product according to claim 1 or 2, wherein said stabilizer is **characterized in that** the solubility parameter distance is 12 or less, and that the vapor pressure at a temperature of 25 degrees centigrade is 0.1 mmHg or less.

4. The non-combustion suction type tobacco product according to claim 3, wherein said stabilizer is a compound containing the ester group.

5. The non-combustion suction type tobacco product according to claim 4, wherein the compound is selected from among medium-chain triglyceride, triester citrate, benzyl benzoate, and ethyl laurate.

6. The non-combustion suction type tobacco product according to claim 5, wherein the triester citrate is triethyl citrate or tributyl citrate.

7. The non-combustion suction type tobacco product according to claim 5, wherein the tobacco particles further contain an additive having at least either one of carbonate and hydrogen carbonate.

8. The non-combustion suction type tobacco product according to claim 5, further comprising a heat source for heating the tobacco particles to given temperature, wherein
said stabilizer has a characteristic where the solubility parameter distance is 17 or less, and that the vapor pressure at a heating temperature of the tobacco particles is 1 mmHg or less.

9. The non-combustion suction type tobacco product according to claim 1, wherein said stabilizer has a content ranging from 5 to 20 percent by weight relative to dry weight of the tobacco particles.

FIG. 1

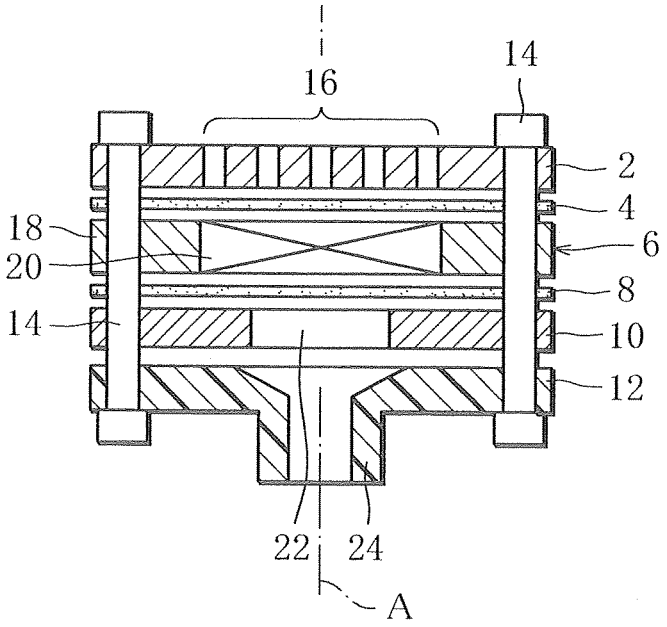


FIG. 2

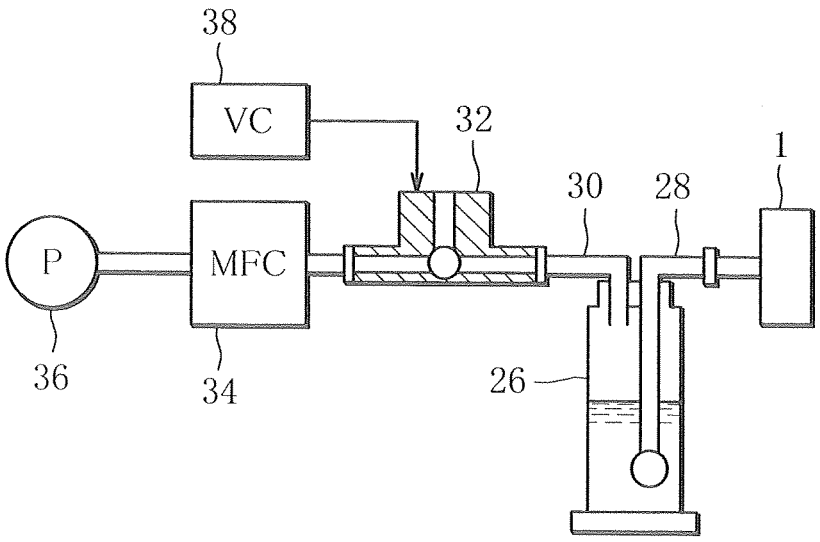
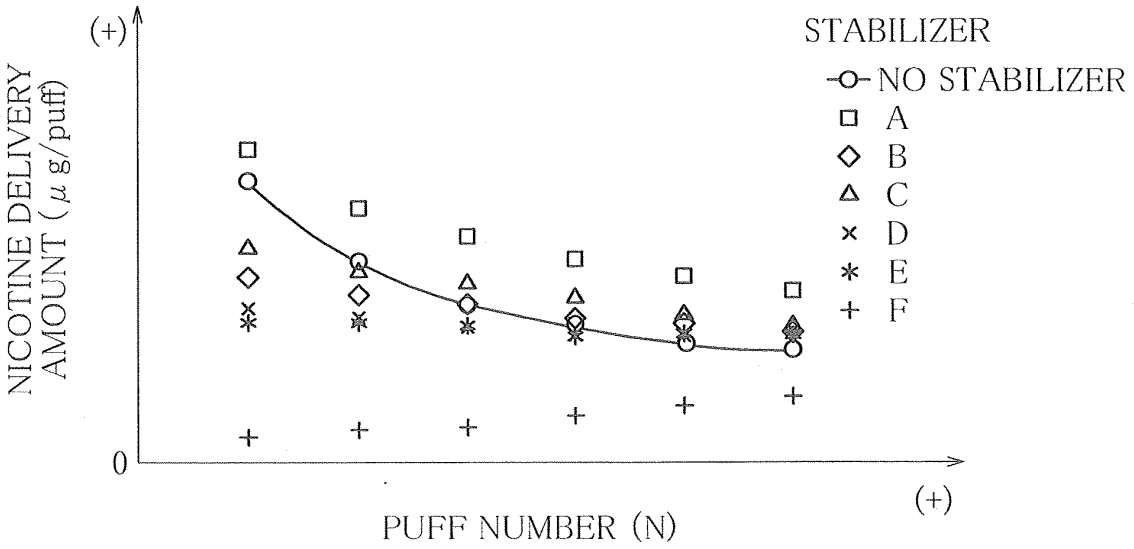


FIG. 3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STABILIZER
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A
B
C
D
E
F

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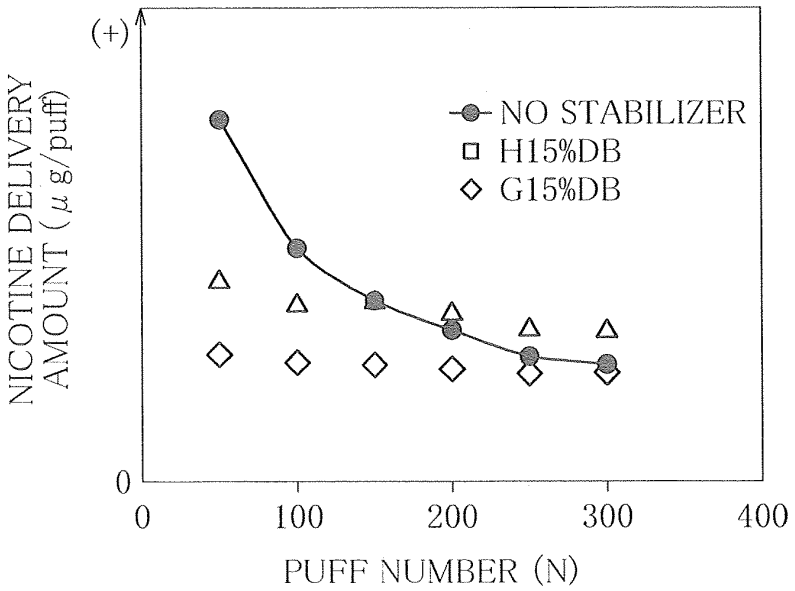
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G15%DB

FIG. 5

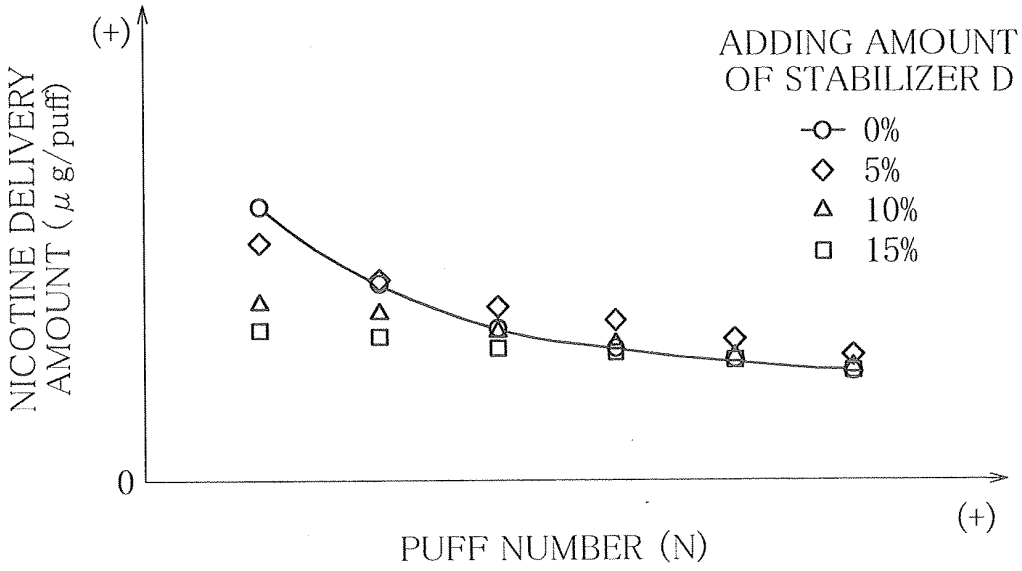
(+)
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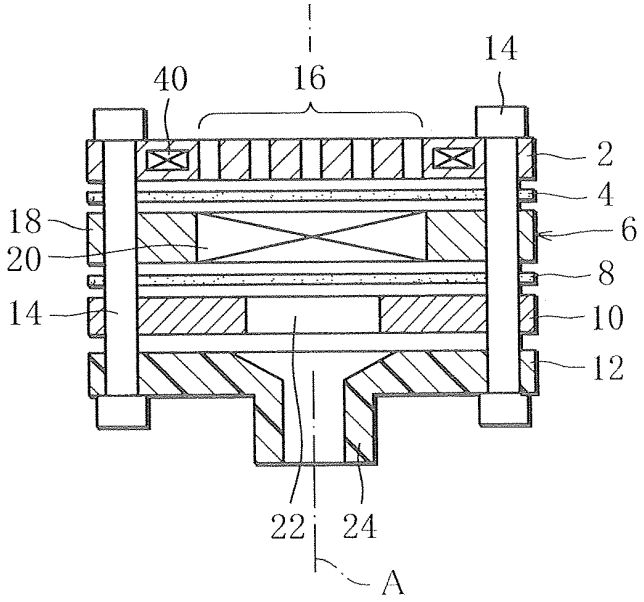
FIG. 6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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/057726

A. CLASSIFICATION OF SUBJECT MATTER
A24F47/00(2006.01)i, *A24B15/28*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A24F47/00, A24B15/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012
Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2009/155957 A1 (Olig AG.), 30 December 2009 (30.12.2009), fig. 1 & EP 2138059 A1 & EP 2227973 A1 & EP 2191735 A1 & EP 2138058 A1 & EP 2303043 A & WO 2009/156181 A2 & JP 2011-525366 A & WO 2010/102832 A1 & WO 2010/060537 A1 & DE 102008030548 A & DE 502008001403 D & DE 502008003198 D & CA 2712412 A	1-9

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
26 April, 2012 (26.04.12)	15 May, 2012 (15.05.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/057726

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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REFERENCES CITED IN THE DESCRIPTION

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