

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

**EP 0 599 897 B1**

(12)

**EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention  
of the grant of the patent:

**21.07.1999 Bulletin 1999/29**

(21) Application number: **92916991.0**

(22) Date of filing: **07.08.1992**

(51) Int. Cl.<sup>6</sup>: **A24D 1/00, A24D 3/04**

(86) International application number:  
**PCT/CA92/00344**

(87) International publication number:  
**WO 93/02575 (18.02.1993 Gazette 1993/05)**

**(54) CONTROL OF CIGARETTE SMOKE CHEMISTRY**

**CHEMISCHE KONTROLLE DES TABAKRAUCHES**

**REGULATION DE LA CHIMIE DE LA FUMEE DES CIGARETTES**

(84) Designated Contracting States:  
**AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL  
SE**

(30) Priority: **08.08.1991 GB 9117118**

(43) Date of publication of application:  
**08.06.1994 Bulletin 1994/23**

(73) Proprietor:  
**Rothmans, Benson & Hedges Inc.  
North York (Toronto), Ontario M3B 3L1 (CA)**

(72) Inventor: **BRACKMANN, Warren, A.  
Collins, MO 64738 (US)**

(74) Representative:  
**Orr, William McLean et al  
URQUHART-DYKES & LORD  
5th Floor, Tower House  
Merrion Way  
Leeds West Yorkshire, LS2 8PA (GB)**

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**EP-A- 0 226 368                      EP-A- 0 364 253  
EP-A- 0 408 354                      WO-A-90/09741**

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**EP 0 599 897 B1**

## Description

[0001] The present invention relates to controlling the chemistry of cigarette smoke entering a smoker's mouth, to provide a desirable combination of high sensory appeal and low tar.

[0002] Tar is a component of cigarette smoke considered undesirable and attempts are continually being made to deliver lower quantities of tar to the smoker. Conventional procedures have included increased filtration and ventilation. However, only a certain level of filtration can be achieved with conventional filters before the pressure drop across the filter becomes unacceptably high.

[0003] Similarly, only a certain level of ventilation can be achieved before the cigarette smoke takes on an unacceptable "airy" taste. Generally, "low tar" cigarettes tend to be unpopular with smokers, since they fail to deliver sufficient flavour in the smoke to satisfy the smoker.

[0004] Another problem encountered by smokers is the increasing levels of tar and flavour delivered by a cigarette as it is smoked, sometimes reaching unacceptable levels in the later puffs.

[0005] EP-A-226,368 describes the provision of a cigarette in which the filler rod is formed from two different blends of tobacco and which has an approximately uniform delivery of flavour along its length. One of the blends is of high flavour-to-tar ratio tobacco, which may be leaves from the higher part of the plant. Such higher flavour-to-tar ratio tobacco is employed in the novel cigarette provided herein.

[0006] The present invention seeks to achieve a unique result, in providing the high flavour level associated with popular brands of cigarettes but at a significantly lower tar level. In addition, the present invention is able to provide a more uniform delivery of flavour and tar as the cigarette is smoked, as compared with a conventional cigarette.

[0007] According to the invention there is provided a cigarette smoke filter element, comprising:

an elongate plug of tobacco smoke filter material;  
an elongate cylinder of non-absorbent microfine fibres provided on said elongate plug and having a lesser resistance to the flow of cigarette smoke radially therethrough than longitudinally through said elongate plug; and,  
an axially-directed annular tobacco smoke flow path located radially outwardly of said elongate cylinder;  
characterised by:  
said axially directed annular tobacco smoke path having a lesser resistance to the flow of cigarette smoke longitudinally therein than longitudinally through said elongate plug; and,  
tobacco smoke flow path directing means located at the upstream end of said filter element in the

intended direction of flow of cigarette smoke thereto for directing cigarette smoke from a cigarette to which the filter element is attached only into said elongate plug of tobacco filter material.

[0008] Figure 1 is a graphical presentation of smoking test results.

[0009] The applicants have found that the ability of a tobacco leaf to produce tobacco type flavour increases as the tobacco plant is ascended and that the ability to produce tar from such leaves also increases but to a much lesser degree. In particular, it has been found that the greatest flavour/tar ratio of the leaves of a tobacco plant is provided by the tips of the highest leaves.

[0010] The flavour produced by tobacco from such leaves, or the tips, generally is too high to be acceptable to a smoker in a conventional cigarette and hence the tobacco usually is blended with tobacco from the whole plant to provide an overall lower flavoured tobacco blend. The applicants have found that it is possible to employ such strongly flavoured tobacco and not only achieve a flavour level comparable to that of popular brands, but thereby deliver a much lower level of tar, consistent with the higher flavour/tar ratio of smoke produced by such tobacco. Alternatively, a higher flavour level may be provided but at a lower or the same tar level, as required.

[0011] There is disclosed in EP-A-453,299, the use of non-absorbent microfine fibers in tubular form to achieve high levels of filtration. Such microfine fibers may be used herein to decrease the flavour level produced by the tobacco. As described therein, the microfine fibers in the cylinder thereof generally each has a diameter of about 0.5 to 10 microns. The cylinder of such fibers generally has a thickness of about 0.05 to about 4 mm and a density of about 0.05 to about 0.3 g/cc.

[0012] The smoke aerosol passing in contact with such filter material impinges on the non-absorbent fibers to cause tar particles to wet and adhere to the surface of the fibers as well as aqueous droplets of flavour components.

[0013] The elongate cylinder of microfine fibers preferably is arranged so that all the tobacco smoke passing through the filter containing the microfine fibers cylinder is directed through the cylinder wall. This result may be achieved by providing an outer annulus of high density conventional acetate filter tow material surrounding the microfine fiber cylinder, which in turn surrounds an inner core. A baffle, or other tobacco flow path directing means, is provided at the upstream end to direct tobacco smoke from the cigarette only into the high density material. Such a known filter structure is disclosed in PCT publication No. WO 90/09741.

[0014] As described therein, the microfine fiber cylinder is a highly efficient filtration medium but rapidly becomes clogged, so that the tobacco smoke must traverse an increasingly longer path through the outer

annulus of conventional tow material and is filtered thereby before passing through the wall of the cylinder of microfine fibers into an inner axial cigarette smoke flow path leading to the downstream end of the filter element. In this way, the filter achieves a greater degree of filtration of the tobacco smoke as smoking proceeds and hence tends to counteract the increasing level of flavour and tar delivery which results as smoking progresses, so that a more uniform flavour delivery to the smoker is achieved.

[0015] EP 364,253 describes a similar filter structure to that provided herein, in which an opening is provided through an elongate cylinder of microfine fibres. However, this opening is provided at the approximate midpoint of the length of the filler, rather than at the upstream end, and does not provide the initial high flavour puffs achieved herein.

[0016] In a further embodiment of the filter element according to the invention conventional cellulose acetate tow material is provided at the core of the filter element, with low flow resistance cellulose acetate tow being provided as the outer annulus. A baffle or other smoke path directing means can be provided to direct smoke into the central core.

[0017] In this novel filter arrangement, ventilation holes may be provided in the filter wrapper closer to downstream end of the filter than is normal to improve CO dispersion of carbon monoxide (CO). In general, ventilation decreases the CO content of the smoke entering the smoker's mouth.

[0018] The higher-than-normal flavour/tar ratio tobacco which is used in a cigarette for which the filter element is envisaged produces a higher-than-normal flavour level in the tobacco smoke from a burning cigarette containing the same. However, by using in the filter element a cylinder of microfine fibers, the flavour level of tobacco reaching the smoker's mouth from the burning cigarette is decreased to conventional levels. However, since the tobacco produces a higher-than-normal flavour-to-tar ratio smoke, this same ratio may be retained when the smoke reaches the smoker's mouth, so that a significantly lower tar delivery results while the same flavour level is achieved as in a conventional highly-flavoured brand of cigarette.

[0019] This result is achieved without the necessity for resorting to high pressure drop filtration or excessive ventilation, both of which are objectionable to a smoker, for the reasons outlined above and lead to a lower level of flavour delivery. The ability to provide a lower tar level for a particular flavour level to a smoker provides considerable versatility in achieving any desired combination of results.

[0020] The uniformity of delivery of the tobacco flavour to the smoker from a cigarette can be improved further by providing a greater proportion of more highly-flavoured tobacco towards the lighting end and a greater proportion of less highly-flavoured tobacco towards the filter end of the cigarette. As mentioned previously, the

flavour strength produced by a cigarette increases as smoking progresses. By providing the greater proportion of less highly-flavoured tobacco towards the filter end of the cigarette, this effect tends to be counteracted.

[0021] A filler rod containing a combination of differently-flavoured tobacco may be provided in the manner described in US-A-4,896,681. Alternatively, discrete segments of differently-flavoured tobacco may be employed in the filler rod.

[0022] It is preferred to employ the lesser flavoured blend in the form of expanded tobacco, since expanded tobacco exhibits a tendency to effect a greater degree of filtration of smoke components than non-expanded tobacco.

[0023] The present invention, therefore, provides a filter element for use with a cigarette, which, in combination, exhibit a high sensory appeal while delivering a low level of tar to the smoker with a more uniform flavour delivery, by a combination of factors, as follows:

1. Use in the tobacco blend from which the cigarette is formed of higher-than-normal quantities of tobacco from the upper levels of the tobacco plant, preferably their tips, which provides an initial high flavour-to-tar ratio, which then is maintained in the smoke delivered to the smoker, but at an acceptable attenuated flavour level;
2. Use of latter puff manipulation in the filter element to decrease the flavour level and tar produced by the latter puffs of smoking of the cigarette; and
3. Use of a flavour strength reset to attenuate the flavour strength of the smoke to the level desired by the smoker.

[0024] The latter puff manipulation with respect to the flavour and tar produced in the latter puffs of smoking the cigarette may be effected, as described above, by utilizing a smoke re-route filtration technique optionally in combination with using lesser strength tobacco at the filter end. Flavour strength reset is achieved, as described above, by utilizing a cylinder of microfine fibers as a filter element, optionally in combination with by using lesser strength tobacco at the filter end or preferably by using expanded tobacco at the filter end, or preferably a combination thereof. Preferably, all these factors are employed, with the cylinder of microfine fibers being incorporated into a smoke re-route filter and a higher proportion of lesser-flavoured expanded tobacco being used at the filter end and a higher proportion of the higher-than-normal flavour tobacco, possessing the high flavour-to-tar ratio, being used at the lighting end.

#### **EXAMPLE**

##### Example

[0025] Smoking tests were carried out to explore the effect of various manipulations of a cigarette. The

tar/puff values were plotted against puff number. The results obtained are plotted graphically in Figure 2.

[0026] The standard Benson & Hedges 100s (B & H) cigarettes (plot 3) increased from an initial tar level of 0.5 mg to a last puff tar level of 1.8 mg for a total of 13.1 mg. Using highly flavoured tobacco only with a standard filter from a Benson & Hedges cigarette produced plot 5, where the tar increased from a 1.0 mg level for the first puff to 3.0 mg for the last puff, for a total tar delivery of 22.5 mg, over twice that delivered by the standard B & H blend.

[0027] The highly flavoured tobacco was provided as a segment at the lighting end of the cigarette and a segment of expanded tobacco was provided at the filter end. Again a standard B & H filter was used. Plot (4) was obtained for this cigarette. In this instance, the tar rose from an initial level of 0.9 mg to 1.9 mg for the latter puff, for a total tar delivery of 12.5 mg, well below that for the highly flavoured tobacco above. A comparison of plots (4) and (5) illustrates the significant improvement in tar delivery which is attainable using a segment of expanded tobacco at the filter end of the cigarette filler rod. Both plots (4) and (5) exhibit a significant dip in the tar delivery during the middle puffs. The reason for this is unknown but is generally a characteristic of all cigarettes to some degree.

[0028] The highly flavoured tobacco used to prepare plot (5) again was smoked, but with the standard B & H filter being replaced by a filter comprising a cylinder of microfine fibers. In this case, plot (2) shown an increase from 0.3 to 1.7 mg during smoking for a total tar deliveries of 10.1 mg, i.e. significantly below the B & H value. A comparison of plots (2) and (5) illustrates the significant effect that the replacement of the conventional filter by one containing a cylinder of microfine fibers has on the tar delivery.

[0029] Finally, in plot (1), there is shown the tar delivery from a cigarette having a filter containing a cylinder of microfine fibers and containing a segment of expanded tobacco at the filter end. The tar increased from 0.2 mg for the first puff to 0.9 mg at the last puff, for a total tar delivery of only 4.7 mg.

[0030] A comparison of plots (1) and (4) illustrates the effect on tar delivery of the utilization of a filter comprising a cylinder of microfine fibers in place of a conventional filter. A comparison of plots (1) and (3) illustrates the effect on the tar delivery of the utilization of a cigarette constructed according to the present invention in comparison to a standard cigarette delivering the same flavour level. It will also be seen that, not only is a lower puff-to-puff level of tar delivery and an overall significantly lower tar delivery achieved, but the curve is flatter in the case of the present invention, so that a more uniform delivery of tar and flavour is achieved.

## Claims

1. A cigarette smoke filter element, comprising:

an elongate plug of tobacco smoke filter material;

an elongate cylinder of non-absorbent microfine fibres provided on said elongate plug and having a lesser resistance to the flow of cigarette smoke radially therethrough than longitudinally through said elongate plug; and, an axially-directed annular tobacco smoke flow path located radially outwardly of said elongate cylinder;

characterised by:

said axially directed annular tobacco smoke path having a lesser resistance to the flow of cigarette smoke longitudinally therein than longitudinally through said elongate plug; and, tobacco smoke flow path directing means located at the upstream end of said filter element in the intended direction of flow of cigarette smoke thereto for directing cigarette smoke from a cigarette to which the filter element is attached only into said elongate plug of tobacco filter material.

2. The filter element claimed in claim 1, characterised in that the elongate plug of tobacco smoke filter material is conventional cellulose acetate tow filter material.
3. The filter element claimed in claim 1 or 2, characterised in that said tobacco flow path directing means is provided by baffle means at said upstream end of said filter.
4. The filter element claimed in any one of claims 1 to 3, characterised in that said annular cigarette smoke path is provided by a low flow resistance cellulose acetate material.
5. The filter element claimed in any one of claims 1 to 4, characterised in that a plurality of ventilation openings is provided through an outer wrapper to said filter element in communication with said annular flow path to facilitate dispersion of carbon monoxide in cigarette smoke flowing in said annular flow path.
6. The filter element claimed in any one of claims 1 to 5, characterised in that at least one opening is provided through said elongate cylinder adjacent the upstream end of the filter element to permit preferential passage of cigarette smoke from said elongate plug through said at least one opening to said annular flow path during initial smoking of a cigarette to which the filter element is attached.
7. The filter element claimed in any one of claims 1 to 6, characterised in that tobacco smoke flow path blocking means is located at the downstream end of

the filter element to permit filtered tobacco smoke to pass only from the annular flow path.

8. The filter element claimed in any one of claims 1 to 7, characterised in that of the microfine fibres in said cylinder each has a diameter of 0.5 to 10 microns.

9. The filter element as claimed in any one of claims 1 to 8, characterised in that said cylinder of microfine fibres has a thickness of 0.5 to 4 mm and a density of 0.05 to 0.3 g/cc.

## Patentansprüche

1. Zigarettenrauchfilterelement, umfassend

einen länglichen Stopfen aus Tabakrauch-Filtermaterial;

einen länglichen Zylinder aus nicht-absorbierenden mikrofeinen Fasern auf dem länglichen Stopfen mit einem geringeren Strömungswiderstand für Zigarettenrauch in radialer Richtung als in axialer Richtung des länglichen Stopfens; und

einen axial gerichteten ringförmigen Tabakrauch-Strömungspfad radial außerhalb des länglichen Zylinders;

dadurch gekennzeichnet,

daß der axial gerichtete ringförmige Tabakrauchpfad einen geringeren Strömungswiderstand für Zigarettenrauch in Längsrichtung durch ihn als in Längsrichtung durch den Stopfen hat; und

daß Tabakrauchströmungspfadumlenkmittel in Strömungsrichtung mit Bezug auf die beabsichtigte Strömungsrichtung eingangsseitig des Filterelements vorgesehen sind, um den Zigarettenrauch einer Zigarette, an der das Filterelement angebracht ist, nur in den länglichen Stopfen aus Tabakrauchfiltermaterial zu richten.

2. Filterelement nach Anspruch 1, dadurch gekennzeichnet, daß der längliche Stopfen aus Tabakrauchfiltermaterial übliches Zelluloseazetat-Faserfiltermaterial ist.

3. Filterelement nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Tabakrauchströmungspfadumlenkmittel durch eine Ablenkplatte am Eingangsende des Filters gebildet sind.

4. Filterelement nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß der ringförmige Zigarettenrauchpfad von einem Zelluloseazetat-Material mit geringem Strömungswiderstand gebildet ist.

5. Filterelement nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß mehrere Lüftungsöffnungen in einer äußeren Hülle des Filterelements in Strömungsverbindung mit dem ringförmigen Strömungspfad zur Erleichterung der Verteilung von Kohlenmonoxid in durch den ringförmigen Strömungspfad strömenden Zigarettenrauch vorgesehen sind.

6. Filterelement nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß wenigstens eine Öffnung durch den länglichen Zylinder nahe dem eingangsseitigen Ende des Filterelements ausgebildet ist, um eine Vorzugsströmung für Zigarettenrauch aus dem länglichen Stopfen durch die wenigstens eine Öffnung zum ringförmigen Strömungspfad zu Beginn des Rauchens einer Zigarette, an der das Filterelement angebracht ist, zu erlauben.

7. Filterelement nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß Absperrmittel für den Tabakrauchströmungspfad am auslaßseitigen Ende des Filterelements vorgesehen sind, um gefilterten Tabakrauch nur durch den ringförmigen Strömungspfad durchzulassen.

8. Filterelement nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß von den mikrofeinen Fasern im Zylinder jede einen Durchmesser von 0,5 bis 10 µm hat.

9. Filterelement nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß der Zylinder aus mikrofeinen Fasern eine Dicke von 0,5 bis 4 mm und eine Dichte von 0,05 bis 0,3 g/cm<sup>3</sup> hat.

## Revendications

1. Élément de filtre pour la fumée de cigarette comprenant :

un tampon allongé d'un matériau de filtre pour la fumée de tabac;

un cylindre allongé de fibres microfines non-absorbantes fourni sur ledit tampon allongé et présentant une résistance à l'écoulement de la fumée de cigarette inférieure radialement à travers celui-ci que longitudinalement à travers ledit tampon allongé; et

une voie d'écoulement de la fumée de tabac annulaire, axialement dirigée, disposée radialement vers l'extérieur dudit cylindre allongé; caractérisé en ce que :

ladite voie pour la fumée de tabac annulaire, axialement dirigée présente une résistance à l'écoulement de la fumée de cigarette inférieure longitudinalement dans celle-ci que longitudinalement à travers ledit tampon allongé;

et

un moyen dirigeant la voie d'écoulement de la fumée de tabac disposé à l'extrémité amont dudit élément de filtre dans la direction projetée de l'écoulement de la fumée de cigarette pour y diriger la fumée de cigarette à partir d'une cigarette à laquelle l'élément de filtre est fixé uniquement dans ledit tampon allongé de matériau de filtre pour le tabac.

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2. Élément de filtre selon la revendication 1, caractérisé en ce que le tampon allongé de matériau de filtre pour la fumée de tabac est un matériau de filtre de filasse d'acétate de cellulose classique.

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3. Élément de filtre selon la revendication 1 ou 2, caractérisé en ce que ledit moyen dirigeant la voie d'écoulement du tabac est fourni par un moyen de déviation à ladite extrémité amont dudit filtre.

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4. Élément de filtre selon l'une quelconque des revendications 1 à 3, caractérisé en ce que ladite voie annulaire pour la fumée de cigarette est fournie par un matériau d'acétate de cellulose de faible résistance à l'écoulement.

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5. Élément de filtre selon l'une quelconque des revendications 1 à 4, caractérisé en ce que de nombreuses ouvertures de ventilation sont fournies à travers un emballage externe audit élément de filtre en communication avec ladite voie d'écoulement annulaire pour faciliter la dispersion du monoxyde du carbone dans la fumée de cigarette s'écoulant dans ladite voie d'écoulement annulaire.

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6. Élément de filtre selon l'une quelconque des revendications 1 à 5, caractérisé en ce que au moins une ouverture est fournie à travers ledit cylindre allongé, adjacente à l'extrémité amont de l'élément de filtre pour permettre un passage préférentiel de la fumée de cigarette à partir dudit tampon allongé à travers ladite au moins une ouverture vers ladite voie d'écoulement annulaire pendant la formation initiale de fumée d'une cigarette à laquelle l'élément de filtre est fixé.

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7. Élément de filtre selon l'une quelconque des revendications 1 à 6, caractérisé en ce qu'un moyen de blocage de la voie d'écoulement de la fumée de tabac est disposé à l'extrémité aval de l'élément de filtre pour permettre à la fumée du tabac filtrée de passer uniquement à partir de la voie d'écoulement annulaire.

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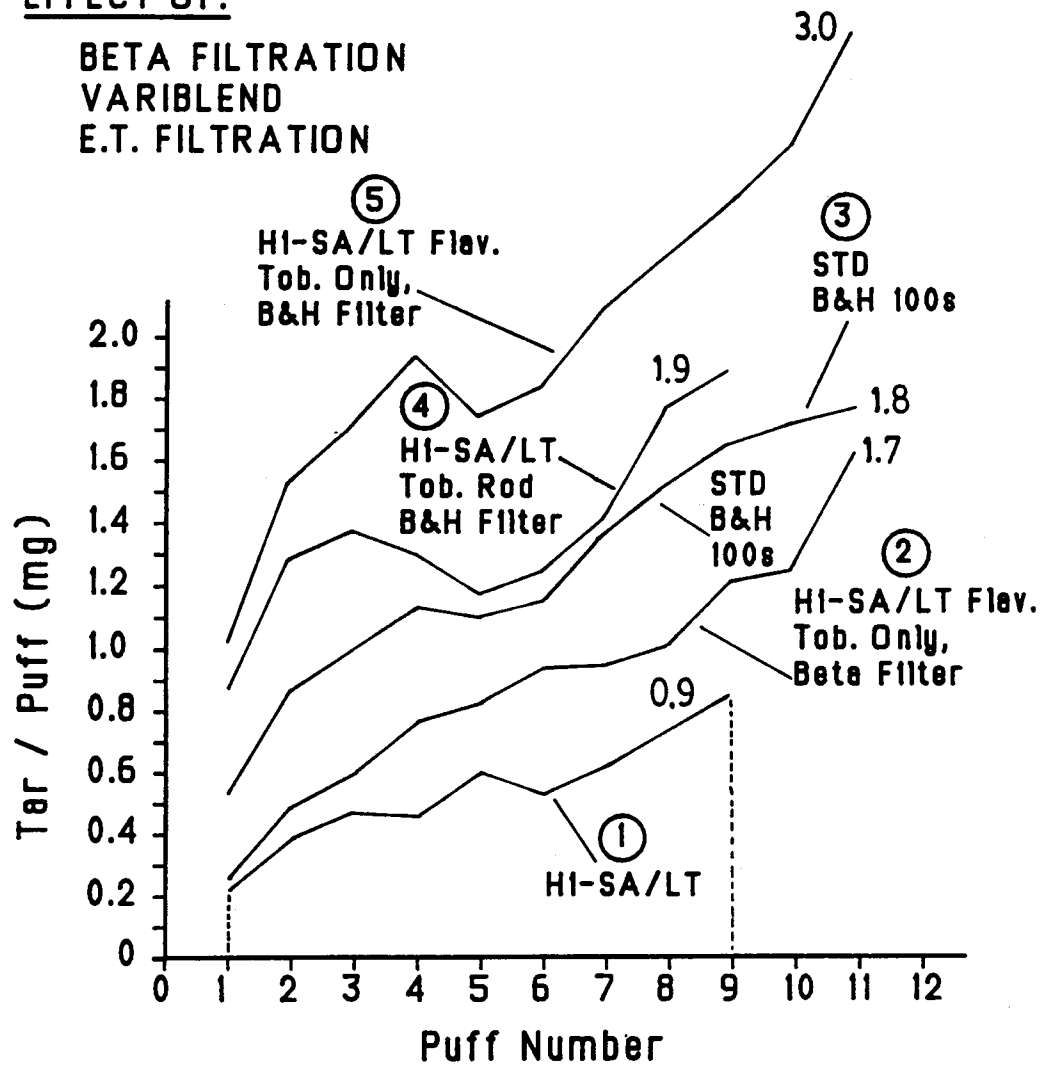
8. Élément de filtre selon l'une quelconque des revendications 1 à 7, caractérisé en ce que chacune des fibres microfines dans ledit cylindre présente un diamètre de 0,5 à 10 microns.

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9. Élément de filtre selon l'une quelconque des revendications 1 à 8, caractérisé en ce que ledit cylindre de fibres microfines présente une épaisseur de 0,5 à 4 mm et une densité de 0,05 à 0,3 g/cm<sup>3</sup>.

EFFECT OF:

BETA FILTRATION  
 VARIBLEND  
 E.T. FILTRATION



TOTAL TAR: ① 4.7 mg  
 ② 10.1 mg  
 ③ 13.1 mg  
 ④ 12.5 mg  
 ⑤ 22.5 mg

FIG.2.