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(54) **Smoking article filter with functional material**

(57) A filter (20) for a smoking article (10) having a functional portion (28). The functional portion (28) includes a plurality of disc elements (30, 31) stacked together to form a cylindrical element. The functional por-

tion (28) includes a functional material (32) retained by the plurality of disc elements (30). Each of the disc elements (30, 31) includes non-woven fibres.

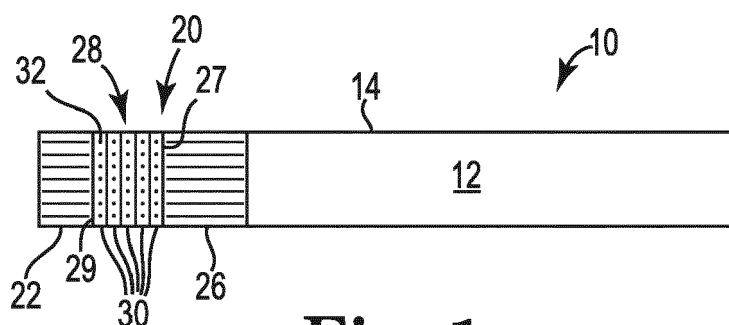


Fig. 1

Description

[0001] The present disclosure relates to a filter for a smoking article with retained functional material.

[0002] Combustible smoking articles, such as cigarettes, typically have shredded tobacco surrounded by a paper wrapper forming a tobacco rod. A cigarette is employed by a smoker by lighting one end of the cigarette and burning the shredded tobacco rod. The smoker then receives mainstream smoke into their mouth by drawing on the opposite end or mouth end of the cigarette, which typically contains a filter. The shredded tobacco can be a single type of tobacco or a blend of two or more types of tobacco depending on the brand of cigarette.

[0003] Filter cigarettes typically include a wrapped rod of tobacco cut filler and a cylindrical filter aligned in end-to-end relationship with the wrapped tobacco rod, with the filter attached to the tobacco rod by tipping paper. In conventional filter cigarettes, the filter may consist of a plug of cellulose acetate tow wrapped in porous plug wrap.

[0004] A number of smoking articles in which an aerosol generating substrate, such as tobacco, is heated rather than combusted have also been proposed in the art. In heated smoking articles, the aerosol is generated by heating the aerosol generating substrate. Known heated smoking articles include, for example, smoking articles in which an aerosol is generated by electrical heating or by the transfer of heat from a combustible fuel element or heat source to an aerosol generating substrate. During smoking, volatile compounds are released from the aerosol generating substrate by heat transfer from the heat source and entrained in air drawn through the smoking article. As the released compounds cool they condense to form an aerosol that is inhaled by the consumer. Also known are smoking articles in which a nicotine-containing aerosol is generated from a tobacco material, tobacco extract, or other nicotine source, without combustion, and in some cases without heating, for example through a chemical reaction.

[0005] Some smoking articles include a filter segment including functional materials that capture or convert components of the smoke from the smoking article or release materials into the smoke as smoke is being drawn through the filter. Such functional materials are known and include, for example, sorbents, catalysts and flavourant materials.

[0006] Such functional material can migrate in the filter element and accumulate in certain areas and degrade the functionality of the filter element. As the particle size of the functional material decreases, migration within the filter element can increase. In some cases, when the particle size of the functional material is small enough, the functional material can escape from the filter element, which is also referred to as "breakthrough".

[0007] It would be desirable to provide a filter that utilizes functional material having a reduced size and corresponding large surface area for efficiency. It is desirable

to provide a filter that retains functional material within the filter to prevent breakthrough. It is desirable that the filter retains functional material within the filter to maintain a stable resistance to draw (RTD).

[0008] According to the current disclosure, there is provided a smoking article or a filter for a smoking article having a functional portion. The functional portion includes a plurality of disc elements stacked together to form a cylindrical element. The functional portion includes a functional material retained by the plurality of disc elements. Each of the disc elements includes non-woven fibres.

[0009] Filters and smoking articles according to the present disclosure provide an effective way to retain functional material without requiring the use of additional bonding materials. Retention of the functional material may allow for the use of smaller sized functional material, with an accordingly larger surface area and efficiency. This in turn may allow for the use of less functional material (and associated cost) to achieve the desired functional effect.

[0010] The term "retain" is used herein to indicate that the functional material remains within the cylindrical element throughout normal processing and handling of the filter and any smoking article incorporating the filter. In particular, the term "retain" is used herein to indicate that functional material is retained by the plurality of disc elements prior to the introduction of smoke through the filter, as well as during the passage of smoke through the filter, such as during consumption of a smoking article incorporating the filter.

[0011] The functional material can be retained by the plurality of disc elements in any suitable manner. In some preferred embodiments, the functional material can be retained by the plurality of disc elements such that the functional material is completely immobilized in the cylindrical element. In some other preferred embodiments, the functional material can be retained by the plurality of disc elements such that it remains within the cylindrical element, but can move at least partially within the cylindrical element.

[0012] Preferably, the functional portion is formed from a plurality of disc elements of non-woven and electrostatically charged fibres. The electrostatic charge may help to retain the functional material, for example, by more securely binding the functional material to a disc element.

[0013] Alternatively or additionally, the functional material can be mechanically retained by the plurality of disc elements. For example, the functional material can be disposed between adjacent disc elements and sandwiched in between the stacked disc elements as they are stacked.

[0014] The fibre material of the plurality of disc elements can be any useful fibre material. In one or more embodiments, the fibre material is formed from polypropylene, polyethylene, polyvinylidene difluoride, nylon, polyesters, polyamides, polytetrafluoroethylene, and the like. Such fibre materials are also suitable for retaining

electrostatic charge, and can be electrostatically charged by any useful method. In one or more embodiments, the electrostatically charged fibre material is charged by tribo-electrification charging, corona charging, electron beam charging, ion beam charging, radiation charging, boundary charging, and the like.

[0015] The plurality of disc elements may include non-woven fibres orientated in any suitable manner, such as an orientation substantially perpendicular or parallel to a longitudinal axis of the filter. However, in some preferred embodiments, at least one of the plurality of disc elements includes randomly orientated non-woven fibres. In a preferred embodiment, all of the plurality of disc elements include randomly orientated non-woven fibres. Disc elements having randomly orientated non-woven fibres can be more effective in retaining the functional material compared to disc elements having fibres with other orientations, because the randomly orientated fibres create less of a clear path for any functional material to travel through.

[0016] Preferably, the cylindrical element has a length of about 20mm or less, and more preferably a length of about 10mm or less. In some embodiments, the cylindrical element has a length of at least 2 mm.

[0017] Preferably, at least one or all of the plurality of disc elements has a thickness of about 2000 micrometres or less, more preferably about 1000 micrometres or less. In some embodiments, at least one or all of the plurality of disc elements has a thickness of at least about 50 micrometers.

[0018] In one or more embodiments, the electrostatically charged fibre material includes electret fibres. Such materials are commercially available under the trade designation 3M FILTRETE fibre (3M Company, St. Paul, MN, USA). Such electret fibres may have a thickness in a range from 3 to 30 micrometres and a weight in a range from 2.5 to 8 denier, and the web may have a basis weight in a range from 10 to 500 g/m². In some embodiments, non-electrostatically charged fibre material can include synthetic fibres. Such materials are commercially available under the trade designation COLBACK fibre (Colbond, Arnhem, the Netherlands). These non-woven fibre webs may have a thickness of up to 600 micrometers and a basis weight in a range from 30 to 250 g/m², and the fibres of these webs may have a thickness of up to 40 micrometers.

[0019] In one or more embodiments, functional material is uniformly applied to at least one disc to form a uniform distribution of functional material on the surface of the at least one disc. Alternatively, for some functional materials, it may be preferably to have a non-uniform distribution of functional material on the surface of the at least one disc. This can include a distribution where the functional material is more heavily distributed in a central region of the at least one disc than in a peripheral region of the at least one disc, or it could include a distribution where the functional material is more heavily distributed in a peripheral region of the at least one disc than in a

central region of the at least one disc.

[0020] In one or more embodiments, at least two of the plurality of disc elements retain a substantially equal amount, by weight, of functional material. That is, preferably, one of the plurality of disc elements retains within about 10 percent of the amount, by weight, of functional material as that retained by at least one other disc element of the plurality of disc elements. In other embodiments, at least two of the plurality of disc elements have different amounts, by weight, of functional material retained thereon. In some preferred embodiments, a downstream disc element retains a greater amount, by weight, of functional material than a disc element disposed upstream of the downstream disc element.

[0021] These functionalized disc elements are then stacked together to form the functional portion. In one or more embodiments, the stacking step includes stacking together the plurality of functionalized disc elements with alternating disc elements formed of fibres without functional material, to form the functional portion. In some embodiments, the functional portion can then be positioned between a mouth end segment and a distal end segment to form the filter.

[0022] Functional material can include removing materials, such as catalysts or sorbents, which capture or convert constituents of the mainstream smoke passing through the filter. Functional material can include releasing materials, which release compounds, such as flavourant, into the mainstream smoke passing through the filter.

[0023] Material that captures smoke constituents includes sorbents such as activated carbon, coated carbon, active aluminium, aluminium oxide, zeolites, sepiolites, molecular sieves, and silica gel, for example. Material that captures smoke constituents includes ion exchange materials such as single amino acids, amino functional materials, and polyelectrolytes, for example. In many embodiments activated carbon is dispersed within the functional portion. In some embodiments, the particle size of the material that captures or converts smoke constituents may be measured using a standard mesh test. For example, at least about 90% by weight of the material may have a particle size between ASTM mesh size 20 and ASTM mesh size 70.

[0024] Material that converts smoke constituents includes catalysts such as manganese, chromium, iron, cobalt, nickel, copper, zirconium, tin, zinc, tungsten, titanium, molybdenum, vanadium materials, and any oxide thereof, titania, ceria and gold or gold on titania and nanostructures such as graphene, graphene oxide, functionalised graphene and carbon nanotubes for example.

[0025] Functional materials are materials that release compounds into the mainstream smoke passing through the functional portion or filter include flavourant material. Flavourant material can include particles of a sorbent or cellulosic material impregnated with liquid flavourant or particulate material such as herbaceous material, or any combination thereof. Flavourant materials include, but are not limited to, materials that contain natural or syn-

thetic menthol, peppermint, spearmint, coffee, tea, spices (such as cinnamon, clove and ginger), cocoa, vanilla, fruit flavours, chocolate, eucalyptus, geranium, eugenol, agave, juniper, anethole and linalool. In addition, flavourant materials may include essential oils, or a mixture of one or more essential oils. An "essential oil" is an oil having the characteristic odour and flavour of the plant from which it is obtained. Suitable essential oils include, but are not limited to, eugenol, peppermint oil and spearmint oil. In many embodiments the flavourant material comprises menthol, eugenol, or a combination of menthol and eugenol. The term "herbaceous material" is used to denote material from an herbaceous plant. A "herbaceous plant" is an aromatic plant, the leaves or other parts of which are used for medicinal, culinary or aromatic purposes and are capable of releasing flavour into smoke produced by a smoking article. Herbaceous material includes herb leaf or other herbaceous material from herbaceous plants including, but not limited to, mints, such as peppermint and spearmint, lemon balm, basil, cinnamon, lemon basil, chive, coriander, lavender, sage, tea, thyme and carvi. The term "mints" is used to refer to plants of the genus *Mentha*. Suitable types of mint leaf may be taken from plant varieties including but not limited to *Mentha piperita*, *Mentha arvensis*, *Mentha niliaca*, *Mentha citrata*, *Mentha spicata*, *Mentha spicata crispa*, *Mentha cordifolia*, *Mentha longifolia*, *Mentha pulegium*, *Mentha suaveolens*, and *Mentha suaveolens variegata*. In some embodiments, flavourant material can include tobacco material.

[0026] The functional material can have an average particle size of about 1000 micrometers or less, or about 1000 nanometers or less. Alternatively or additionally, the functional material can have an average particle size of about 5 nanometers or more, or about 1 micrometer or more.

[0027] In some embodiments, such as those where the functional material includes materials that capture smoke constituents as sorbents or releasing materials such as flavourants, the functional material can have an average particle size between about 1 micrometer and 1000 micrometers, more preferably between about 50 micrometers and 750 micrometers.

[0028] In other embodiments, such as those where functional material includes materials that convert smoke constituents such as catalysts, graphene or carbon nanotubes, the functional material can have an average particle size between about 5 nanometers and 5000 nanometers, more preferably between about 5 nanometers and 1000 nanometers.

[0029] The functional material can be present in the functional portion in an amount from about 1 mg or more, or from about 5 mg or more. Alternatively or additionally, the functional material can be present in the functional portion in an amount from about 180 mg or less, or from about 100 mg or less.

[0030] In some embodiments, such as those where the functional material includes materials that capture smoke

constituents as sorbents or releasing materials such as flavourants, the functional material can be present in the functional portion in an amount from about 50 mg to about 180mg, or from about 80 mg to about 120 mg. Such loading amounts can be preferable for micro-sized functional material, such as activated carbon, where the average particle size is in a range from about 1 to 1000 micrometers.

[0031] In some other embodiments, such as those where functional material includes materials that convert smoke constituents such as catalysts, graphene or carbon nanotubes, the functional material can be present in the functional portion in an amount from about 5 mg to about 100mg, or from about 5 mg to about 50 mg. Such loading amounts can be preferable for nano-sized functional material, such as graphene or carbon nanotubes, where the average particle size is in a range from about 1 to 1000 nanometers.

[0032] The functional portion may include between 2 and 20 disc elements. In one or more embodiments, the functional portion includes between 6 and 12 disc elements.

[0033] In some embodiments, the plurality of disc elements include a first disc element retaining functional material, and a second disc retaining functional material, the second disc element being disposed upstream of the first disc element. In one or more of these embodiments, the first disc element can retain functional material having a large average particle size, such as in a range from about 1 to 1000 micrometers. Alternatively or additionally, the second disc element can retain functional material having a small average particle size, such as in a range from about 5 to 1000 nanometres. In some preferred embodiments, the average particle size of the functional material retained by the first disc element is greater than the average particle size of the functional material retained by the second upstream disc element. Such arrangements can provide several benefits. For example, the larger sized particles of functional material retained by the first disc element are less likely to break free of the first disc element due to their size, and therefore there is less concern to place these particles towards the downstream end of the cylindrical element. Conversely, the smaller sized functional material retained by the second upstream disc element are more likely to break free of the second disc element due to their size, and therefore the provision of one or more disc elements downstream of this second disc element can help to increase the chances of such smaller sized particles being re-retained by a disc element disposed further downstream of the second disc element, should these smaller sized particles break free of the second disc element. Furthermore, if the first disc element has larger particles retained thereon, such larger particles can act as a further barrier against any smaller particles that have broken free of an upstream disc element, such as the second disc element, and thereby further improve the effectiveness of the first disc element in retaining any functional material that has bro-

ken free of an upstream disc element.

[0034] Filters according to the disclosure can be attached to a tobacco rod to form all or at least part of a smoking article. Preferably, the filter is axially aligned with the tobacco rod. In many embodiments, the filter is joined to the tobacco rod with tipping paper. In one or more embodiments, the filter includes three filter segments in axial alignment with each other, one of the segments comprising the functional portion.

[0035] In many embodiments the overall length of the smoking article is between about 70 mm and about 130 mm. In some embodiments the overall length of the smoking article is about 85 mm. The external diameter of smoking article can be between about 5.0 mm and about 8.5 mm, or between about 5.0 mm and about 7.1 mm for slim sized smoking articles or between about 7.1 mm and about 8.5 mm for regular sized smoking articles. The overall length of the filter of the smoking article can be between about 18 mm and about 36 mm. In some embodiments the overall length of the filter is about 27 mm.

[0036] The resistance to draw (RTD) of the smoking articles and the filters of the present disclosure can vary. In many embodiments the RTD of the smoking article with the filter is between about 50 to 130 mm H₂O. The RTD of a smoking article with the filter refers to the static pressure difference between the two ends of the specimen when it is traversed by an air flow under steady conditions in which the volumetric flow is 17.5 millilitres per second at the output end. The RTD of a specimen can be measured using the method set out in ISO Standard 6565:2002.

[0037] Preferably, the filter includes a mouth end filter segment, a rod end filter segment and the functional portion separates the mouth end segment from the rod end segment. The mouth end segment and the rod end segment can each include a plurality of non-woven fibres, such as cellulose acetate fibres. In one or more embodiments, the fibres of the mouth end filter segment and the rod end filter segment are not electrostatically charged. The fibres of the mouth end filter segment and the rod end filter segment can have any suitable orientation, such as a random orientation or an orientation substantially parallel to a longitudinal axis of the filter. In one or more embodiments, the mouth end segment and the rod end segment have a longitudinal length in a range from 2 to 15 mm, or in a range from 3 to 10 mm, or in a range from 3 to 7 mm. In one or more embodiments, the mouth end filter segment and the rod end filter segment are provided without functional material.

[0038] In one or more embodiments, smoking articles according to the present disclosure may be packaged in containers, for example in soft packs or hinge-lid packs, with an inner liner coated with one or more flavourants.

[0039] Any suitable smoking article may include the filters described herein. The term "smoking article" includes cigarettes, cigars, cigarillos and other articles in which a smokable material, such as a tobacco, is lit and

combusted to produce smoke. The term "smoking article" also includes articles in which smokable material is not combusted such as but not limited to smoking articles that heat the smoking composition directly or indirectly, or smoking articles that neither combust nor heat the smoking composition, but rather use air flow or a chemical reaction to deliver nicotine or other materials from the smokable material.

[0040] It will be understood that any of the features described above are equally applicable to a smoking article or a filter for a smoking article according to this disclosure.

[0041] According to this disclosure, there is provided a method of forming a smoking article or a filter for a smoking article, having a functional portion, the method comprising the steps of providing a plurality of disc elements of non-woven fibres, disposing functional material on at least the surface of each of the plurality of disc elements, and stacking together the plurality of disc elements to form a cylindrical element defining the functional portion of the filter, the functional material being retained by the plurality of disc elements.

[0042] In some embodiments, functional material is applied and electrostatically retained to one or more of the plurality of disc elements of non-woven and electrostatically charged fibres to form a plurality of functionalized disc elements.

[0043] The terms "upstream" and "downstream" refer to relative positions of elements of the smoking article or filter described in relation to the direction of mainstream smoke as it is drawn from a tobacco rod and through the filter.

[0044] The term "sorbent" refers to material that captures one or more smoke constituents.

[0045] The term "particle size" refers to the largest cross sectional dimension of an individual particle within the particulate material. The "average" particle size refers to the arithmetic mean particle size for the particles. The particle size distribution for a sample of particulate material may be determined using a known sieve test.

[0046] All scientific and technical terms used herein have meanings commonly used in the art unless otherwise specified. The definitions provided herein are to facilitate understanding of certain terms used frequently herein.

[0047] As used herein, the singular forms "a", "an", and "the" encompass embodiments having plural referents, unless the content clearly dictates otherwise.

[0048] As used herein, "or" is generally employed in its sense including "and/or" unless the content clearly dictates otherwise.

[0049] As used herein, "have", "having", "include", "including", "comprise", "comprising" or the like are used in their open ended sense, and generally mean "including, but not limited to". It will be understood that "consisting essentially of", "consisting of", and the like are subsumed in "comprising," and the like.

[0050] In many of the depicted figures, various aspects

of smoking articles or components of smoking articles described above are illustrated. The schematic drawings are not necessarily to scale and are presented for purposes of illustration and not limitation. Various drawings depict various aspects described in this disclosure. However, it will be understood that other aspects not depicted in the drawings fall within the scope and spirit of this disclosure. Like numbers used in the figures refer to like components, steps and the like. However, it will be understood that the use of a number to refer to a component in a given figure is not intended to limit the component in another figure labelled with the same number. In addition, the use of different numbers to refer to components is not intended to indicate that the different numbered components cannot be the same or similar.

[0051] The disclosure will be further described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a schematic cross section view of a smoking article having a filter according to the present disclosure; and

Figure 2 shows a schematic cross section view of another filter according to the present disclosure having alternating functional material loaded discs.

[0052] The smoking article **10** shown in **Figure 1** includes a tobacco substrate or tobacco rod **12** attached to an axially aligned filter **20**. The filter **20** is joined to the tobacco rod **12** with tipping paper **14**. The tobacco rod **12** includes tobacco material **13** such as cut tobacco shreds.

[0053] **Figure 1** illustrates a smoking article **10** having a downstream mouth end filter segment **22**, an upstream rod end filter **26** segment and a functional portion **28** separating the mouth end segment **22** from the rod end segment **26**. The functional portion **28** includes a plurality of disc elements **30** stacked together to form a cylindrical element. The functional portion **28** includes a functional material **32** retained within the plurality of disc elements **30**. Each of the disc elements **30** are defined by non-woven fibres orientated perpendicular to a longitudinal axis of the filter **20**. The functional portion **28** has an upstream end **27** and a downstream end **29**. The upstream end **27** extends toward the tobacco rod **12**.

[0054] **Figure 2** illustrates a filter **20** according to the present disclosure having alternating functional material loaded discs **30**. The functional portion **28** includes a functional material **32** retained within the plurality of disc elements **30** and each of these functionalized disc elements **30** are separated by non-functionalized disc elements **31** comprising electrostatically charged fibres without functional material. In other words, the functional portion **28** comprises an alternating arrangement of disc elements **30** comprising retained functional material **32** with disc elements **31** comprising electrostatically charged fibres without functional material. Each of the disc elements **30** and **31** are defined by non-woven fibres

orientated perpendicular to a longitudinal axis of the filter **20**.

5 Claims

1. A smoking article comprising:

a filter comprising a functional portion comprising a plurality of disc elements stacked together to form a cylindrical element, the functional portion comprising a functional material retained by the plurality of disc elements, wherein each of the disc elements comprise non-woven fibres.

2. A smoking article according to claim 1, further comprising:

a mouth end filter segment; and
a rod end filter segment, wherein the functional portion separates the mouth end segment and the rod end segment.

3. A smoking article according to any preceding claim, wherein at least one of the plurality of disc elements comprises randomly orientated non-woven fibres.

4. A smoking article according to any preceding claim, wherein at least one or all of the plurality of disc elements has a thickness of about 1000 micrometres or less.

5. A smoking article according to any preceding claim, wherein the functional material comprises a removing material.

6. A smoking article according to any preceding claim, wherein the functional material comprises particles having an average particle size of less than about 2000 micrometers.

7. A smoking article according to any preceding claim, wherein the functional material is mechanically retained by the plurality of disc elements.

8. A smoking article according to claim 7, wherein the functional material is mechanically retained by the plurality of disc elements by disposing the functional material between adjacent stacked disc elements.

9. A smoking article according to any preceding claim, wherein the plurality of disc elements comprise electrostatically charged fibres, such that the functional material is electrostatically retained by the plurality of disc elements.

10. A smoking article according to any preceding claim, wherein the functional material is included in the filter

in an amount from about 180 mg or less.

11. A smoking article according to any preceding claim, wherein the plurality of disc elements comprise a first disc element having functional material retained thereon, and a second disc having functional material retained thereon, the second disc element being disposed upstream of the first disc element, and wherein the average particle size of the functional material retained by the first disc element is greater than the average particle size of the functional material retained by the second upstream disc element. 5 10
12. A filter for a smoking article comprising: 15
a functional portion comprising a plurality of disc elements stacked together to form a cylindrical element, the functional portion comprising a functional material retained by the plurality of disc elements, wherein each of the disc elements comprise non-woven fibres. 20
13. A method of forming a filter having a functional portion, the method comprising: 25
providing a plurality of disc elements of non-woven fibres;
disposing functional material on at least the surface of each of the plurality of disc elements; and
stacking together the plurality of disc elements to form a cylindrical element defining the functional portion of the filter, wherein the functional material is retained by the plurality of disc elements. 30 35
14. A method according to claim 13, wherein the functional material is electrostatically retained on the plurality of disc elements.
15. A method according to claim 13 or claim 14, wherein the stacking step comprises stacking together the plurality of functionalized disc elements such that the functional material is retained between adjacent stacked disc elements. 40 45

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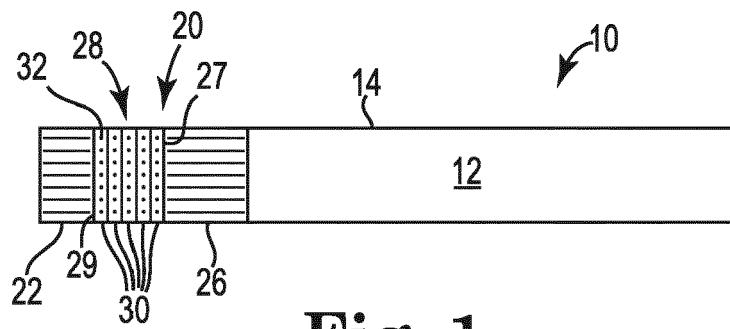


Fig. 1

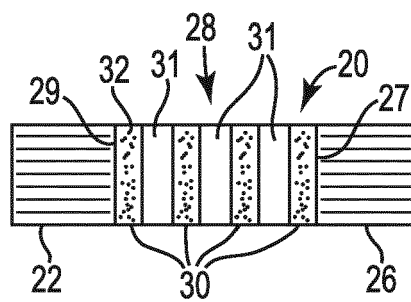


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 13 15 7202

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 30 August 2013	Examiner Koob, Michael
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ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 13 15 7202

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82