

Description

The invention relates to a filter for a cigarette comprising a porous plug affixed to the end of the cigarette for drawing smoke from the cigarette through the plug, and a plurality of ventilating air ducts positioned and distributed circumambiently around and within the periphery of the plug, each of the ducts having an air egress opening at the mouth end of the filter and having an air ingress opening exteriorly of the filter cigarette located remote from said end along the filter, the ducts being closed to the ingress of smoke thereto.

A filter of this type is known from DE-A-30 11 959. This prior art filter is destined to combine reduction of the amount of smoke particles, particularly tar, and gaseous smoke components reaching the smoker's mouth by ventilating with a pressure drop across the cigarette corresponding to that of a cigarette provided with a filter of low to medium efficiency. DE-A-30 11 959, thus, is primarily concerned with the draw characteristics of a ventilated, low-tar cigarette.

The problem to be solved by the present invention is to design a filter of the type defined above in such a way that it provides substantial dispersion of the smoke drawn through the filter of standard dimensions (20-27 mm in circumference) within about 1 cm distance from the mouth end of the filter when drawn at the rate of 17.5 cm³/sec.

In accordance with the invention a filter solving this problem is characterised by the equation:

$$K = \frac{UA_v}{100n} - A_v$$

wherein

A_v = average cross-sectional area of the individual ducts (14; 34);

A_f = total cross-sectional area of the filter;

n = number of ducts (14; 34);

$100q_v$

$U = \frac{100q_v}{q_v + q_s}$ = percent ventilation air for the total flow rate through the filter

wherein

q_v = total flow rate through the ducts (14; 34)

q_s = flow rate through the plug (2; 6)

said variables being so selected that

$3 \leq n \leq 7$

U = approximately 60—approximately 95%

$A_v/A_f < 0.01$ and

$K > 0.035$

A filter designed in accordance with the teaching of the invention causes the smoke stream to become intensely turbulent immediately upon leaving the mouth end of the filter. The smoke becomes rapidly and uniformly dispersed in the smoker's mouth within a very short distance from the filter end and, therefore, impinges on a large number of taste receptors. This produces an intense cigarette taste, despite the fact that the level of undesirable particulate matter and consequently also of taste effective particles may be very low.

Preferable embodiments are described in the sub-claims.

The invention will now be further described in connection with two embodiments shown in the drawings. In these, Fig. 1 is a perspective view of one preferred filter element of the present invention;

Fig. 2 is a perspective view of the filter of Fig. 1 attached to a cigarette with tipping material shown in an unwrapped condition; and

Fig. 3 is a perspective view of even another preferred filter of the present invention attached to a cigarette with tipping material shown in an unwrapped condition.

In Figure 1, a filter plug 2 having a circumference of from 20 to 27 mm is shown. The filter plug 2 comprises a cellulose acetate filter element 10 or any other filter made from, for example, fibrous or foamed materials for filtering of tobacco smoke which may be known in the art circumscribed by a non-porous wrapper 12. It is realized that in the use of the term "non-porous wrapper", this includes non-porous outer surfaces of foamed material which are integral with the filter element as well as non-porous wrapping material which is not integral with the filter element. The filter plug 2 is provided with a plurality of grooves 14 therein extending longitudinally therealong. Although only four grooves are shown symmetrically spaced around the filter element, it is realized that the grooves may be randomly spaced wherein the centers of adjacent grooves are at least eight groove radii distance apart, that is, for a groove of, for example, 0.0040 cm² (0.05 cm radius), the center of the adjacent grooves will be at least 0.4 cm from their centers.

The filter plugs 2 are generally prepared by taking a standard filter rod of cellulose acetate or the like wrapped with a non-porous wrapping material, then subjecting the wrapped filter rod to a mold or other

treating means designed for putting appropriate grooves therein. One such method is known as a heat molding technique, which is well known in the art.

In Figure 2, a filter plug 2 of Figure 1 is attached to a tobacco column or cigarette 3 and is positioned for being wrapped by tipping paper 16 which includes a plurality of perforations 18 therein circumferentially surrounding filter plug 2 and disposed for flow communication with the grooves 14 wherein ventilating air radially enters the grooves 14 through the perforations 18. As shown in Figure 2, ventilating air enters through the tipping perforations 18 travelling down the grooves 14 and toward the smoker's mouth. The size of perforations 18 and the number of flow communication with grooves 14 will be determined in accordance with the amount of ventilating air desired.

In Figure 3, another preferred filter plug 6 of the present invention is shown attached to a tobacco column or cigarette 7 and is positioned for being wrapped by tipping paper 36 which includes a plurality of perforations 38 therein circumferentially surrounding filter plug 6 and disposed for flow communication with the grooves 34 wherein ventilating air radially enters the grooves 34 through the perforations 38. The filter plug 6 is comprised of a cellulose acetate filter element 30 or any other filter made from fibrous or foamed materials for tobacco smoke which may be known in the art enclosed by a tubular plastic sleeve 32. The plastic sleeve 32, may have grooves 34 running only partway of the length along the outer surface as shown, or may extend substantially the entire length. If the grooves 34 extend the entire length, sealing means will be provided to prevent the ingress of smoke from the tobacco column therein or the sleeve will have a cross-sectional area sufficiently greater than the cross-sectional area of the tobacco column so that grooves 34 will be open to the atmosphere. The means for preparing a tubular sleeve may be any known in the art, such as those prepared by extruding.

A more comprehensive understanding of the invention can be obtained by considering the following examples. However, it should be understood that the examples are not intended to be unduly limitative of the invention.

Examples I—XXIII

A number of cigarettes were prepared by taking a standard cellulose acetate filter element of 24.6 mm in circumference and 27 mm in length wrapped with a non-porous wrapping paper from Schweitzer Division, Kimberly-Clark Corporation identified as Type 322. A specified number of grooves were made in each filter and then attached to a cigarette or tobacco column with a tipping paper. The tipping paper was provided with ventilating holes in flow communication with the grooves and the amount of ventilating air introduced was adjusted by varying the size and number of ventilating holes. The cigarettes were then smoked in accordance with the accepted test method of the Federal Trade Commission as published by H. C. Pillsbury, et al for "Tar and Nicotine in Cigarette Smoke", J. Assoc. Offic. Anal. Chem. Vol. 52, pages 458—462, dated 1969.

The results for each example are listed in Table 1 below.

TABLE 1

(12)

	Example	n^1	A_v^2	A_t^3	U^4	K^5	L^6
5	I	1	.0025	.49	65	.316	—
	II	2	.0025	.49	68	.164	19.1
10	III	3	.0025	.49	68	.109	16.3
	IV	4	.0025	.49	64	.076	13.5
	V	5	.0025	.49	67	.063	11.2
15	VI	6	.0025	.49	65	.051	9.5
	VII	7	.0025	.49	65	.043	8.3
	VIII	8	.0025	.49	65	.037	7.3
20	IX	8	.0022	.50	82	.049	8.0
	X	31	.0004	.52	65	.011	4.9
25	XI	4	.0040	.48	85	.098	10.5
	XII	4	.0040	.48	80	.092	10.5
	XIII	4	.0040	.48	70	.080	10.5
30	XIV	4	.0040	.48	60	.068	10.5
	XV	4	.0040	.48	50	.056	10.5
35	XVI	4	.0028	.50	73	.088	12.9
	XVII	4	.0006	.52	68	.088	28.3
	XVIII	4	.0014	.52	79	.102	18.9
40	XIX	4	.0073	.49	80	.091	7.7
	XX	4	.0061	.49	67	.077	8.5
45	XXI	4	.0091	.50	69	.077	6.8
	XXII	4	.0102	.50	72	.079	6.5
50	XXIII	8	.0008	.51	80	.050	13.4

¹—Number of grooves in the filter²—Average cross-sectional area of each groove in cm²³—Cross-sectional area of filter (including the grooves) in cm²⁴—Percent of ventilating air in the total flow stream

$$K = \frac{UA_t}{100n} - A_v$$

⁶—Average distance between adjacent grooves

$$L = \frac{\text{Average distance between adjacent grooves}}{\text{Average radius of each groove}}$$

(13)

From the above examples it was found, by visual appearance, that in Examples III—VII, XI—XIII, and XVI—XVIII, substantially all of the exiting smoke had been dispersed within one centimeter of the exit of the filter. In Examples VIII—X, and XIX—XXIII the ventilating air acted like a sheath and circumscribed the exiting smoke instead of dispersing it. In Example XV it appeared that there was insufficient ventilating air to disperse the smoke. Furthermore, in a taste test of the cigarettes, cigarettes of Examples III—VII, XI—XIII, and XVI—XVIII, exhibited exceptional taste amplitude whereas the remaining examples showed a diminished taste. As for Examples I and II, very little smoke dispersion was noted, and very little taste was obtained.

10 Claims

1. Filter for a cigarette comprising a porous plug (2; 6) affixed to the end of the cigarette (3; 7) for drawing smoke from the cigarette (3; 7) through the plug (2; 6) and a plurality of ventilating air ducts (14; 34) positioned and distributed circumambiently around and within the periphery of the plug (2; 6), each of the ducts (14; 34) having an air egress opening at the mouth end of the filter and having an air ingress opening exteriorly of the filter cigarette located remote from said end along the filter, the ducts (14; 34) being closed to the ingress of smoke thereto, characterised by the equation:

$$K = \frac{UA_i}{100n} - A_v$$

wherein

A_v = average cross-sectional area of the individual ducts (14; 34);

A_i = total cross-sectional area of the filter;

n = number of ducts (14; 34);

$$U = \frac{100q_v}{q_v + q_s} = \text{percent ventilation air for the total flow rate through the filter}$$

wherein

q_v = total flow rate through the ducts (14; 34)

q_s = flow rate through the plug (2; 6)

said variables being so selected that

$$3 \leq n \leq 7$$

U = approximately 60—approximately 95%

$$A_v/A_i < 0.01 \text{ and}$$

$$K > 0.035$$

whereby substantial dispersion of the smoke drawn through the end of the filter is obtained within about 1 cm distance from the end of the filter when drawn at the rate of 17.5 cm³/sec.

2. Filter according to claim, characterised by four to six ventilating air ducts (14; 34).

3. Filter according to claim 1, characterised in that U is between about 65 to 90.

4. Filter according to claim 1, characterised by four or five ventilating air ducts (14; 34).

5. Filter according to claim 1, characterised in that the ducts (14; 34) are substantially symmetrically spaced around the porous plug (2; 6).

6. Filter according to claim 1, characterised in that the ducts (14; 34) are grooves.

7. Filter according to claim 6, characterised in that the grooves are substantially semi-circular in cross-section.

8. Filter according to claims 6 or 7, characterised in that the centers of adjacent ducts (14; 34) are at least eight groove radii distance apart.

Revendications

1. Filtre pour cigarette, comprenant un tampon filtrant poreux (2; 6) fixé au bout d'une cigarette (3; 7) pour aspirer de la fumée de la cigarette (3; 7) à travers le tampon filtrant (2; 6) et une pluralité de conduits d'air de ventilation (14; 34) positionnés et répartis circonférentiellement sur le pourtour et à l'intérieur de la périphérie du tampon filtrant (2; 6), chacun des conduits (14; 34) comportant une ouverture de sortie d'air au niveau de l'extrémité du filtre et comportant une ouverture d'entrée d'air à l'extérieur de la cigarette à filtre, située à distance de ladite extrémité le long du filtre, les conduits (14; 34) ne laissant pas la fumée pénétrer en leur intérieur, caractérisée par l'équation:

$$K = \frac{UA_i}{100n} - A_v$$



From the above examples it was found, by visual appearance, that in Examples III—VII, XI—XIII, and XVI—XVIII, substantially all of the exiting smoke had been dispersed within one centimeter of the exit of the filter. In Examples VIII—X, and XIX—XXIII the ventilating air acted like a sheath and circumscribed the exiting smoke instead of dispersing it. In Example XV it appeared that there was insufficient ventilating air to disperse the smoke. Furthermore, in a taste test of the cigarettes, cigarettes of Examples III—VII, XI—XIII, and XVI—XVIII, exhibited exceptional taste amplitude whereas the remaining examples showed a diminished taste. As for Examples I and II, very little smoke dispersion was noted, and very little taste was obtained.

10 Claims

1. Filter for a cigarette comprising a porous plug (2; 6) affixed to the end of the cigarette (3; 7) for drawing smoke from the cigarette (3; 7) through the plug (2; 6) and a plurality of ventilating air ducts (14; 34) positioned and distributed circumambiently around and within the periphery of the plug (2; 6), each of the ducts (14; 34) having an air egress opening at the mouth end of the filter and having an air ingress opening exteriorly of the filter cigarette located remote from said end along the filter, the ducts (14; 34) being closed to the ingress of smoke thereto, characterised by the equation:

$$K = \frac{UA_i}{100n} - A_v$$

wherein

A_v = average cross-sectional area of the individual ducts (14; 34);
 A_i = total cross-sectional area of the filter;
 n = number of ducts (14; 34);

$$U = \frac{100q_v}{q_v + q_s} = \text{percent ventilation air for the total flow rate through the filter}$$

wherein

q_v = total flow rate through the ducts (14; 34)
 q_s = flow rate through the plug (2; 6)
 said variables being so selected that
 $3 \leq n \leq 7$
 U = approximately 60—approximately 95%
 $A_v/A_i < 0.01$ and
 $K > 0.035$

whereby substantial dispersion of the smoke drawn through the end of the filter is obtained within about 1 cm distance from the end of the filter when drawn at the rate of 17.5 cm³/sec.

2. Filter according to claim, characterised by four to six ventilating air ducts (14; 34).
3. Filter according to claim 1, characterised in that U is between about 65 to 90.
4. Filter according to claim 1, characterised by four or five ventilating air ducts (14; 34).
5. Filter according to claim 1, characterised in that the ducts (14; 34) are substantially symmetrically spaced around the porous plug (2; 6).
6. Filter according to claim 1, characterised in that the ducts (14; 34) are grooves.
7. Filter according to claim 6, characterised in that the grooves are substantially semi-circular in cross-section.
8. Filter according to claims 6 or 7, characterised in that the centers of adjacent ducts (14; 34) are at least eight groove radii distance apart.

Revendications

1. Filtre pour cigarette, comprenant un tampon filtrant poreux (2; 6) fixé au bout d'une cigarette (3; 7) pour aspirer de la fumée de la cigarette (3; 7) à travers le tampon filtrant (2; 6) et une pluralité de conduits d'air de ventilation (14; 34) positionnés et répartis circonférentiellement sur le pourtour et à l'intérieur de la périphérie du tampon filtrant (2; 6), chacun des conduits (14; 34) comportant une ouverture de sortie d'air au niveau de l'extrémité du filtre et comportant une ouverture d'entrée d'air à l'extérieur de la cigarette à filtre, située à distance de ladite extrémité le long du filtre, les conduits (14; 34) ne laissant pas la fumée pénétrer en leur intérieur, caractérisée par l'équation:

$$K = \frac{UA_i}{100n} - A_v$$



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où

A_v = aire de section droite moyenne des conduits individuels (14; 34);

A_f = aire de section droite totale du filtre;

n = nombre de conduits (14; 34);

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$$U = \frac{100q_v}{q_v + q_s} = \text{pourcentage d'air de ventilation par rapport au débit total traversant le filtre,}$$

10 où

q_v = débit total traversant les conduits (14; 34),

q_s = débit traversant le tampon filtrant (2; 6),

lesdites variables étant choisies de façon que:

$$3 \leq n \leq 7$$

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U = environ 60 — environ 95%

$A_v/A_f < 0,01$ et

$K > 0,035$,

de sorte que l'on obtient une dispersion notable de la fumée aspirée à travers la sortie du filtre sur une distance d'environ 1 cm de la sortie du filtre, lorsque l'aspiration a lieu à un débit de 17,5 cm³/s.

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2. Filtre selon la revendication 1, caractérisé en ce qu'il comporte quatre à six conduits d'air de ventilation (14; 34).

3. Filtre selon la revendication 1, caractérisé en ce que U est compris entre environ 65 et 90.

4. Filtre selon la revendication 1, caractérisé en ce qu'il comporte quatre ou cinq conduits d'air de ventilation (14; 34).

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5. Filtre selon la revendication 1, caractérisé en ce que les conduits (14; 34) sont répartis sensiblement symétriquement tout autour du tampon filtrant poreux (2; 6).

6. Filtre selon la revendication 1, caractérisé en ce que les conduits (14; 34) sont des rainures.

7. Filtre selon la revendication 6, caractérisé en ce que les rainures ont une section droite sensiblement semi-circulaire.

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8. Filtre selon la revendication 6 ou 7, caractérisé en ce que les centres de conduits adjacents (14; 34) sont séparés par une distance d'au moins huit rayons de rainure.

Patentansprüche

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1. Filter für eine Zigarette mit einem porösen Stopfen (2, 6), der sich an das Ende der Zigarette (3, 7) zum Durchziehen von Rauch aus der Zigarette (3, 7) durch den Stopfen (2, 6) anschließt und mit einer Mehrzahl von Belüftungskanälen (14, 34), die ringsum verteilt innerhalb des Randes des Stopfens (2, 6) angeordnet sind, wobei jeder der Kanäle (14, 34) eine Luftauslaßöffnung am mundseitigen Ende des Filters und eine entlang des Filters von diesem Ende entfernt und außerhalb der Filterzigarette angeordnete Lufteintrittsöffnung enthält, und wobei die Kanäle (14, 34) gegen den Eintritt von Rauch abgedichtet sind, gekennzeichnet durch die Gleichung:

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$$K = \frac{U A_v}{100n} A_f$$

wobei

A_v = die mittlere Querschnittsfläche der einzelnen Kanäle (14, 34);

A_f = die gesamte Querschnittsfläche des Filters;

n = die Anzahl der Kanäle (14, 34);

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$$U = \frac{100q_v}{q_v + q_s} = \text{der prozentuale Anteil der Belüftungsluft für die gesamte Durchflußrate durch den Filter,}$$

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wobei

q_v = die gesamte Durchflußrate durch die Kanäle (14, 34);

q_s = die Durchflußrate durch den Stopfen (2, 6);

wobei die die Veränderlichen so ausgewählt werden, daß

$$3 \leq n \leq 7;$$

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U = ungefähr 60 — ungefähr 95%;

$A_v/A_f < 0,01$ und

$K > 0,035$

ist, wodurch die hauptsächlichste Zerstreuung des durch das Ende des Filters gezogenen Rauches innerhalb einer Entfernung von dem Ende des Filters von etwa 1 cm bei einem Zug von 17,5 cm³/sek erreicht wird.

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(15)

2. Filter nach Anspruch 1, gekennzeichnet durch vier bis sechs Belüftungskanäle (14, 34).
3. Filter nach Anspruch 1, dadurch gekennzeichnet, daß U etwa zwischen 65 und 90 liegt.
4. Filter nach Anspruch 1, gekennzeichnet durch vier oder fünf Belüftungskanäle (14, 34).
5. Filter nach Anspruch 1, dadurch gekennzeichnet, daß die Kanäle (14, 34) im wesentlichen symmetrisch um den porösen Stopfen (2, 6) beabstandet sind.
6. Filter nach Anspruch 1, dadurch gekennzeichnet, daß die Kanäle (14, 34) Nuten sind.
7. Filter nach Anspruch 6, dadurch gekennzeichnet, daß die Nuten einen im wesentlichen halbkreisförmigen Querschnitt aufweisen.
8. Filter nach einem der Ansprüche 6 oder 7, dadurch gekennzeichnet, daß die Mittellinien benachbarter Kanäle (14, 34) einen Abstand von mindestens dem 8-fachen Nutenradius aufweisen.

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