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54 Cigarette filter rod elements and cigarettes incorporating such filter rod elements.

57 A cigarette filter rod element (1) having a flow path therethrough which includes a barrier in the form of a substantially planar disc (3) made from a layer of micro-fine fibres with a diameter of between 0.5 and 10 microns and provided with one or more flow openings (2) in the range of 0.1 mm to 3.0 mm in diameter with a combined total area of between 0.1 mm² and 10 mm².

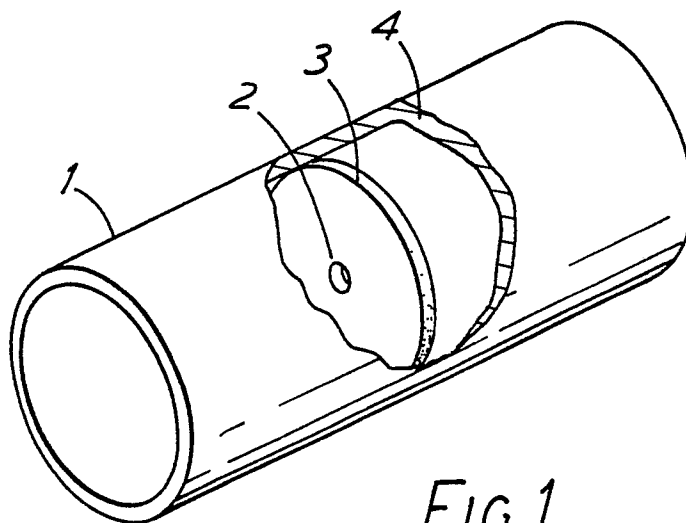


FIG. 1

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Cigarette Filter Rod Elements and Cigarettes Incorporating Such Filter Rod Elements

This invention relates to cigarette filter rod elements and cigarettes incorporating such filter rod elements.

It is well known that when either a smoker or a smoking machine smokes a conventional filter-tipped cigarette, the amount of 'tar' in each puff increases in each successive puff. The 'tar' yield of the last few puffs is usually several times higher than that from the first few puffs. Consequently the 'tar' in the last few puffs may be perceived by a smoker as 'too strong', and a smoker may therefore consider a cigarette as 'smoother' if the 'tar' delivery profile can be made more even.

There have been many attempts in the past to achieve an 'even' puff cigarette by modifying the filter. Mullor, U.S. Patent 2,763,267 and Clayton et al, U.S. Patent 3,809,097 proposed to use a plurality of discs to be placed inside a cigarette filter rod and placed transverse to the smoke flow. These designs, however, can only improve filtration efficiency, without any ability of evening the cigarette 'tar' profile.

Patterson, U.S. Patent 3,648,712 proposed to use a low gas permeability disc placed transversely inside an ordinary cellulose acetate filter rod. The disc is of a diameter which is 5 to 25 percent less than the diameter of the filter rod and this filter can therefore only achieve improved filtration efficiency, with no ability to even the 'tar' delivery profile.

B.A.T. GB Patent 1,339,238 proposed placing a disc of a blocking plug between a tobacco rod and an ordinary cellulose acetate filter rod. This disc has an orifice for smoke to flow through. The disadvantage of this design is that the pressure drop of the cigarette will increase to an unacceptable level as the orifice of the plug becomes clogged up at the later puffs.

Brackmann et al., U.S. Patent 3,882,877 proposed placing a disc of micro-fine fibres in between two filter rod segments. This filter is designed to increase filtration efficiency. However, it could not cause the 'tar' delivery to be more even, furthermore the pressure drop may increase to an unacceptable level at the later puffs.

Browne et al., U.S. Patents 4,460,000 and 4,469,112 proposed using a compound filter that contains a perforated barrier disc through which the whole smoke passes to a cellulose acetate filter rod segment. As the smoking process proceeds, more and more 'tar' builds up on the cellulose acetate fibres around the exit of the perforations. The disadvantage of this design is that the build-up of 'tar' near the perforations will greatly increase the flow resistance of the cigarette filter to an unacceptable level.

G.B. Patent 2 102 271 A, G.B. Patent 2,103,065 A and G.B. Patent 2 105 566 A of Filtona (U.K.), proposed to employ two flow paths, i.e. the low pressure drop path which has low filtration efficiency and the high pressure drop path which has high filtration efficiency, for the smoke to flow in a filter rod. During the initial few puffs of a cigarette, the smoke tends to flow through the low pressure drop path. The smoke then switches to flow through the high pressure drop path due to the presence of a blocking mechanism on the low pressure drop path. The disadvantage of these filters is that they are very complicated and difficult to manufacture.

It is the objective of the present invention to provide a cigarette with a more even puff-by-puff 'tar' delivery profile and with an acceptable pressure drop by the use of a special cigarette filter.

The term "filter rod element" will be used herein to define an element which may form part of a filter rod for attachment to a cigarette, or which may itself provide the whole filter rod.

A cigarette filter rod element can be formed comprising a cylindrical hollow tube with a disc of fibrous material placed inside it and which provides the whole filter rod. If the edge of the disc is in tight contact or sealed with the inside wall of the hollow tube, the smoke that enters one end is confined to flowing through the disc and out through the other end of the tube. The disc can be made of at least one layer of micro-fine fibres of which the average diameter is in the region of 0.5 to 10 microns.

When a filter rod element as set forth is in abutment with a tobacco rod, it forms a filter-tipped cigarette. When this filter-tipped cigarette is smoked, the smoke stream flows through the hollow tube without being filtered until it reaches the disc. When the smoke stream passes through the disc, it enters into the layer of micro-fine fibres, which can be randomly oriented or oriented in any other particular way, and a fraction of the smoke particulates will be collected by the fibres by the commonly known mechanisms such as diffusion, impaction, interception etc. That is to say, this disc has a certain level of filtration efficiency to filter out the smoke particulates. As is well known in the art of fibrous filtration, the filtration efficiency can be increased greatly when the voidage between the micro-fine fibres is reduced due to the accumulation of collected smoke particulates. Consequently, the layer of micro-fine fibres will be quickly clogged up and the pressure drop across the disc will increase to a very high and unacceptable level. Surprisingly, it has been found that if one or more suitably sized apertures are provided in the disc, no

matter whether the apertures are at the centre or any other particular location, the disc does not clog up and the pressure drop across the disc only increases, if at all, to a very moderate and still acceptable level. There will always be a fraction of the total smoke stream which passes through the apertures without being filtered by the micro-fine fibres. These apertures therefore act as a controlled leakage venue for the smoke stream so that the disc is not clogged up by the accumulated smoke particulates. Due to the discovery of a particular range of packing density and thickness of these micro-fine fibres, and together with the novel concept of providing one or more apertures on the said disc, the filter rod as set forth above will increase in filtration efficiency as the smoking proceeds without the usual enormous increase in the pressure drop. As the filtration efficiency at the last few puffs is markedly higher than during the early puffs, less 'tar' is being delivered to the smoker's mouth at that stage. A smoker will therefore experience a much more even taste as compared with the experience from a conventional filter-tipped cigarette with a similar total 'tar' yield.

According to the present invention therefore, a cigarette filter rod element has a flow path therethrough which includes a barrier in the form of a substantially planar disc made from a layer of micro-fine fibres with a diameter of between 0.5 and 10 microns and provided with one or more flow openings in the range 0.1 mm to 3.0 mm in diameter with a combined total area of between 0.1 mm² and 10 mm².

Preferably the layer of micro-fine fibres has a packing density of 0.05 to 0.3 and the thickness of said layer is between 0.05 and 4 mm.

The invention also includes a cigarette incorporating a filter rod element as set forth above.

The invention can be performed in many ways and some embodiments will now be described by way of example and with reference to the accompanying drawings in which:

Figure 1 is a perspective view, with parts broken away for clarity, of a cigarette filter rod element according to the present invention;

Figure 2 is a cross-sectional view of a cigarette provided with the filter rod element shown in Figure 1;

Figure 3 is a cross-sectional view of another embodiment of a cigarette provided with the filter rod element according to the present invention;

Figure 4 is a perspective view of a commercially available laminate containing micro-fine fibres;

Figure 5 is a perspective view of a sandwiched board using the laminate shown in Figure 4;

Figure 6 is a perspective view of a filter rod element obtained from the sandwich shown in Figure 5;

Figure 7 is a perspective view of another embodiment of an alternative form of sandwich board;

Figure 8 is a perspective view of a double-unit filter rod segment obtained from the 'sandwich' board shown in Figure 7;

Figure 9 is an enlarged cross-sectional view of the filter rod element shown in Figure 6;

Figure 10 is a longitudinal cross-sectional view of a multiple length rod from which the filter rod elements shown in Figure 12 are cut;

Figure 11 is a cross-sectional view of the filter rod shown in Figure 8;

Figure 12 is a cross-sectional view of another embodiment of a cigarette provided with a filter rod element according to the present invention; and

Figure 13 is a cross-sectional view of another embodiment of a filter rod element according to the present invention;

As shown in Figure 1, a cigarette filter rod 1 is formed from an element which comprises a tube 4, a barrier disc 3 provided with an aperture 2 and made from a layer of micro-fine fibres between 0.5 to 10 microns diameter. The tube 4 may be made of any convenient material such as paper or plastics material. The edge of disc 3 is in close contact with the inside wall of the tube 4 so that end-to-end flow path communication through the tube has to pass through disc 3. The aperture 2 can be a single aperture or up to ten apertures, between one and three apertures being preferred. A single aperture may be located conveniently at or around the centre of the disc. If multiple apertures are used, they may be spread evenly on the disc or around the centre, and each individual aperture may be different in size and shape to the others. The disc may be made of a plurality of layers of fibres, at least one layer being of micro-fine fibres of 0.5-10 microns in diameter.

The aperture or apertures act as a flow opening and are 0.1 mm to 3.0 mm in diameter with a combined total opening area of 0.1 mm² to 10 mm². The layer of micro-fine fibres has a packing density of 0.05 to 0.3 and the thickness of said layer is between 0.05 mm and 4 mm.

Figure 2 shows a cross-sectional view of a cigarette provided with the filter rod 1 formed from the element shown in Figure 1. Wrapped tobacco rod 6 is shown abutting the filter rod 1, the two being held in place by a tipping paper 5.

Figure 3 shows another embodiment of the present invention in which a filter rod 11 consists of two filter rod elements, one of which is provided by an element 1 and the other by a plain element 7, abutting

each other and which are held together by a plug wrap 10. The plain element 7 has a filling of known filter material 9, for example cellulose acetate tow with the fibres extending predominately axially along its length, or has non-woven fibrous material such as DANAKLON ES. and is enclosed by a wrapper 8. The filter rod 11 and the tobacco rod 6 abut each other and are held in place by a tipping paper 5. The use of plug wrap 10 may not be necessary if the tobacco rod 6, and the two elements are all combined together at the same time in a suitably designed cigarette making machine. The plain element 7 is at the mouth end of the cigarette but the filter is equally effective if the elements are reversed. It will be seen that in effect this arrangement provides a filter rod having an outer tube formed by wrapper 8 and tube 4, a barrier 3 and the combined tube on one side of the barrier containing a porous material.

Figure 4 is a perspective view of a commercially available laminate fabric known as EHP (also known as EVOLUTION, KIMGUARD) made by Kimberly-Clark, USA. Other similar laminates which are equally suitable are SMS, BLUE DRAPE, LX43, LX293, LX274, LX275, LX276 all made by Kimberly-Clark. The laminates comprise three layers. Layer 15 consists of meltblown micro-fine polypropylene fibres with a fibre diameter ranging from 1 micron to 8 microns, the majority being 1 to 3 microns. Layers 14 and 16 consist of coarse polypropylene fibres of around 20 microns diameter which are employed to protect the integrity of the micro-fine fibres. Layers 14, 15 and 16 are point-bonded by either thermal or ultra-sonic techniques or any other suitable technique. The shaded area 17 represents the locations where point-bonding takes place, and may appear as square or round dots, or any other shapes arranged in any convenient or artistic pattern. One grade of EHP laminate which has been tested and proved to be effective has a total thickness of 0.5 mm, a total fabric weight of 60 g/m² and the three layers being approximately the same thickness. Each layer has about equal fabric weight of 20 g/m².

As will be appreciated by those familiar with the art of making cigarette filters with high speed machinery, it will be very difficult to insert a thin, flexible and relatively fragile disc of a fabric material inside a tube with acceptable consistency. It is therefore advantageous to improve the handlability of a laminate fabric that contains micro-fine fibres such as EHP. One way is to sandwich the laminate such as EHP between two layers of substantially supportive porous rigid material as shown in Figure 5 in which layer 21 represents a layer of micro-fine fibres or a layer of laminate. Layer 21 is sandwiched by layers 20 and 22 which can be any material that is porous and sufficiently rigid and strong to be handled by modern filter-making machinery. One suitable material is a non-woven fabric, for example, DANAKLON ES (Polypropylene/polyethylene bicomponent fibres, 20 decitex, made by Danaklon, Denmark) which can be used as layers 20 and 22 and EHP fabric used as layer 21. By selecting the right temperature, pressure and duration, these bicomponent fibres together with EHP fabric will form a rigid sandwich board 19 as shown in Figure 5. Furthermore, the EHP fabric will be thermally bonded to layers 20 and 22 during this process. The combined weight of this sandwich board can be typically 2000-3000 g/m², having a total thickness L of 10-15 mm with acceptable mechanical rigidity and strength. Thicker sandwich board can be made by an increase of the total fibre weight. The layer 21 may be perforated with apertures of suitable size at pre-determined locations before it is sandwiched. A rod element can then be obtained from this sandwich board 19 by punching perpendicularly through the board as shown at 23 with the necessary aperture of layer 21 situated approximately at the centre of the punched rod element. A rod element 25 obtained in this way is shown in Figure 6. Alternatively, the sandwich board 19 can be made with layer 21 unperforated, the necessary apertures on layer 21 have to be made by drilling through either layer 20, or layer 22, or both layers. A laser beam, a hot needle or any other suitable techniques may be employed for this purpose. The rod elements, similar to rod element 25, can then be obtained similarly by punching method described above. Figure 9 shows a cross-sectional view of a rod element obtained in this way. The channel 24 is made during the process of making the aperture on layer 21 by a laser beam or a hot needle and is shown to extend from layer 20, through layer 21, and penetrating into layer 22. This channel 24 will not affect the effectiveness of the micro-fine fibres.

After the rod element 25 shown in Figure 6, or the rod element shown in Figure 9 has been wrapped with a suitable plug wrap, it suitably forms a filter rod, which can be employed to replace filter rod 1 in Figure 2, or Figure 3, to form a filter-tipped cigarette.

Figure 7 shows another embodiment of a sandwich board from which filter rod segments can be obtained. In this embodiment, layer 31 is the rigid and porous material, being sandwiched between two layers 30 of micro-fine fibres or laminate fabric such as EHP. Layer 31 can be any material which is porous, rigid and strong such as the non-woven fabric made from DANAKLON ES bicomponent fibres. The sandwich board 34 can be obtained in a way similar to that of sandwich board 19 and materials in layers 30 and 31 may be bonded together to form a rigid board by applying a suitable temperature and pressure, or any other suitable methods, such as chemical binding, application of adhesive, mechanical stitching etc. Once a board of suitable stability and rigidity is made, the filter rod segments can be obtained by punching

through the board perpendicularly as indicated at 33. For example, filter rod element 35 is obtained in this way and is shown in Figure 8.

The filter rod element 35 consists of layers 30 of micro-fine fibres or the laminate fabric and layer 31. The aperture 2 can be drilled by a conventional method such as a laser beam or a heated needle either before, during or after the filter rod segments 35 are punched out of the sandwich board 34.

Figure 11 is a cross-sectional view of the filter rod obtained from sandwich board 34. Channels 40 are made either by a laser beam or a hot needle during the process of making aperture 2 as described above. The length of the channels 40 may be minimal or may be as long as the thickness of layer 31 but will not affect the effectiveness of the filter rod.

Figure 10 shows how a continuous multiple filter rod is assembled so that a convenient multiple filter rod length can be cut from it. For example, a 6-up filter rod is very commonly used in many modern cigarette-making machines. Length M represents the length of a single filter rod and length N represents the common 6-up filter rod. The dual filter rod as indicated as length M may be combined with tobacco rod 6 as shown in Figure 12 to form a filter-tipped cigarette. The tobacco rod 6 can be in abutment either with the end containing material 31 or material 9 with the same effect.

Figure 13 shows another embodiment of a filter rod element according to the present invention. DISC 3 is made of micro-fine fibres or a laminate fabric which contains at least one layer of micro-fine fibres and has an uneven surface.

Tip ventilation holes as indicated by reference numeral 45 in Figures 2, 3 and 12 may be provided to form either a tip-ventilated filter rod, or a tip-ventilated filter-tipped cigarette.

Example

Table 1 shows the comparison of puff-by-puff 'tar' yields from a conventional filter-tipped cigarette and that from a cigarette fitted with the present invention, the 'tar' yield profile of the experimental cigarette is clearly much flatter in terms of 'tar' delivery than that of the conventional filter-tipped cigarette.

TABLE 1

COMPARISON OF PUFF-BY-PUFF 'TAR' YIELDS		
	(1) 'TAR' PER PUFF (mg)	
PUFF NO	(2) CONTROL CIGARETTE	(3) CIGARETTE FITTED WITH EXPERIMENTAL FILTER
1	0.48	0.64
2	0.62	0.83
3	0.64	0.88
4	0.66	0.96
5	0.93	0.98
6	1.04	1.07
7	1.12	1.16
8	1.17	1.16
9	1.25	1.24
10	1.59	1.29
Notes:		

(1) Weight of 'tar' without water and nicotine.

(2) Conventional filter-tipped cigarette; filter rod is made with cellulose acetate tow, 2.7 denier per filament, 35,000 total denier.

(3) Experimental cigarette consists of the tobacco rod as that of the control, but fitted with a filter rod as shown in Figure 12. Material 9 is cellulose acetate tow, 8 denier per filament, 30,000 total denier. The layer 30 is the EHP fabric (60 g/m²), the size of aperture 2 is 0.8 mm diameter. Layer 31 is made of DANAKLON ES fibres.

Claims

1. A cigarette filter rod element having a flow path therethrough which includes a barrier in the form of a substantially planar disc made from a layer of micro-fine fibres with a diameter of between 0.5 and 10 microns and provided with one or more flow openings in the range of 0.1 mm to 3.0 mm in diameter with a combined total area of between 0.1 mm² and 10 mm².
2. A cigarette filter rod element as claimed in claim 1 in which the layer of micro-fine fibres has a packing density of 0.05 to 0.3 and the thickness of said layer in between 0.05 mm and 4 mm.
3. A cigarette filter rod element as claimed in claim 2 in which the surface of the disc is uneven.
4. A cigarette filter rod element as claimed in claim 1, claim 2 or claim 3 in which said disc is located between layers of porous material to form a laminate barrier.
5. A cigarette filter rod element as claimed in claim 4 in which said porous material comprises coarse fibres of 20 microns or more in diameter.
6. A cigarette filter rod element as claimed in claim 4 in which said porous material comprises layers of granular material (e.g. plastics material beads).
7. A cigarette filter rod element as claimed in claim 4 in which said porous material comprises a foamed material (e.g. polypropylene).
8. A cigarette filter rod element as claimed in claim 4, 5, 6 or 7 in which said porous material is provided with apertures.
9. A cigarette filter rod element as claimed in claim 8 in which said disc is located in a tube which provides said flow path from end to end thereof and which is provided by a plug wrap or a separate member.
10. A cigarette filter rod element as claimed in claim 9 in which said separate member is made from a synthetic plastics material card or paper.
11. A cigarette filter rod element as claimed in claim 9 or claim 10 in which said tube contains a porous material on at least one side of the barrier.
12. A cigarette filter rod element as claimed in claim 11 in which said porous material is cellulose acetate tow material with the fibres extending predominantly axially along the tube, or non-woven fibrous material, (eg DANAKLON ES) (eg a conventional filter tip segment).
13. A cigarette filter rod element as claimed in claim 11 or claim 12 in which said barrier is formed from a sheet of sandwiched board comprising said layer of micro-fine fibres or said laminate sandwiched between layers of substantially rigid porous support material (e.g. DANAKLON).
14. A cigarette filter rod element as claimed in claim 13 in which the flow opening in the micro-fine fibre layer is formed by a hot needle or laser beam.
15. A cigarette filter rod element as claimed in claims 4 to 12 in which said barrier is formed from a sheet of sandwiched board comprising two layers of micro-fine fibres or said laminate between which is sandwiched a layer of substantially rigid porous support material, said board being cut to provide double unit filter rod segments which are alternately assembled together with filter rod elements of porous fibrous materials and wrapped to form a multiple length of cigarette filter rods which are then cut across the centre of each element to provide individual filter rods comprising half of each double unit filter rod element and half of said fibrous filter rod element.
16. A cigarette incorporating a filter rod element as set forth in any one of the preceding claims.

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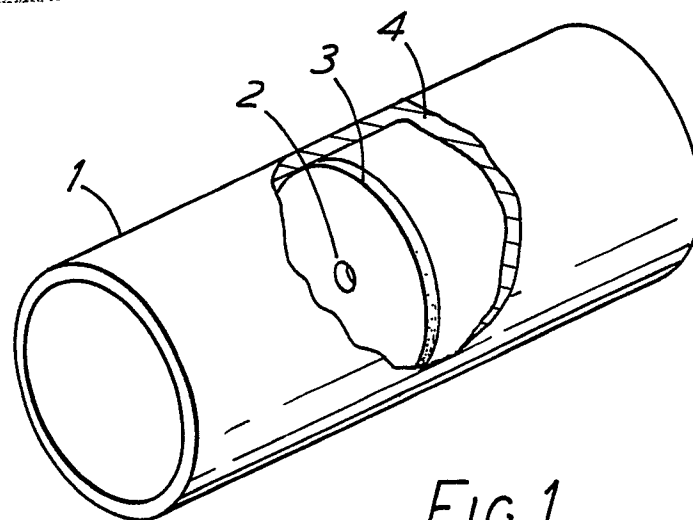


FIG. 1

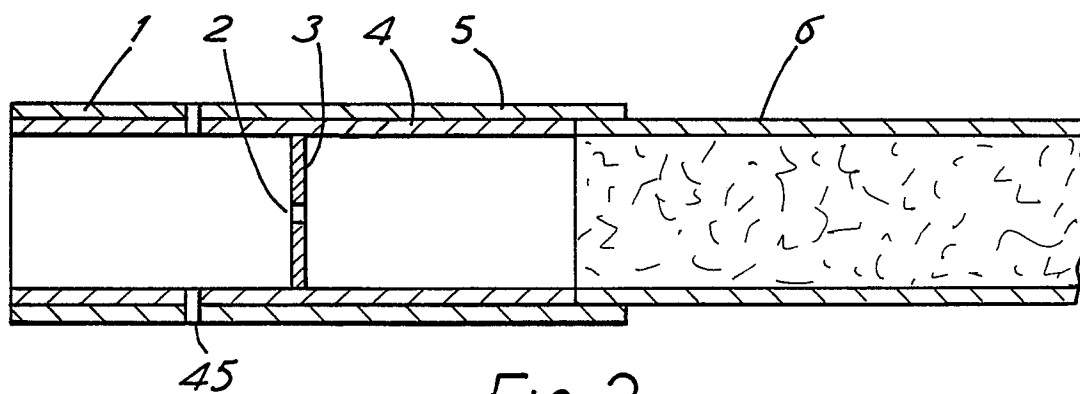


FIG. 2

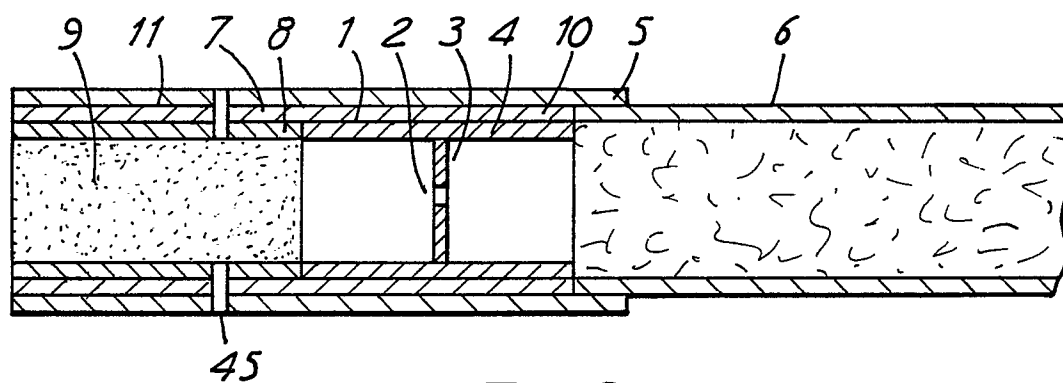


FIG. 3

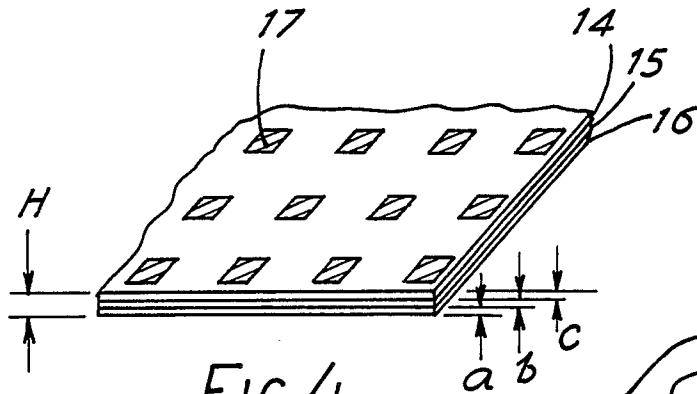


FIG. 4

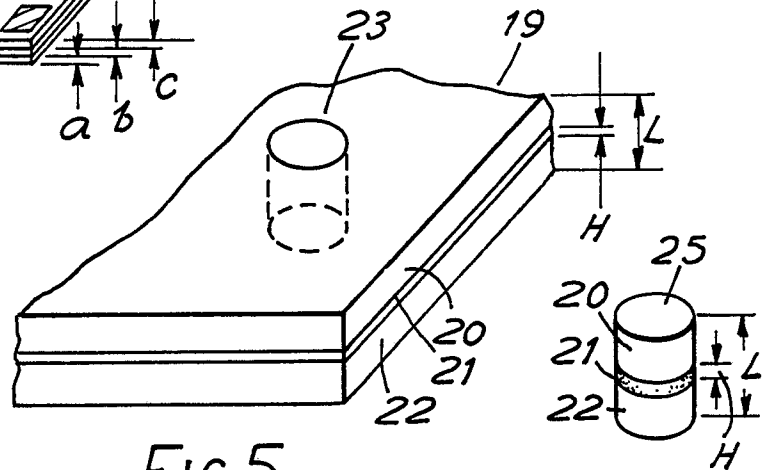


FIG. 5

FIG. 6

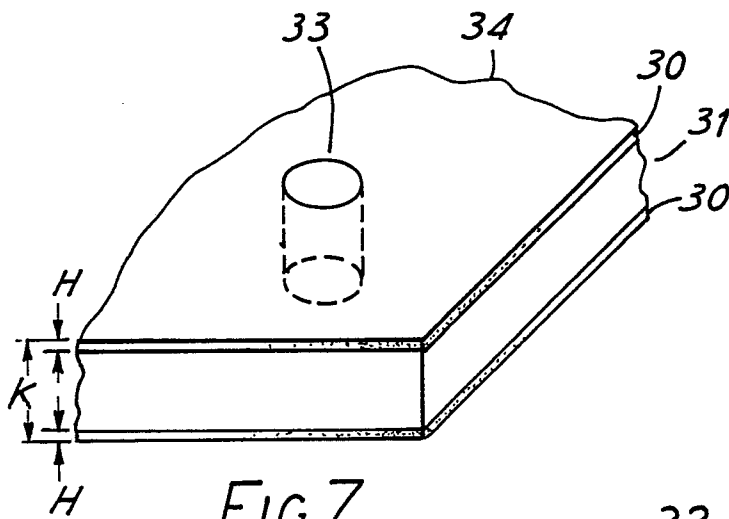


FIG. 7

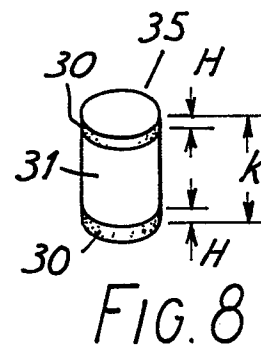


FIG. 8

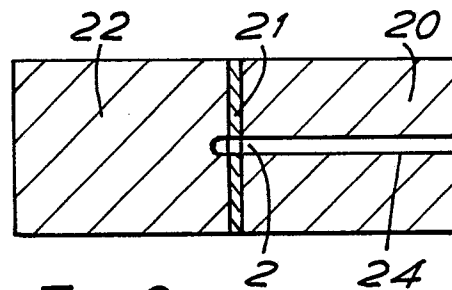
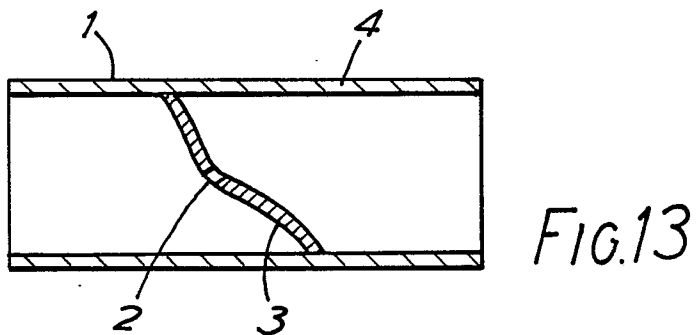
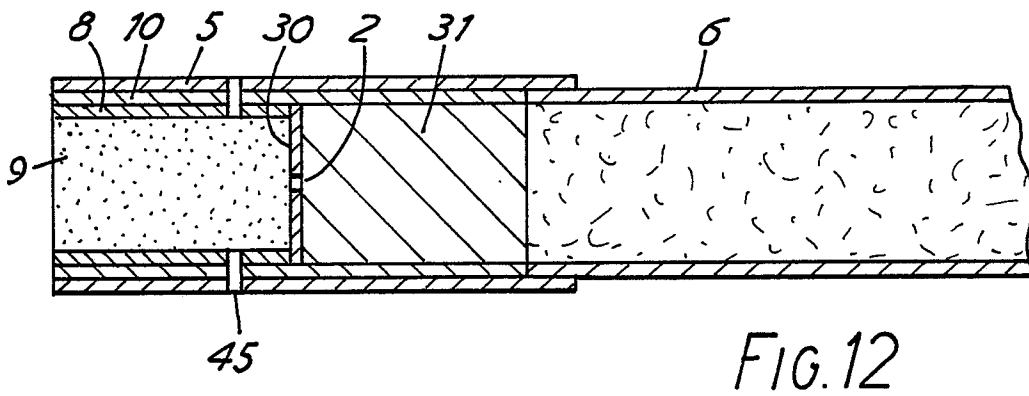
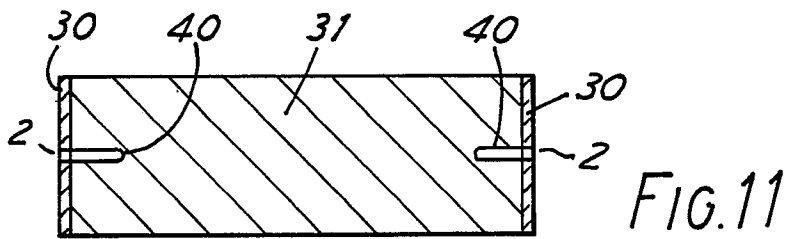
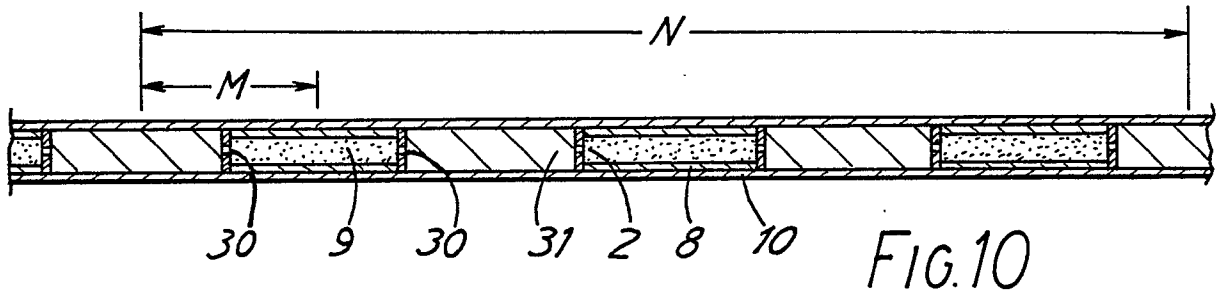


FIG. 9

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EP 89 31 0430

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-254004 (RHODIA AG) * abstract * ---	1	A24D3/04
A	DE-A-2243349 (BRITISH-AMERICAN TOBACCO CO. LTD) * page 2, line 4 - page 3, line 14; figure 1 * ---	1, 4	
A,D	US-A-4469112 (BROWNE) * abstract; figures 1, 2 * ---	1	
A	EP-A-213081 (BAUMGARTNER PAPIERS S.A.) * page 5, line 16 - page 8, line 26; figures 1-3 * ---	1	
A	US-A-4059121 (BRACKMANN) * abstract; figure 1 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			A24D A24C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 16 JANUARY 1990	Examiner RIEGEL R.E.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	