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(71) Applicant: **Reemtsma Cigarettenfabriken GmbH**
22761 Hamburg (DE)

(72) Inventor: **Fuhrmann, Jan**
22761 Hamburg (DE)

(74) Representative: **Gulde & Partner**
Patent- und Rechtsanwaltskanzlei mbB
Wallstraße 58/59
10179 Berlin (DE)

(54) **FILTER ELEMENT FOR A SMOKING ARTICLE**

(57) A filter element (10) for use in a smoking article (80) is formed from a conventional filter material (20), such as cellulose acetate. The filter element (10) includes

a cavity (30) that is devoid of filter material (20), wherein a surface of the filter element facing the cavity (30) is at least partially provided with at least one adsorbent (40).

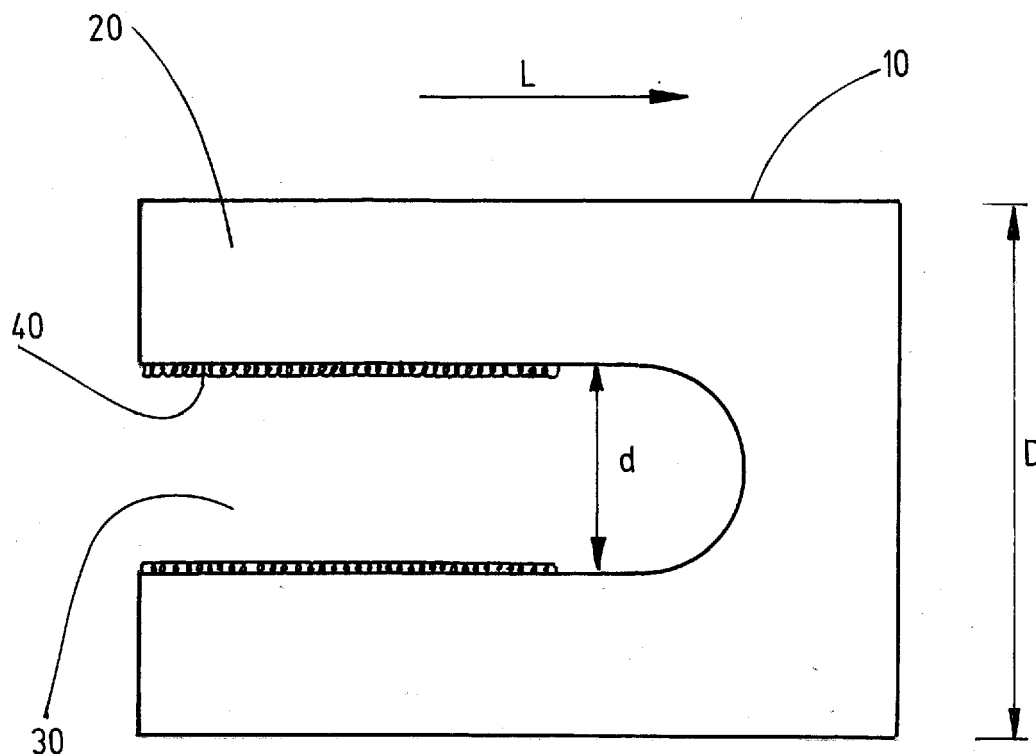


Fig.1A

DescriptionFIELD OF INVENTION

5 **[0001]** The present invention relates generally to a filter element for a smoking article and to a smoking article including such a filter element.

BACKGROUND OF THE INVENTION

10 **[0002]** Filter elements for smoking articles are generally known in the art. Such filter elements are basically used to screen out filterable materials in the smoke generated during smoking.

[0003] The invention is mainly directed to filter elements for conventional smoking articles, such as cigarettes. However, with respect to the present invention, the terms "smoking article" and "smoking" are intended to include both conventional smoking articles, such as cigarettes, where tobacco is combusted in order to generate inhalable smoke, as well as
15 electronic smoking or vaping devices, such as e-cigarettes or shishas, where a respective liquid is vaporized or atomized in order to generate inhalable vapor. Such vapor is also referred to as "smoke" below.

[0004] Smoking sensation can be influenced by filter elements in various ways. It is an object of the present invention to suggest a new filter element which provides both effective filtering action and satisfying smoking sensation.

20 **[0005]** This object is solved by a filter element with the features of the independent claim. Preferred embodiments and further developments are described with respect to the dependent claims.

SUMMARY OF THE INVENTION

25 **[0006]** In accordance with one aspect of the present invention there is provided a filter element for use in a smoking article. The filter element is formed from a conventional filter material, such as cellulose acetate. The filter element includes a cavity that is devoid of filter material, wherein a surface of the cavity, i.e. a surface of the filter element facing the cavity, is at least partially provided with at least one adsorbent.

[0007] According to a first variant, the respective surface is partially or completely provided with one adsorbent.

30 **[0008]** According to an alternative second variant, the surface of the filter element facing the cavity may be provided with a first adsorbent in a first area of the surface and with a second adsorbent that is different from the first adsorbent in a second area of the surface, which second area at least partially differs from the first area.

[0009] The adsorbent can be at least one of a group of adsorbents including activated carbon, zeolites, alumina, silica, silica gel, ion exchange resins, polyester resins, sepiolite, and carbon species, such as impregnated carbon, activated carbon fibres, or highly activated carbon. Further suitable adsorbents and/or catalysts that are known in the art for filtering
35 smoke or removing components from smoke can be used.

[0010] Preferably, the cavity forms a channel that extends into the filter element and at least partially along a longitudinal direction of the filter element. Preferably, the cavity or channel extends along a direction along which smoke is drawn during operation of a smoking article including the filter element, i.e. when the user draws or puffs on the smoking article. With respect to an arrangement of the filter element in a smoking article, according to a first variant, the cavity or channel
40 extends into the filter element from a mouth side. According to an alternative second variant, the channel or cavity may extend into the filter element from a rod side. According to an embodiment, the channel completely extends through the filter element, preferably along the longitudinal direction of the filter element.

[0011] The cavity or channel devoid of filter material, during smoking, allows at least a certain amount of smoke to proceed through the filter element without being filtered, i.e. with original taste that is not altered by passing filter element material. Thereby, smoking sensation can be enhanced. On the other hand, due to the provision of the adsorbent on
45 the inner surface of the filter element facing the cavity, still a certain filtering or retention effect can be provided with respect to the portion of the smoke that passes through the cavity or channel, and not through the filter material surrounding the cavity or channel. Still further, providing the adsorbent on the inner surface of the cavity, and not embedded into the filter material results in a lower pressure drop compared to a solution in which the adsorbent is embedded into the filter
50 material.

[0012] Form and dimension of the cavity or channel can vary. Needless to say that the above mentioned effect of the cavity or channel increases with proportional to the size or volume of the cavity in relation to the size or volume of the filter element, i.e. the filter material surrounding the cavity or channel. It is also possible to provide more than one cavity or channel. Thereby, in particular the area of active surface, i.e. surface that is provided with the adsorbent, can be
55 increased, which raises the retention effect of the adsorbent.

[0013] One or more channels may e.g. extend in parallel along a longitudinal direction of the filter element, which generally has a circular-cylindrical form. Also the channel or channels can have a circular-cylindrical form, and can partially, in the form of a blind hole, or completely, in the form of a through hole, extend into/through the filter element.

[0014] According to a first embodiment, the cavity or channel is formed directly in the filter element, i.e. the surface of the filter element facing the cavity is formed by filter material. With respect to this embodiment, the adsorbent is directly applied to the inner surface of the cavity, i.e. to the filter material in this area.

[0015] According to a second embodiment, the cavity or channel is a tube that is formed from a preferably self-supporting, sheet-like tube material. According to this embodiment, the cavity or channel has a wall separate from the filter material of the filter element. In general, a tube material differs from the filter material. However, the tube can also be formed by the same material, such as cellulose acetate. Providing such a tube in advance may serve to simplify the production of the inventive filter element. The tube may be formed as a single central or inner core of the filter element, which central core, in the finished filter element, is surrounded by filter material.

[0016] Suitable tube materials are e.g. paper materials or polymeric materials known in the art. The tube material can include one or a plurality of layers, e.g. two to three paper layers.

[0017] According to a first variant, at least the inner surface of the tube material facing the cavity of the tube is at least partially provided with the adsorbent. The adsorbent can be applied to the respective surface by any suitable application technology.

[0018] According to a second variant, the tube material may already include the adsorbent. In particular, charcoal paper may be used as tube material or as a layer of a multilayered tube material. In case the tube material includes multiple layers, at least the innermost layer of the multiple layers, i.e. the layer that faces the cavity of the tube, includes the adsorbent. According to a third embodiment, a cavity or channel directly formed in the filter element can partially be lined with a lining material corresponding to the tube material. The adsorbent may be applied to or integrated into the lining material as described above with respect to the tube material.

[0019] According to a further embodiment, it is possible to color or print the tube material or lining material, at least on the surface facing the cavity, in order to achieve visual differentiation and recognizability.

[0020] An inventive smoking article includes an above described filter element.

[0021] According to a preferred embodiment, the smoking article, in the form of a conventional cigarette, includes a wrapped tobacco rod and a filter. The filter consists of or includes at least one of the inventive filter elements. The wrapped tobacco rod and the filter are connected by a tipping paper which overwraps the filter and a part of the wrapped tobacco rod.

[0022] According to a preferred embodiment, the filter includes at least a first filter element and a second filter element of the above described type, wherein a surface of the first filter element facing the cavity of the first filter element is provided with a first adsorbent, and wherein a surface of the second filter element facing the cavity of the second filter element is provided with a second adsorbent that is different from the first adsorbent.

[0023] The characteristics, features and advantages of this invention and the manner in which they are obtained as described above, will become more apparent and be more clearly understood in connection with the following description of exemplary embodiments, which are explained with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] In the drawings, same element numbers indicate same elements in each of the views:

Figure 1A is a schematic cross-sectional illustration of an exemplary filter element according to a first embodiment;
 Figure 1B shows the filter element of Fig. 1A in front view;
 Figure 2 is a schematic cross-sectional illustration of an exemplary filter element according to a second embodiment;
 Figure 3A is a schematic cross-sectional illustration of an exemplary filter element according to a first variant of a third embodiment;
 Figure 3B is a schematic cross-sectional illustration of an exemplary filter element according to a second variant of the third embodiment;
 Figure 4 is a schematic cross-sectional illustration of an exemplary filter element according to a fourth embodiment;
 Figure 5A is a schematic cross-sectional illustration of an exemplary filter element according to a fifth embodiment;
 Figure 5B shows the filter element of Fig. 5A in front view;
 Figure 6A is a schematic cross-sectional illustration of an exemplary smoking article including the filter element of Fig. 4;
 Figure 6B is a schematic cross-sectional illustration of an exemplary smoking article including the filter element of Fig. 4 as a first filter element and a variant of the filter element of Fig. 4 as a second filter element; and
 Figure 6C is a schematic cross-sectional illustration of an exemplary smoking article including the filter element of Fig. 2.

[0025] The figures are generally not drawn in scale, but only exemplarily indicate the elements of the respective filter elements and smoking articles.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] Figure 1A is a schematic cross-sectional illustration of an exemplary filter element 10 according to a first embodiment. Figure 1B shows the filter element 10 of Fig. 1A in front view.

[0027] The filter element 10 is formed from a conventional filter material 20, such as cellulose acetate. Other filter materials known in the art can likewise be used. The filter material 20 may be wrapped in a plug wrap (not shown). The filter element 10 has a circular-cylindrical form. Similar forms can also be used. The length of the filter element 10 (in the longitudinal direction L) can vary between about 5mm and 40mm, preferably between 6mm and 30mm. The diameter D of the filter element 10 may also vary between about 2mm and 15mm, preferably between 4mm and 10mm.

[0028] The filter element 10 includes a cavity (or channel) 30, which extends into the filter element 10 along the longitudinal direction L. The cavity 30 is devoid of filter material 20. Form and size of the cavity can vary. The cavity 30 can e.g. have the form of a blind hole, as in Fig. 1A, and extend into the filter element up to a certain depth, depending on the length of the filter element. Preferably, the depth of the cavity 30 is at least 1/3 of the length of the filter element 10. The cavity can also be circular-cylindrical. An inner diameter d may vary, depending on the diameter D of the filter element 10. The cross-sectional area of the cavity 30 should be at least 3mm², preferably between 10mm² and 30mm². In other words, in case the cavity is circular-cylindrical, the diameter of the cavity should be at least 1 mm, preferably between 3mm and 7mm.

[0029] At least part of the inner surface of the cavity 30 is provided with an adsorbent 40. One or more adsorbents can be provided on the surface of the cavity 30. Adsorbents can e.g. be selected from a group including activated carbon, zeolites, alumina, silica, silica gel, ion exchange resins, polyester resins, sepiolite, and carbon species, such as impregnated carbon, activated carbon fibres, or highly activated carbon. Further suitable adsorbents and/or catalysts that are known in the art for filtering smoke or removing components from the smoke can be used.

[0030] The adsorbent 40 can be applied to the inner surface of the filter element facing the cavity, which surface is formed by filter material 20, by any suitable application technology.

[0031] Figure 2 is a schematic cross-sectional illustration of an exemplary filter element 110 according to a second embodiment.

[0032] The filter element 110 of Fig. 2 mainly differs from the filter element 10 in Fig. 1A in that the cavity 130 now forms a channel that completely extends through the filter element 110 along the longitudinal direction. Further, not only part of the inner surface of the cavity 130 is provided with the adsorbent, but essentially the entire surface.

[0033] Figures 3A and 3B are a schematic cross-sectional illustrations of a first and second variant of an exemplary filter element 210 according to a third embodiment.

[0034] In contrast to the filter elements 10, 110 according to Fig. 1 and 2, in the filter elements 210, 210' according to Fig. 3A, 3B, the cavity 130 is provided by a tube formed from a tube material 50. The tube forms a single central or inner core of the filter element 210, 210', which inner core is surrounded by filter material 20. The tube material 50 can e.g. be a paper material or a suitable polymeric material.

[0035] According to the first variant shown in Fig. 3A, the inner surface of the tube material that faces the cavity of the tube is provided with one adsorbent 40.

[0036] In contrast, according to the second variant shown in Fig. 3B, a first area of the inner surface of the tube material 50 facing the cavity of the tube is provided with a first adsorbent 40, while a second area of the inner surface of the tube material facing the cavity is provided with second adsorbent 40' different from the first adsorbent 40. The first area and the second area may partially overlap.

[0037] Needless to say that respective variants, including different areas of the surface of the filter element facing the cavity being provided with different adsorbents 40, 40', are applicable also with respect to the embodiments according to Fig. 1, 2 described above and the embodiments described below with reference to Fig. 4, 5. The number of different areas/different adsorbents may vary and is not limited to two.

[0038] Preferably, the tube material 50 is self-supporting, so that the tube can be formed in advance and has a predefined stability with respect to collapsing. The thickness of the tube material 50, defining a thickness of a wall of the tube, can vary, e.g. between about 0.1 mm to 1 mm.

[0039] Figure 4 is a schematic cross-sectional illustration of an exemplary filter 310 element according to a fourth embodiment.

[0040] This embodiment differs from the embodiments in Fig. 3A, 3B in that in the filter element 310 the adsorbent 40 is not only applied to the inner surface of the tube material facing the tube, but the tube material 150 itself already includes the adsorbent 40, i.e. the adsorbent 40 is integrated or embedded into the tube material 150. Charcoal paper would e.g. represent a respective tube material 150.

[0041] Figure 5A is a schematic cross-sectional illustration of an exemplary filter element 410 according to a fifth embodiment. Figure 5B shows the filter element of Fig. 5A in front view.

[0042] The filter element 410 of Fig. 5 differs from the filter element 310 of Fig. 4 (and the other filter elements described above) in that a plurality of cavities or channels 230, 231, 231, 233 is included in the filter element 410. The number of

cavities or channels may vary, e.g. between 1 and 5. When using a plurality of channels, the sum of the surface areas of the channels can be increased compared to the provision of only one channel having the same cross-sectional area as the sum of the cross-sectional areas of the plurality of channels.

[0043] Needless to say that also in the embodiments according to Fig. 1 to 3B a plurality of channels or cavities can be included into the respective filter elements.

[0044] Figure 6A is a schematic cross-sectional illustration of an exemplary smoking article including the filter element of Fig. 4; Figure 6B is a schematic cross-sectional illustration of an exemplary smoking article including the filter element of Fig. 4 as a first filter element and a variant of the filter element of Fig. 4 as a second filter element; and Figure 6C is a schematic cross-sectional illustration of an exemplary smoking article including the filter element of Fig. 2.

[0045] Figure 6A illustrates, in a longitudinal view, a smoking article 80 in the form of a cigarette. The cigarette comprises a wrapped tobacco rod 60, which includes an amount of a tobacco blend wrapped in a cigarette paper (not shown), and a filter. The filter is composed of the filter elements 510 and 310, where the filter element 310 is the filter element described above with reference to Fig. 4. The filter element 510 simply consists of a suitably filter material, e.g. the filter material 20 discussed above, e.g. cellulose acetate, which can be wrapped in a plug wrap (not shown).

[0046] The filter 510, 310 is connected to the wrapped tobacco rod 60 by a tipping paper 70, which overwraps the filter, i.e. the filter elements 510, 310, and a part of the wrapped tobacco rod 60. As shown in Fig. 6A, the filter can be designed as a filter having more than one segment, namely the filter elements 510, 310. The ordering of these filter elements, along the longitudinal direction of the smoking article can be changed. Further, any one of the filter elements 10, 110, 210, 410, 510 may be used instead of the filter element 310 in the embodiment according to Fig. 6A.

[0047] The smoking article 180 shown in Fig. 6B differs from the smoking article according to Fig. 6A in that instead of the filter element 510 (without cavity) a second inventive filter element 310' forms part of the filter. The filter element 310' differs from the filter element 310 by the adsorbent 40' included in the tube material 150', which differs from the adsorbent 40 included in the tube material 150 of the filter element 310. According to this embodiment, different effects that can be achieved by different adsorbents can be combined.

[0048] Apparently, also more than two filter elements including different adsorbents can be combined in this way. In this context, also filter elements without tube material, as described e.g. with reference to Fig. 2, and/or filter elements where the adsorbent is only applied to the tube material (as shown in Fig. 3A) can be used.

[0049] As shown in Fig. 6C with respect to the smoking article 280, the filter can also only comprise one filter element, e.g. the filter element 110 according to Fig. 2 (or any other filter element described above). In order to achieve an effect similar to that achieved by the embodiment according to Fig. 6B, instead of the filter element 110 according to Fig. 1, a filter element as described with reference to Fig. 3B may be used, i.e. a filter element in which different areas of the surface of the filter element facing the cavity or channel are provided with different adsorbents.

[0050] While this invention has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the scope of the appended claims.

LIST OF REFERENCE SIGNS

[0051]

10, 110, 210, 210', 310, 410, 510	filter element
20	filter material
30, 130, 230, 231, 232, 233	cavity
40, 40'	adsorbent
50, 150, 150'	tube material
60	tobacco rod
70	tipping paper
80, 180, 280	smoking article
L	longitudinal direction
D, d	diameter

Claims

1. A filter element (10; 110; 210; 210'; 310; 410; 510) for use in a smoking article (80), the filter element (10) being formed from a filter material (20), such as cellulose acetate, wherein the filter element (10) includes a cavity (30; 130) that is devoid of filter material (20), wherein a surface of the filter element facing the cavity (30; 130) is provided with an adsorbent (40).

2. The filter (10) element according to claim 1, wherein the adsorbent (40) is at least one of a group of adsorbents including activated carbon, zeolites, alumina, silica, silica gel, ion exchange resins, polyester resins, sepiolite, and carbon species, such as impregnated carbon, activated carbon fibres, or highly activated carbon.
- 5 3. The filter element (10; 110) according to claim 1 or 2, wherein the cavity (30; 130) forms a channel that extends into the filter element (10; 110) and at least partially along a longitudinal direction (L) of the filter element (10; 110).
- 10 4. The filter element (110) according to claim 3, wherein the channel (130) completely extends through the filter element (110).
5. The filter element (210; 310) according to claim 3 or 4, wherein the channel (130) is a tube that is formed from a tube material (50; 150).
- 15 6. The filter element (210; 310) according to claim 5, wherein the tube is formed as a single central core of the filter element (210; 310).
7. The filter element (210; 310) according to claim 5 or 6, wherein the tube material (50; 150) is a paper material or a polymeric material.
- 20 8. The filter element (210) according to any one of claims 5 to 7, wherein at least the inner surface of the tube material facing the cavity of the tube is provided with the adsorbent (40).
9. The filter element (310) according to any one of claims 5 to 8, wherein the tube material (150) includes the adsorbent (40).
- 25 10. The filter element according to claim 9, wherein the tube material includes multiple layers, and wherein the innermost layer of the multiple layers that faces the cavity of the tube includes the adsorbent.
11. The filter element (310) according to any one of claims 5 to 10, wherein the tube material (150) comprises or consists of charcoal paper.
- 30 12. The filter element according to any one of claims 1 to 11, wherein the filter element (410) includes a plurality of cavities (230; 231; 232; 233) that are devoid of filter material (20), wherein a surface of the filter element facing at least one of the cavities (230; 231; 232; 233) is provided with the adsorbent (40).
- 35 13. A smoking article (80; 180; 280), including a filter element (10; 110; 210; 210'; 310; 410; 510) according to any one of claims 1 to 12.
14. The smoking article (80) according to claim 13, comprising a wrapped tobacco rod (60) and a filter (510, 310) including the filter element (310), the wrapped tobacco rod (60) and the filter (510, 310) being connected by a tipping paper (70) which overwraps the filter (510, 310) and a part of the wrapped tobacco rod (60).
- 40 15. The smoking article (180) according to claim 14, wherein the filter (310, 310') includes at least a first filter element (310) and a second filter element (310') according to any one of claims 1 to 12, wherein a surface of the first filter element (310) facing the cavity of the first filter element (310) is provided with a first adsorbent (40), and wherein a surface of the second filter element (310') facing the cavity of the second filter element (310') is provided with a second adsorbent (40') that is different from the first adsorbent (40).
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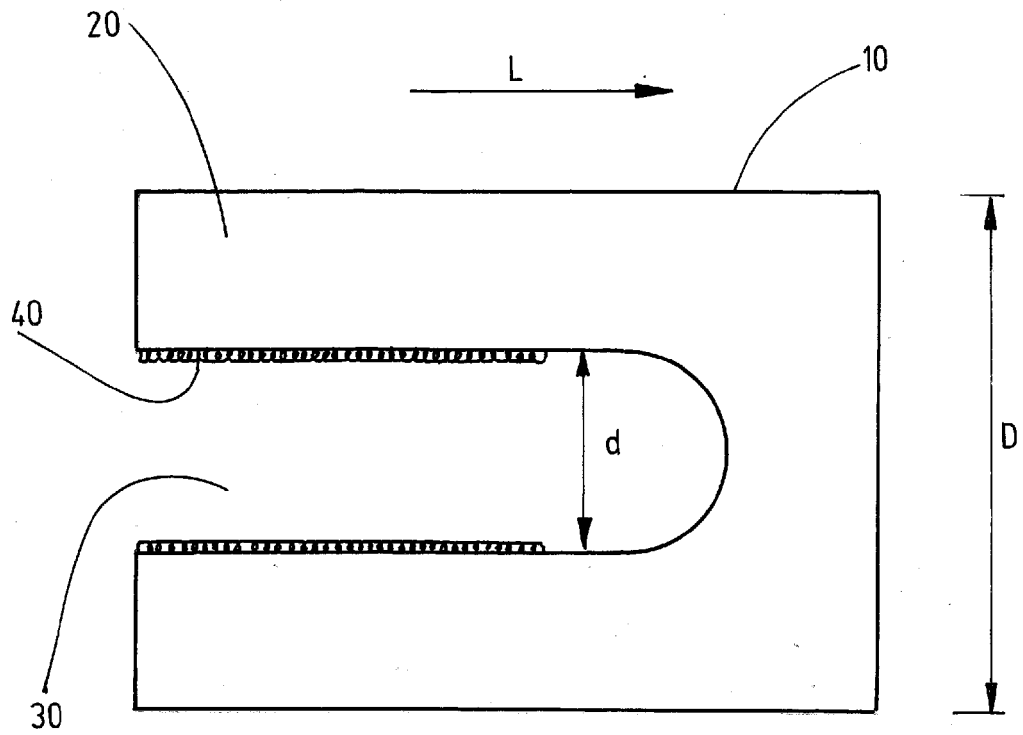


Fig.1A

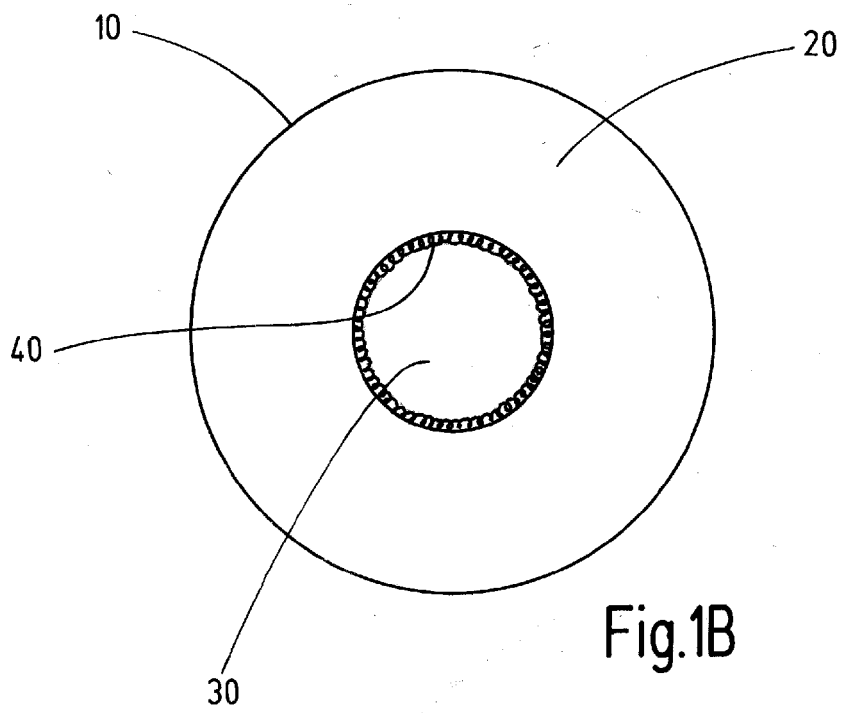
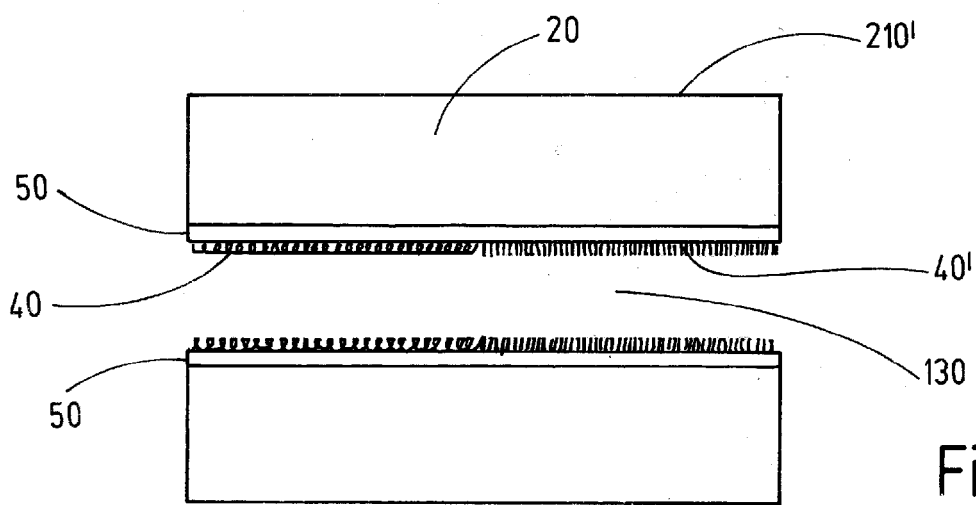
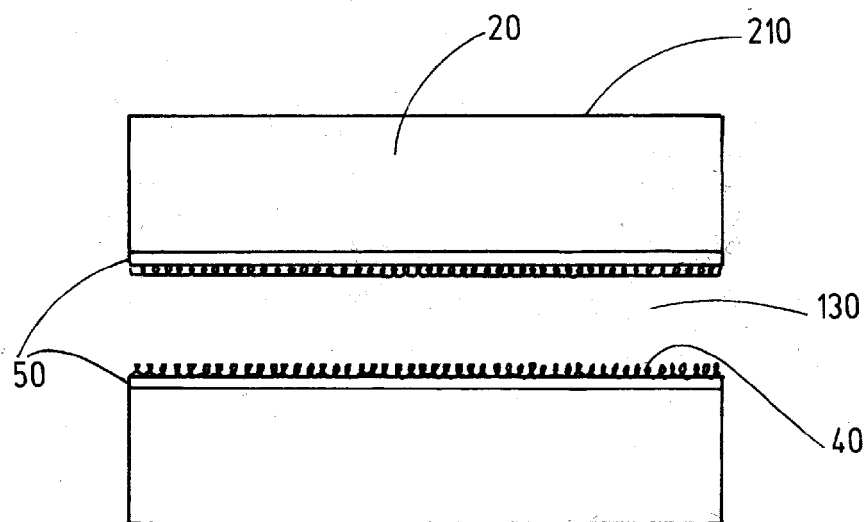
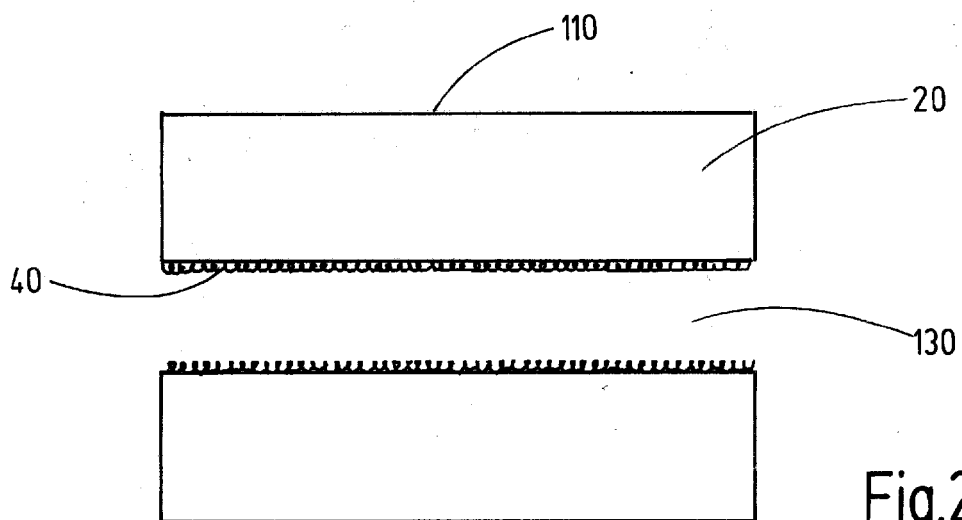


Fig.1B



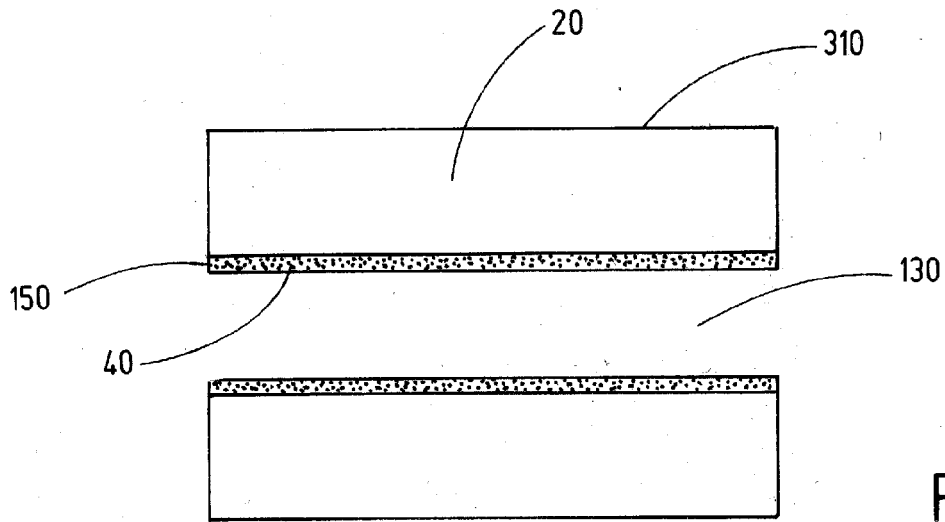


Fig. 4

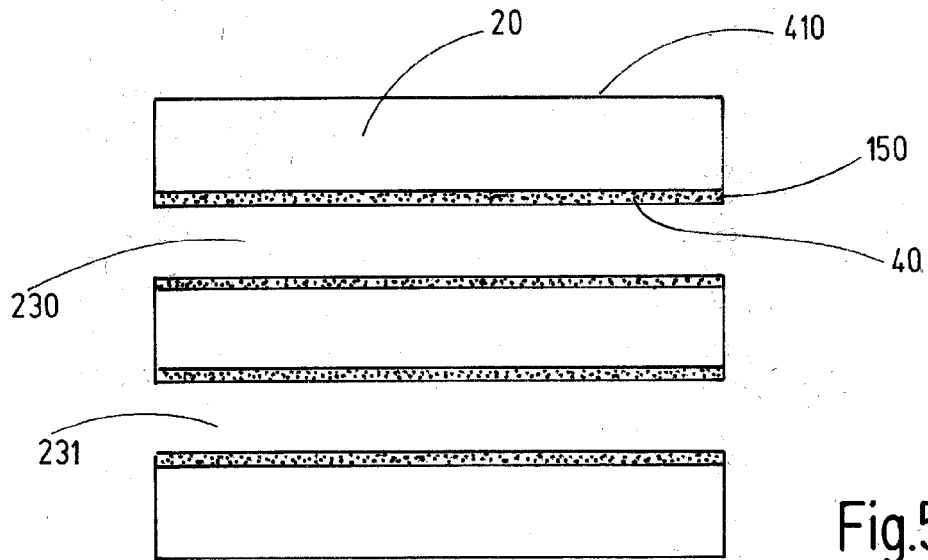


Fig. 5A

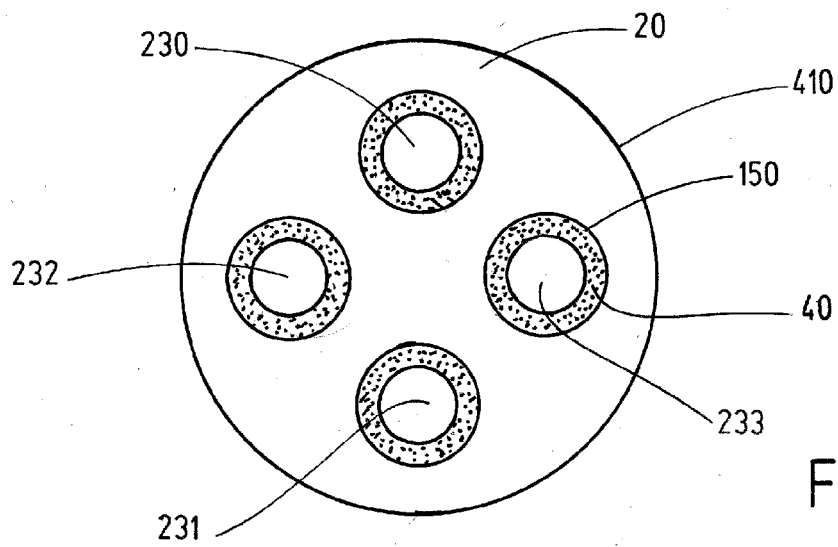
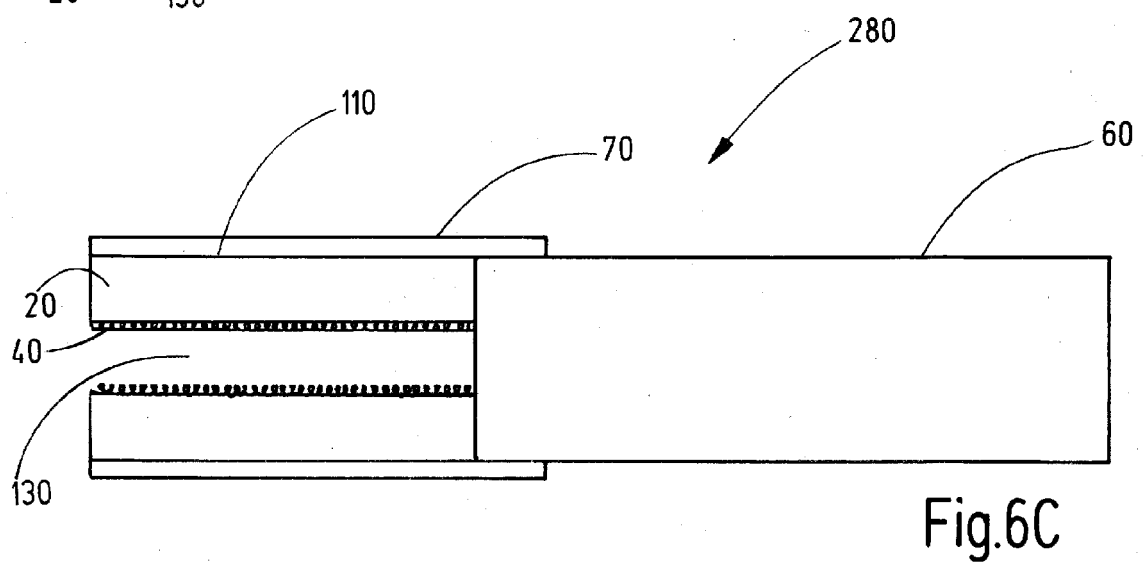
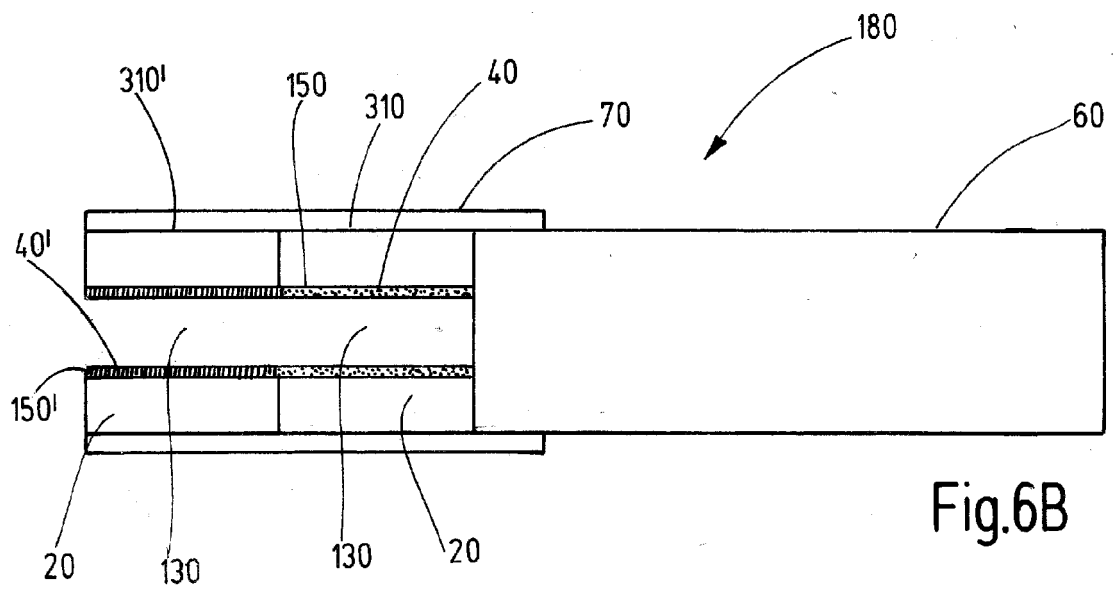
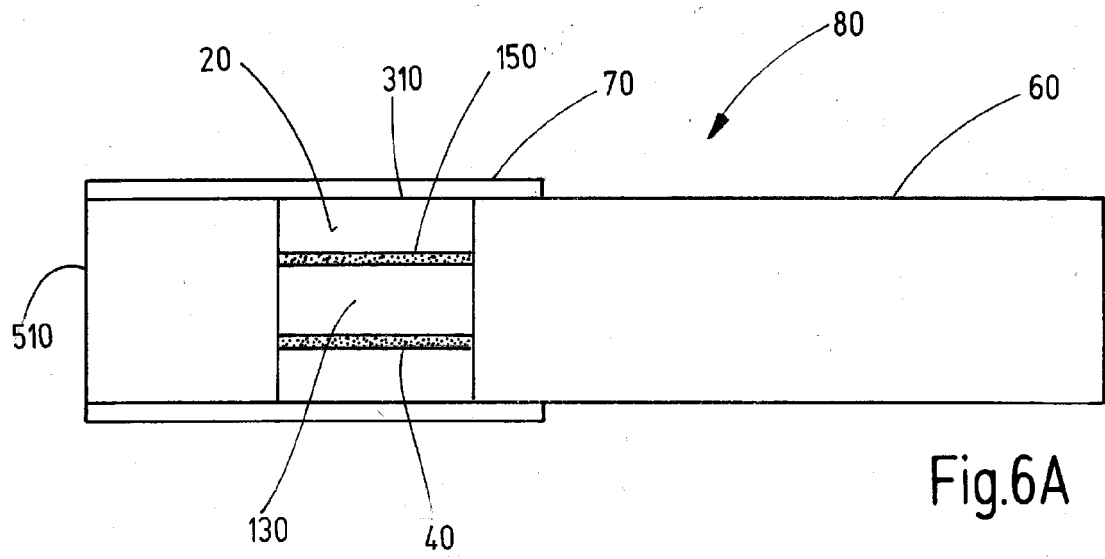


Fig. 5B





EUROPEAN SEARCH REPORT

 Application Number
EP 16 19 2750

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 13 March 2017	Examiner Villányi Kelemen, K
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 16 19 2750

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