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[54]	Title:	SMOKING ARTICLE WITH CONCENTRIC FILTER	
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[57]	Abstract:	<p>A smoking article (10) incorporates a tobacco rod (12) and a filter attached to the tobacco rod. The filter includes a concentric filter segment having a central core portion with sorbent material and an outer periphery layer circumscribed about the central core portion. At least about 80 weight pcnt of the sorbent in the smoking article is disposed in the central core portion. The central core portion has a lower RTD than the periphery layer. A ventilation zone is disposed adjacent an upstream end of the concentric sorbent segment.</p>	

### EXAMPLES

A smoking article prototype (Example A) and a reference smoking article (Comparative Example) were similarly constructed except for the location of the ventilation zone. Example A and Comparative Example were then tested and the results are reported below.

Example A and the Comparative Example were constructed as shown in Figure 2 herein except the location of the ventilation zone was altered in the Comparative Example. The concentric sorbent segment included a central core portion formed of paper containing 8.4 mg of activated carbon. The periphery layer was formed of cellulose acetate and the second and third filter segments were formed of cellulose acetate. The central core portion exhibited an RTD of 780 mm WG and the periphery layer exhibited an RTD of 1600 mm WG. The concentric sorbent segment had a length of 12 mm and the second and third filter segments each had a length of 7.5 mm.

Example A had ventilation located on the second filter segment and 2.5 mm from the upstream end of the concentric sorbent segment. Comparative Example had the ventilation zone located on the concentric sorbent segment and 4.5 mm from the downstream end of the concentric sorbent segment. Table 1 reports selected physical and analytical results for the Example A and Comparative Example.

Table 1

	Filter Dilution (%)	Total RTD (mmH <sub>2</sub> O)	Filter RTD (mmH <sub>2</sub> O)	TAR (mg/cig)	Smoke nicotine (mg/cig)	CO (mg/cig)
Ex. A	49	96	96	5.7	0.48	8.2
Comp. Ex.	45	126	104	6.4	0.59	8.1

Smoke constituent analysis was performed on both Example A and Comparative Example to evaluate the impact of the ventilation position on the carbon efficiency. Table 2 reports the means and standard deviations for both Example A and Comparative Example for analysed smoke constituents.

Table 2

Smoke constituent (ug/mg SN)			Standard Deviation		Diff (Comp-Ex. A)
	Comp	Ex. A	Comp	Ex. A	
Propionaldehyde	62.8	52.4	2.3	4.9	-10.3
Butyraldehyde	47.1	41.5	2.2	3.0	-5.6
Crotonaldehyde	27.9	25.6	1.72	3.4	-2.3
Acetone	312.7	268.7	15.8	26.7	-44.0
Methylethylketone	75.2	66.7	3.7	6.3	-8.5
Acetaldehyde	772.2	637.8	27.5	42.3	-134.4
Acrolein	71.5	58.4	3.7	7.0	-13.1
Formaldehyde	41.7	35.5	2.5	3.3	-6.1
1,3-Butadiene	72.2	58.6	3.7	3.3	-13.6
Benzene	67.5	57.0	2.7	2.9	-10.4
Isoprene	577.8	440.3	36.3	28.2	-137.5
Acrylonitrile	13.6	11.5	0.6	1.1	-2.0
Toluene	104.2	94.3	5.6	5	-9.9

The results reported above indicate that the position of the ventilation zone upstream or near the upstream end of the concentric sorbent segment enhances the efficiency of the sorbent in the concentric filter segment.

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## SMOKING ARTICLE WITH CONCENTRIC FILTER

The present disclosure relates to a smoking article with a concentric filter segment with a sorbent disposed in the core of the concentric filter segment.

5 Filter cigarettes typically comprise 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. In some cases, it is known to use a filter plug with a concentric core design wherein one material is used for the inner core and another material surrounds the core and forms an outer portion of the concentric filter  
10 plug.

It would be desirable to provide a novel smoking article that has an efficient sorbent containing filter segment to capture smoke constituents. It is desirable that the novel smoking article utilize a minimum amount of sorbent material to reduce cost and potentially minimize the effect on taste. Providing a novel smoking article construction that improves  
15 sorbent efficiency is particularly desirable.

According to the current disclosure, there is provided a smoking article having a tobacco rod and a filter attached to the tobacco rod. The filter includes a concentric sorbent segment having a central core portion with sorbent material and an outer periphery layer circumscribed about the central core portion. The central core portion has lower resistance to draw, a lower density, or both a lower resistance to draw and density, than the periphery layer. A ventilation zone is disposed adjacent an upstream end of the concentric sorbent  
20 segment.

Smoking articles according to the present disclosure provide an effective way to improve smoke constituent contact with the sorbent material. Smoke constituents preferentially pass through the central core portion of the concentric sorbent segment. The novel smoking article construction concentrates mainstream smoke flow through the central core portion of the concentric sorbent segment, increasing the efficiency of the sorbent material. This in turn allows for the use of less sorbent material (and associated cost) to achieve the desired level of smoke constituent capture. In addition, the use of less sorbent  
25 material in the smoking article may assist in minimizing the sorbent material's effect on the taste of the smoking article.  
30

Smoking articles according to the disclosure include a filter attached to a tobacco rod. The filter or filter element is axially aligned with a tobacco rod. In many embodiments, the filter or filter element is joined to the tobacco rod with tipping paper. The filter or filter element can be formed of one or more segments. Preferably, the smoking article includes  
5 three filter segments in axial alignment with each other.

The filter includes a concentric filter segment. The concentric filter segment includes a central core portion with sorbent material and an outer periphery layer circumscribed about the central core portion. The outer periphery layer and the central core may be separated from one another by a permeable or, more preferably, an impermeable layer of material.  
10 The material separating the outer periphery and the central core is permeable if it has a porosity of 20 Coresta units or greater, and it is impermeable if it has a porosity of less than 20 Coresta units.

The resistance to draw (RTD) of the central core portion is less than the RTD of the periphery layer. In many embodiments the RTD of the central core portion is less than about  
15 90% of the RTD of the periphery layer or less than about 75% of the RTD of the periphery layer or less than about 65% of the RTD of the periphery layer. In many embodiments, the RTD of the central core portion is about 10% to about 90% or about 20% to about 75%, or about 30% to about 65% of the RTD of the periphery layer. Measurement of the RTD is further discussed below.

In some embodiments the periphery layer RTD can be increased relative to the central core by increasing an amount of plastizier in the periphery layer relative to an amount of plastizier in the central core portion. In some cases, the outer periphery layer may have more than about 8 weight % pasticizer or more than about 9 weight % plastisizer. In addition, or in the alternative, the outer periphery layer may have less than about 12 weight  
20 % plasticizer. Further, in some embodiments the central core portion may also contain plasticizer. For example, the central core portion may have less than about 7 weight % plasticize or less than about 6 weight % plasticizer. In addition, or in the alternative, the central core may have greater than about 3 weight % plasticizer. The central core portion may also have a lower density than the periphery layer. In many embodiments, the central  
25 core portion has a density that is less than about 90%, less than about 75%, or less than about 65% of the density of the periphery layer.  
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The central core portion can have a cylindrical form. The central core can be formed of cellulose-based material and sorbent material dispersed or impregnated within in the

cellulose-based material. In many embodiments the cellulose-based material is a nonwoven web of cellulosic material such as paper, for example. In other embodiments the central core may be cellulose acetate.

The term "sorberent" refers to material that captures one or more smoke constituents.  
5 The term "smoke" or "tobacco smoke" refers to the mixture of vapor and particulate phase given off as a tobacco material undergoes combustion or heating, or both combustion and heating. Sorbents include carbon (for example, activated carbon, coated carbon, beaded carbon), active aluminium, zeolites, sepiolites, molecular sieves, and silica gel, for example. In many embodiments at least about 80 weight % or at least about 90 weight %, or the entire  
10 amount (100 weight %) of total smoking article sorberent material is in the central core.

In many embodiments the smoking articles contains less than about 25 mg, less than about 15 mg, or less than about 10 mg of sorberent material. In some embodiments the smoking articles contains about 1 mg to about 25 mg, about 1 mg to about 15 mg, or about 1 mg to about 10 mg of sorberent material, such as activated carbon, for example. In many  
15 embodiments the central core contains less than about 25 mg, less than about 15 mg, or less than about 10 mg of sorberent material. In some embodiments the central core contains about 1 mg to about 25 mg, about 1 mg to about 15 mg, or about 1 mg to about 10 mg of sorberent material, such as activated carbon, for example. In many embodiments the sorberent can be incorporated within the paper forming the central core or disposed on the paper  
20 surface forming the central core. In some embodiments, the sorberent is both incorporated within the paper forming the central core and disposed on the paper surface forming the central core.

The outer periphery layer can have an annular form and surround the central core portion. The outer periphery layer can have a density that is greater than the density of the  
25 central core. In many embodiments the periphery layer does not include sorberent material. The outer periphery layer can be formed of any useful filtration material. In many embodiments the outer periphery layer is formed from cellulose acetate. In other embodiments the outer periphery layer is formed of a nonwoven web of cellulosic material such as paper.

30 In some embodiments the filter only includes the concentric sorberent segment. In many embodiments, the filter includes the concentric sorberent segment in axial alignment with a second filter segment separating the concentric sorberent segment from the tobacco rod. In preferred embodiments, the filter element includes the concentric sorberent segment in

axial alignment and separating a second filter segment and a third filter segment. The concentric sorbent segment has an upstream end and a downstream end. The upstream end extends toward the tobacco rod.

5 The outer periphery layer can have a first outer diameter and the central core portion can have a second outer diameter. Preferably, the second outer diameter is at least about 40% of the first outer diameter, more preferably at least about 60%. In addition, or in the alternative, the second outer diameter is less than about 90% of the first outer diameter, more preferably less than about 80%. The second outer diameter is preferably between about 40% and about 90% of the first outer diameter, more preferably between about 60% and about 80% of the first outer diameter.

10 The second filter segment and the third filter segment can be formed of any useful filtration material. In many embodiments the second filter segment and the third filter segment are formed of a cellulose-based material. The cellulose-based material can be a nonwoven web of cellulosic material such as paper. In other embodiments, one or both of the second and third filter segments may be formed of cellulose acetate. In many 15 embodiments, the second filter segment and the third filter segment are formed of uniform filtration material such as cellulose acetate tow. The second filter segment and the third filter segment can be designed to adjust the physical properties of the smoking article such as resistance to draw, for example.

20 A ventilation zone is disposed adjacent to the upstream end of the concentric sorbent segment. The ventilation zone admits ambient air into the smoking article and combines the admitted ambient air with mainstream smoke. The ventilation zone has an increased porosity that allows a greater amount of airflow into the device along the ventilation zone as compared to areas adjacent to the ventilation zone. The ventilation zone may be provided 25 by a plurality of apertures or perforations formed in the tipping paper. This plurality of apertures or perforations can circumnavigate the circumference of the smoking article. In many embodiments the ventilation zone provides ambient air dilution of the mainstream smoke of at least about 30%, or at least about 40% or at least about 60%. In addition, or in the alternative, the ventilation provides ambient air dilution of less than about 90%, or less 30 than about 80%. In some embodiments, the dilution level may be between about 30% and about 90%, between about 40% and about 90%, or between about 60% and about 80%. The term "dilution" refers to the percentage by volume of air that is included in the smoke delivered to the consumer from the mouth end of the filter with the ventilation completely

open. The level of ventilation or dilution achieved by the ventilation elements can be determined using ISO test method 9512:2002.

Applicants have discovered that positioning the ventilation zone near or adjacent to the upstream end of the concentric sorbent segment can improve the efficiency of the sorbent material in the concentric sorbent segment. While not wishing to be bound by any particular theory, it is believed that positioning the ventilation zone near or adjacent to the upstream end of the concentric sorbent segment concentrates the smoke toward the central core portion and the sorbent material, as the smoke flows through the concentric filter segment.

In many embodiments the ventilation zone is disposed within about 5 mm or within about 3 mm or within about 1 mm of the upstream end of the concentric sorbent segment. In preferred embodiments, the ventilation zone is disposed within about 5 mm or within about 3 mm or within about 1 mm upstream from the upstream end of the concentric sorbent segment. In some embodiments, the ventilation zone is disposed along the length of the second filter segment separating the concentric sorbent segment from the tobacco rod. Preferably, the ventilation zone is within about 5 mm or within about 3 mm or within about 1 mm upstream from the concentric sorbent segment, for example within the second filter segment. In some embodiments the ventilation zone is located in at least two positions along the length of the filter to further guide the mainstream smoke through the central core portion of the concentric sorbent segment. For example, a first ventilation zone can be within about 5 mm or within about 3 mm or within about 1 mm of the upstream end of the concentric sorbent segment (for example, any of these distances upstream of the upstream end of the concentric sorbent segment) and a second ventilization zone can be downstream of this first ventilation zone, in the concentric sorbent segment..

In many embodiments the overall length of smoking article is between about 70 mm and about 130 mm, or about 85 mm. The external diameter or outer periphery layer first outer 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, more preferably about 27 mm. The length of individual filter segments (i.e., concentric sorbent segment, second filter segment, and third filter segment) can vary depending if only the concentric sorbent segment is present or if the second filter segment is

also present or if the third filter segment is also present. The second and third filter segments is preferably between about 5 and about 10 mm and the concentric sorbent segment is preferably between about 8 to about 16 mm.

The resistance to draw (RTD) of the smoking articles of the present disclosure can vary. In many embodiments the RTD of the smoking article is between about 90 to 130 mm H<sub>2</sub>O. The RTD of a smoking article 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. The RTDs of the outer periphery layer and the central core portion can be tested by first separating the concentric sorbent segment from the rest of the filter. The RTD of the outer periphery layer of the concentric sorbent segment can then be tested by blocking off the upstream end of the central core portion of the concentric sorbent segment and utilizing the RTD test method described above. The RTD of the central core portion of the concentric sorbent segment can be tested by blocking off the upstream end of the outer periphery layer of the concentric sorbent segment and utilizing the RTD test method described above. The portions of the concentric sorbent segment can be blocked off with an impermeable material, for example an impermeable adhesive.

Smoking articles according to the present invention may be packaged in containers, for example in soft packs or hinge-lid packs, with an inner liner coated with one or more flavourants.

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 according to the present disclosure having two filter segments; and

Figure 2 shows a schematic cross section view of a smoking article according to the present disclosure having three filter segments.

The smoking article 10 shown in Figure 1 and Figure 2 includes a tobacco substrate or tobacco rod 12 attached to an axially aligned filter 11. The filter 11 is joined to the tobacco rod 12 with tipping paper 14. The tobacco rod 12 includes tobacco material 13 such as cut tobacco shreds.

Figure 1 illustrates a smoking article 10 having a concentric sorbent segment 20 and a second filter segment 15 in axial alignment with each other. The second filter segment 15 separates the tobacco rod 12 from the concentric sorbent segment 20. The concentric sorbent segment 20 has an upstream end 22 and a downstream end 21. The upstream end 22 extends toward the tobacco rod 12.

Figure 2 illustrates a smoking article 10 having three filter segments where the concentric sorbent segment 20 is in axial alignment and separates a second filter segment 15 and a third filter segment 17. The concentric sorbent segment 20 has an upstream end 22 and a downstream end 21. The upstream end 22 extends toward the tobacco rod 12.

A ventilation zone 30 is disposed adjacent to the upstream end 22 of the concentric sorbent segment 20. The ventilation zone 30 is provided by a plurality of apertures or perforations formed in tipping paper 14 that is otherwise generally air impermeable. The ventilation zone 30 can circumnavigate the circumference of the smoking article 10. Positioning the ventilation zone 30 near or adjacent to the upstream end 22 of the concentric sorbent segment 20 appears to improve the efficiency of the sorbent material in the concentric sorbent segment 20. The ventilation zone 30 can be disposed within about 5 mm or within about 3 mm of the upstream end 22 of the concentric sorbent segment 20. In preferred embodiments, the ventilation zone 30 is disposed within about 5 mm or within about 3 mm upstream from the concentric sorbent segment 22 and along the length of the second filter segment 15, as illustrated.

The filter 11 includes a concentric sorbent segment 20. The concentric sorbent segment 20 includes a central core portion 23 including a sorbent material and an outer periphery layer 24 circumscribed about the central core portion 23. The central core portion 23 has a lower resistance to draw or density than the periphery layer 24, as described above.

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## Claims

1. A smoking article comprising:  
a tobacco rod;  
5 a filter attached to the tobacco rod, the filter comprising;  
a concentric sorbent segment including a central core portion comprising sorbent material  
and an outer periphery layer circumscribed about the central core portion, the central  
core portion having a lower resistance to draw than the periphery layer, at least about 80  
weight % of the sorbent in the smoking article is disposed in the central core portion; and  
10 a ventilation zone disposed adjacent an upstream end of the concentric sorbent segment  
wherein the ventilation zone is disposed within about 5 mm or within about 3 mm or within about  
1 mm upstream from the upstream end of the concentric sorbent segment.
2. A smoking article according to claim 1 further comprising a second filter segment axially aligned with  
15 and between the tobacco rod and the concentric sorbent segment and the ventilation is disposed along a  
length of the second filter segment.
3. A smoking article according to claim 2 wherein the concentric sorbent segment separates a third  
filter segment from the second filter segment.  
20
4. A smoking article according to claim 3 wherein the third filter segment comprises cellulose  
acetate tow and the second filter segment comprises cellulose acetate tow
5. A smoking article according to any one of claims 1 to 4 wherein a resistance to draw of the  
25 central core portion is about 75% or less of a resistance to draw of the periphery layer.
6. A smoking article according to any one of claims 1 to 4 wherein the central core portion has a  
lower density than the periphery layer.
- 30 7. A smoking article according to any one of claims 1 to 4 wherein the smoking article comprises  
less than about 25 mg of sorbent material.
8. A smoking article according to any one of claims 1 to 4 wherein the sorbent comprises activated  
carbon.

9. A smoking article according to any one of claims 1 to 4 wherein the smoking article comprises less than about 15 milligrams of activated carbon.
10. A smoking article according to any one of claims 1 to 4 wherein the entire amount of the sorbent in the smoking article is disposed in the central core portion of the smoking article.
11. A smoking article according to any one of claims 1 to 4 wherein the central core portion comprises carbon material dispersed in cellulose material.
12. A smoking article according to any one of claims 1 to 4 wherein the central core portion comprises paper impregnated with carbon material and the periphery layer comprises cellulose acetate tow.
13. A smoking article according to any one of claims 1 to 4 further comprising a second ventilation zone disposed along the concentric sorbent segment.

