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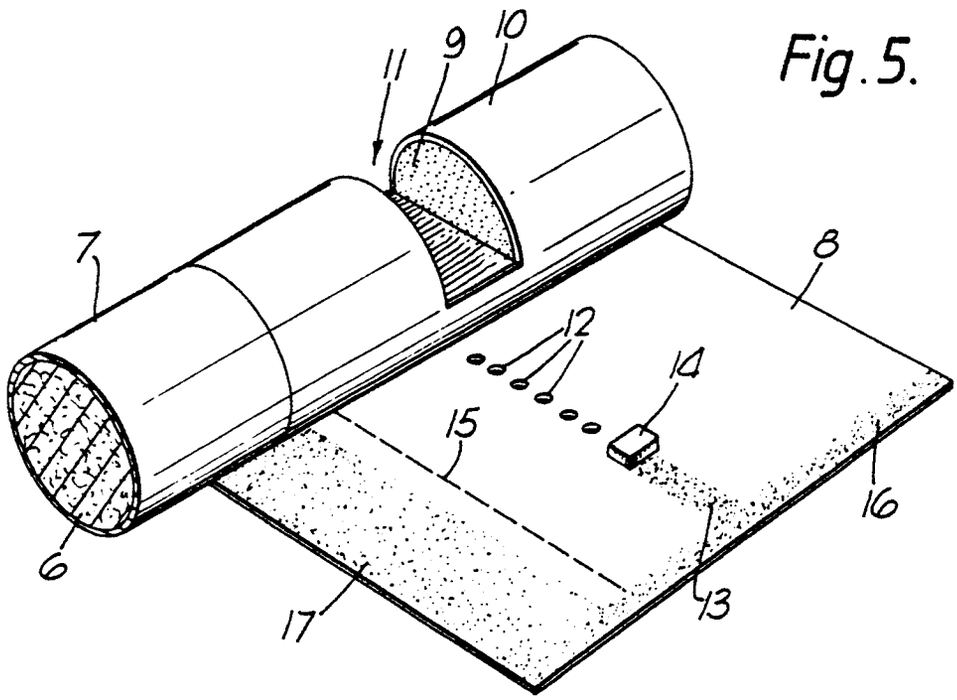
(54) **Filter device for smoking rod.**

(57) A filter device for a smoking rod has a notch (11) formed in a plug core (9) and plugwrap (10). Air may be drawn into the core (9) through an air-permeable tipping wrapper (8). The filter efficiency, smoke dilution and draw resistance of the filter device can be controlled by varying the number and shape of the notches. The invention also provides for the smoke dilution to be variable under the control of the smoker by arranging for the air-permeable part of the tipping wrapper (8) to be rotatable into and out of alignment with the notch (11), with the extent of rotation limited by a projection (14) formed on the inner surface of the wrapper (8) and located in the notch (11).

Fig. 5.



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FILTER DEVICE FOR SMOKING ROD

Conventional filter devices for the buccal end of a cigarette or other smoking rod comprise a cylindrical plug of filter material, such as a tow of cellulose acetate fibres, which may be wrapped in a plugwrap and then united to a tobacco rod of the smoking rod by a surrounding tipping wrapper, which may be porous or perforated to allow ventilating air into the filter plug. Very many proposals have been made for engineering such filter devices, by the provision of grooves and cavities for controlling the pressure drop and dilution of the smoke drawn through, and the filter efficiency of, the plug. The present invention relates to a novel arrangement for improving such characteristics of the device.

It is known from GB-A-l336465 to form longitudinal indentations in the opposite sidewalls of a filter plug to promote smoke flow through and between the indentations, but there is no suggestion of providing an air permeable surrounding tipping wrapper for the ingress of ventilating air into the indentations. GB-A-2066648 and GB-A-2ll5678 disclose the formation in the peripheral surface of a filter plug of grooves which are in alignment with perforated portions of a surrounding tipping wrapper, for the ingress of ventilating air. However in the former disclosure, the grooves are only intended to provide an annular opening through the air impermeable plugwrap, and are formed by rotating the wrapped plug through 360° relatively to a cutting device. This rotation of the wrapped plug is difficult to achieve in practice in conjunction with a high speed filter making machine. In the latter disclosure, the grooves extend essentially axially, with a small helical component, and the walls of the groove are sealed except at their downstream ends, the purpose being to cause the ventilating air passing into the plug along the grooves to swirl and cool the smoke within the plug. In neither case are the grooves intended to provide cavities within the filter plug for the control of pressure drop and filter efficiency.

In another known construction, the filter plug is divided into at least two axially spaced sections with a cavity between the sections. Assembly of this type of device is difficult and the existence of the cavity demands an extra stiff plugwrap if the existence of the cavity is to be disguised from the smoker handling the buccal end of the smoking rod.

In accordance with the present invention, a filter device for the buccal end of a smoking rod comprises a cylindrical plug of filter material, which is provided at its periphery with at least one notch formed by cutting away part of the filter material, the notch extending only part way around the circumference of the plug and the plug being surrounded by a tipping wrapper which is permeable to air, at least where it overlies the notch, for the ingress of ventilating air into the notch and hence into the plug.

One important advantage of this arrangement is that the notch may be cut very simply by holding the filter plug, or part of a filter rod from which the plug is to be cut, along one side, for example by vacuum retention in a groove at the periphery of a drum, and cutting the notch across the diametrically opposite side of the plug or rod by means, for example, of a mechanical or laser cutter. Thus rotation of the drum may carry the plug or rod past a cutter at a cutting station. The notch may be cut at the filter making machine, or as a separate operation between the filter making and cigarette tipping. Preferably, however the notches are cut during otherwise conventional cigarette tipping, where the filter rod is being cut into individual or multi-length tips.

A second important advantage is that, in the conventional case in which the plug is wrapped in a plugwrap, the sheet forming the plugwrap may be air-impermeable, or of uncertain or variable air-permeability, because the plugwrap will be cut away with the filter material at the notch so that there is completely free access for ventilating air through the tipping wrapper and into the cavity formed by the notch.

A third important advantage is that the required pressure drop and filter efficiency, in the filter plug upstream of the cavity formed by the notch, alongside the cavity, and downstream of the cavity, can be finely tuned by the almost infinite choice of appropriate notch shape and size. Thus if the notch is cut by a milling tool, the notch can be given any shape of cross-section by appropriate choice of the shape of the milling tool.

Milled notches have the advantage that the circumferential ends of the notches, where they open into the periphery of the plug, will be generally square so that the axial width of the notch where it opens into the periphery of the plug will be substantially constant around the circumferential extent of the notch. As a result, slight axial misalignment with a circumferentially extending row of ventilating perforations in the tipping wrapper will not affect the number of perforations which are exposed to the notch and hence the

quantity of ventilating air admitted. However, milling tools have the disadvantage that, with some filter materials, they may tend to drag fibres of the material to the edges of the notch where they project slightly at the periphery of the plug. This can lead to assembly problems when the plug is subsequently united to a tobacco rod by the surrounding tipping wrapper.

An alternative way of forming a notch, of V section, involves the use of a cutter consisting of a pair of rotating disk knives working at an angle to one another or even a single disk knife if the notch is cut obliquely at an end of the filter plug. The material removed to form the notch then comes away cleanly.

The formation of at least one of the notch sidewalls in an oblique plane which is inclined to a radial plane perpendicular to the axis of the plug, as would inevitably occur when a notch is V-shaped, leads to a number of advantages, particularly in the extra possibilities of fine tuning the desired characteristics. This is because the smoke takes a path of least resistance, so passing through the cavity unevenly. Most of the smoke passes across the cavity at its widest point, and least at its narrowest point. In the case where the upstream wall is oblique, smoke and air mixing would also be assisted by the tendency for the smoke to leave the upstream wall of the notch at an angle. Filter efficiency for a given resistance to draw is also higher with oblique notch walls particularly when the filter plug is of fibrous material. This is because smoke enters or leaves the oblique walls of the notch at an angle to the fibres of the filter plug which are conventionally parallel to the axis of the plug. Smoke particles crossing fibres at an angle are more efficiently removed than those travelling parallel to the fibres. Furthermore, some of the ventilating air entering the notch through the tipping wrapper causes smoke to deposit on the base of the notch, particularly when the notch faces are oblique, hence increasing filtration efficiency by impaction/condensation of smoke particles on the fibres.

Some experimental results are presented in the following table:-

Number of Notches	Pressure drop along filter Pa	Filter length mm	Filter efficiency % of dry tar removed from smoke
0	902	25.0	53
1	902	26.5	55
2	902	28.0	58

The filter plug was 7.85mm in diameter and made of a fibrous acetate core surrounded by an impermeable plug wrap. The tipping wrapper around the plug contained no perforations but was permeable to the extend that, with a notch or notches present, approximately 35% of the air drawn out of the filter had entered through the tipping wrapper. Each V-shaped notch had a maximum depth of 3mm, a maximum axial width of 4mm and an included angle of 53° between the two side walls, one of which lay in a radial plane normal to the filter axis. The two notches were formed on opposite sides of the filter with their radial plane side walls facing one another but axially offset by lmm.

When the notch is cut across one side of the plug, the base of the notch will generally extend across a chord of the circular cross-section of the plug. Some deviation from this may of course occur if, for example, the plug is held in the grooved periphery of a drum which rotates to carry the plug past a cutter at a stationary cutting station. In general, however, in order to provide a cavity of sufficient volume significantly to affect the pressure drop and filter efficiency characteristics, the maximum depth of the notch will be at least lmm, preferably at least 2mm. The depth will not normally however be greater than the radius of the plug, at least when the notch is spaced from the ends of the plug, so that there is sufficient filter material alongside the notch to provide a firm and stiff interconnection between the filter material at the ends of the plug on each side of the notch. The volume of filter material removed in the formation of the notch is

important as the resulting cavity must have sufficient volume to allow adequate development of turbulence of the ventilating air, and hence adequate mixing of smoke and air. The volume of material removed is also important in terms of residual filter efficiency and resistance to draw, that is pressure drop, and, as already mentioned, filter rigidity.

There may be more than one axially or angularly offset notches.

The notch of a filter device in accordance with the invention is additionally useful in the adaptation of the device to a variable ventilation, that it to say a variable dilution, filter device. Variable dilution filter devices are known. For example, US-A-4433696 discloses a device with a multi section filter plug, one of the sections being axially displaceable, upon tapping the device, within an outer plug wrap, to close to a variable extent ventilating holes in a surrounding tipping wrapper. Such a construction is difficult to assemble and tolerances are critical if the movable section of the filter plug is not to be displaced inadvertently, thereby accidently varying the ventilation characteristics, or to be jammed immovably.

EP-A-0100215 and EP-A-0105682 disclose arrangements in which at least a perforated part of an outer tipping wrapper is rotatable relatively to a perforated plugwrap whereby the extent of overlap between the perforations, and hence the amount of ventilating air which can enter the filter plug is adjustable. These arrangements suffer the disadvantage either that the rotatable tipping wrapper can be pulled axially off the buccal end of the plugwrap, or that the tipping wrapper has to be formed in three circumferential bands, of which the middle band is perforated and rotatable.

According to an additional feature of the invention, at least a part of the tipping wrapper is rotatable around the filter plug and is formed with an air-permeable section extending part way around the circumference, the rotatable part being formed on its inner surface with a raised projection which rides in the notch, the projection engaging the ends of the notch to limit rotation of the tipping wrapper part relatively to the plug, such rotary motion varying the extent to which the air-permeable section of the tipping wrapper is in alignment with the notch.

A row of the ventilating perforations extends in one circumferential direction partly around the tipping wrapper from the projection such that when the projection is at one end of the notch, no ventilating openings in the tipping wrapper are in alignment with the notch, and when the projection is at the other end of the notch, the perforations in the tipping wrapper open into the full length of the notch. The smoker can then control a graded variation in the amount of ventilating air drawn into the filter plug through the cavity formed by the notch. Normally, with such an arrangment, the filter plug will be wrapped with an air impermeable plugwrap, through which the notch opens, so that perforations not aligned with the notch are closed by the plugwrap.

The raised projection on the inner surface of the tipping wrapper may be a blob of polymer or dried adhesive.

The air-permeable section extending part way around the tipping wrapper may be formed by taking a normal perforated tipping wrapper and blocking off a portion of the perforations with an adhesive or polymer coating.

The projection on the inner surface of the tipping wrapper serves not only the purpose of limiting the rotation of the tipping wrapper relatively to the plug, but also, by engagement with the downstream face of the notch, of preventing the rotatable portion of the tipping wrapper from being displaced axially off the buccal end of the plug. For this reason, at least the downstream face of the notch is preferably located in a radial plane perpendicular to the axis of the plug.

Some examples of filter tip cigarettes incorporating filter devices in accordance with the invention are illustrated diagrammatically in the accompanying drawings, in which:-

Figures I to 4 are schematic sections through four cigarettes; and,

Figure 5 is a schematic perspective view of a fifth cigarette shown partially assembled.

Each of the illustrated cigarettes incorporates a conventional tobacco rod comprising a tobacco filler 6 in a tubular paper wrapper 7. The tobacco rod is united by a conventional tipping wrapper 8 to a filter plug comprising a core 9 of acetate or other fibrous filter material enclosed within an air impermeable plugwrap 10. A notch 11 is cut through the plugwrap 10 and into the core 9. In Figure I the notch is V shaped in Figures 2 and 5 it is of substantially square cross-section, and in Figures 3 and 4 it is formed by a oblique cut at one end of the filter plug. The tipping wrapper 8 has a ring of ventilating perforations 12 in alignment with the notch 11.

In the Figure 5 example, the tipping wrapper 8 is shown partially unwrapped. The row of ventilating perforations 12 are covered and closed by adhesive 13 on one side of a projecting blob 14 of adhesive or plastics material. The tipping wrapper 8 is also provided with a line of weakness 15.

Upon assembly, the tipping wrapper is wrapped around the tobacco rod and filter plug, which are in axial alignment, and secured by adhesive I6 where one edge of the tipping wrapper overlaps the other, and adhesive I7, which provides the bond between the tobacco rod and filter plug. The projection I4 then lies in the notch II. The tipping wrapper is then broken at the line I5 by sharply rotating the part of the tipping wrapper on one side of the line relatively to that on the other. Subsequently the part of the tipping wrapper with the perforations I2 and projection I4 is free to rotate around the filter plug to an extend limited by the projection I4, to bring the ventilating perforations I2 gradually into and out of alignment with the notch II, thereby to vary the ventilating air which may be drawn in during smoking. The projection I4 also prevents the rotary part of the tipping wrapper from being pulled axially off the end of the filter plug.

Claims

I. A filter device for the buccal end of a smoking rod, comprising a cylindrical plug (9) of filter material, which is provided at its periphery with at least one notch (II) formed by cutting away part of the filter material, the notch (II) extending only part way around the circumference of the plug (9) and the plug being surrounded by a tipping wrapper (8) which is permeable to air, at least where it overlies the notch (II), for the ingress of ventilating air into the notch (II) and hence into the plug (9).

2. A filter device according to claim I, wherein at least a part of the tipping wrapper (8) is rotatable around the filter plug (9) and is formed with an air-permeable section (I2) extending part way around the circumference, the rotatable part being formed on its inner surface with a raised projection which rides in the notch, the projection (I4) engaging the ends of the notch (II) to limit rotation of the tipping wrapper part relatively to the plug (9), such rotary motion varying the extent to which the air-permeable section (I2) of the tipping wrapper (8) is in alignment with the notch (II).

3. A filter device according to claim I or claim 2, wherein the notch (II) has sidewalls which lie in radial planes perpendicular to the axis of the plug (9).

4. A filter device according to claim I or claim 2, wherein the notch (II) has at least one sidewall which is inclined to a radial plane perpendicular to the axis of the plug (9).

5. A filter device according to any of the preceding claims, wherein the air-permeability of the tipping wrapper is provided by perforations.

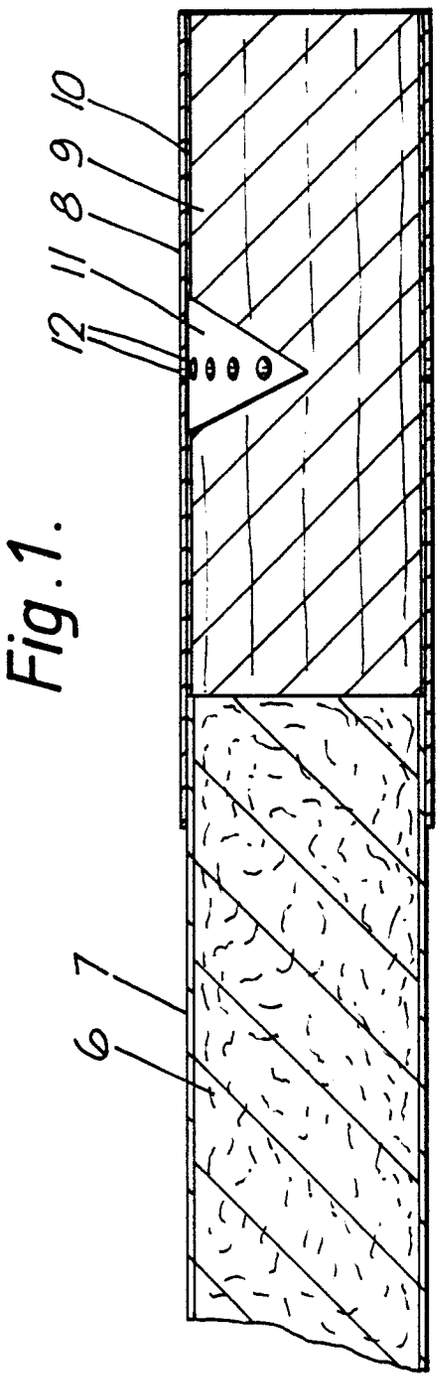


Fig. 1.

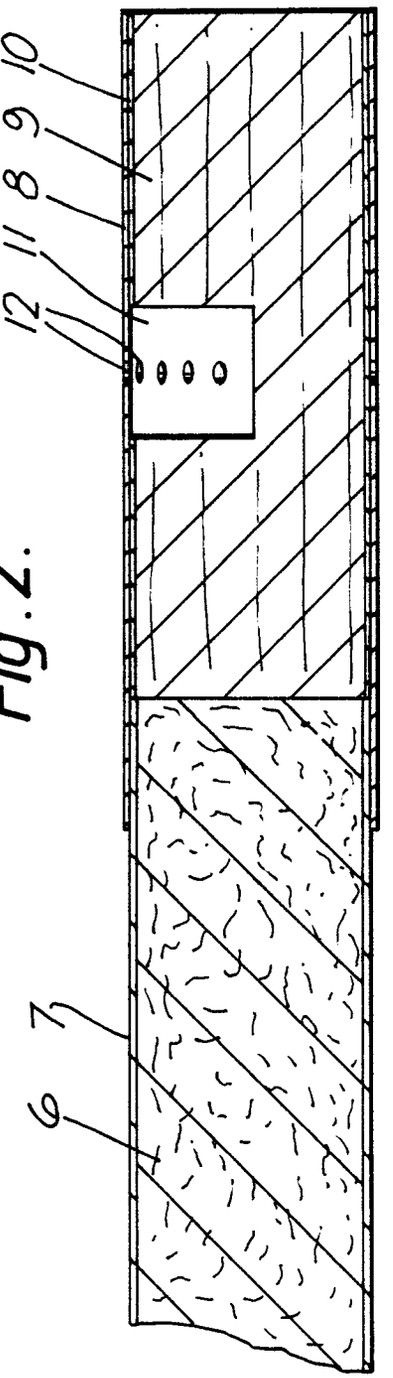


Fig. 2.

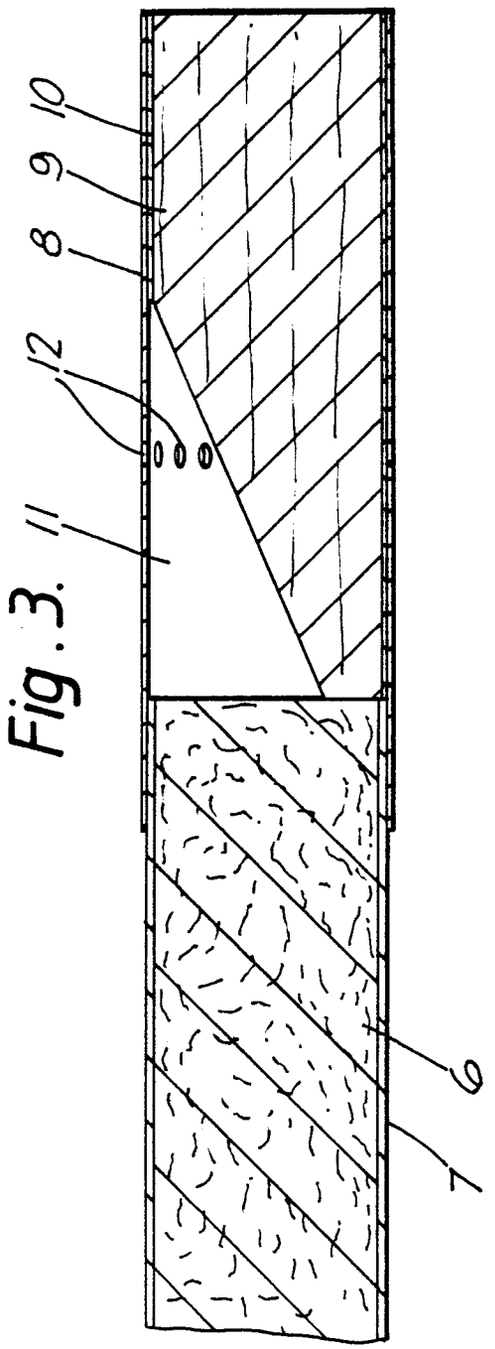


Fig. 3.

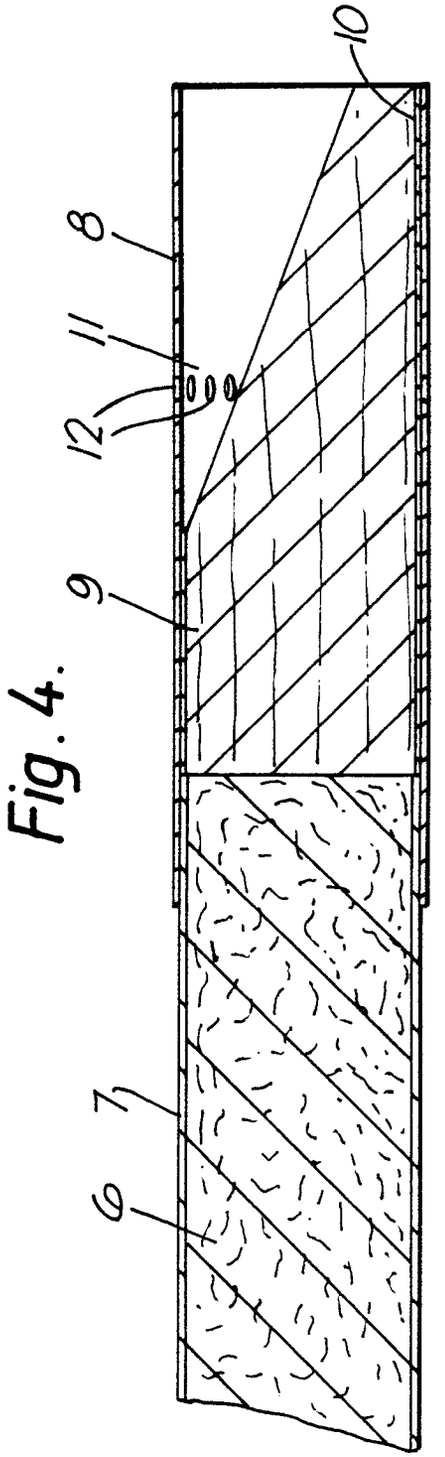
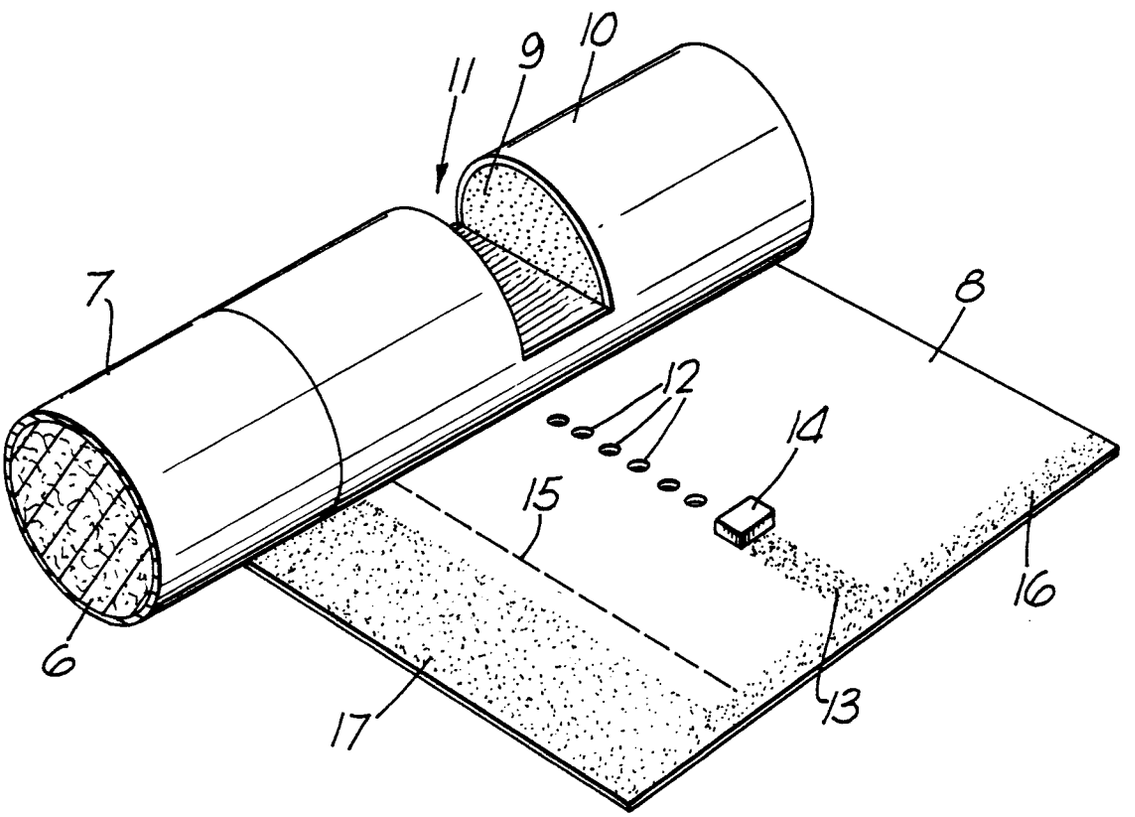


Fig. 4.

Fig. 5.



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EUROPEAN SEARCH REPORT

Application number

EP 86 30 9587

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.4)
A	US-A-3 756 250 (MORGENSTERN) * Figures 1-7; column 4, line 50 - column 6, line 58 *	1,4,5	A 24 D 3/04
A	US-A-3 847 161 (MORGENSTERN) * Figures 1-3; abstract *	1,4,5	
A	US-A-4 273 141 (JAN VAN TILBURG) * Abstract *	1,5	
A	GB-A-2 150 409 (BRITISH-AMERICAN TOBACCO CORP.) * Figures 1-3; page 1, line 128 - page 2, line 88 *	1,5	
A,D	GB-A-2 115 678 (BROWN & WILLIAMSON TOBACCO CORP.) * Figures 1-4; abstract *	1,5	TECHNICAL FIELDS SEARCHED (Int. Cl.4) A 24 D A 24 C
A,D	GB-A-1 336 465 (EASTMAN KODAK COMPANY) * Figures 1-24; page 3, line 103 - page 4, line 104 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19-03-1987	RIEGEL R.E.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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