

SMOKING ARTICLE WITH A FLOW RESTRICTOR

Background

Heretofore, cigarettes with high levels of ventilation have usually had unacceptably low levels of resistance to draw (RTD) unless some counter measure was in place to make-up the shortfall in RTD. In the past, high density cellulose acetate filter segments were used to address the shortfall. However such filtered segments tended to reduce tar delivery (FTC), with little or no effect upon gas phase components of mainstream tobacco smoke, such as carbon monoxide (CO) and nitrogen oxide (NO). This solution tended to worsen the CO to tar (FTC) ratios in lower delivery (FTC tar) cigarettes.

Ventilation has a desirable attribute in that, when operating alone, it will reduce both the particulate phase and the gas phase of mainstream smoke. Highly ventilated cigarettes however have drawbacks in RTD as previously discussed.

Brief Description of the Drawings

Figs. 1 is a side view of a smoking article constructed in accordance with a preferred embodiment, wherein the filter tipping paper has been partially unfolded to reveal internal filter components.

Figs. 2 and 3 are side views of smoking articles with the tipping paper partially unwrapped to reveal filter components of further embodiments.

Fig. 4 is a side view a smoking article with the tipping paper partially unwrapped to reveal filter components including a flow restricting filter segment having end-to-end symmetry.

Figs. 5 and 6 are side views of smoking articles with the tipping paper partially unwrapped to reveal filter components of further embodiments.

Fig. 7 illustrates a process whereby the presently disclosed filter rods are formed and inserted into smoking articles.

Detailed Description of Preferred Embodiments

Presently disclosed embodiments provide the benefit of a highly ventilated smoking article with desired amounts of resistance to draw and/or provisions for facilitating high speed cigarette manufacturing on conventional cigarette making equipment.

Referring to Fig. 1, a preferred embodiment provides a smoking article 10 comprising a tobacco rod 12 and a filter 14 connected with the tobacco rod 12 by a tipping paper 16. Preferably, the filter 14 comprises a first filter segment 18 at an upstream portion 20 of the filter 14, a mouthpiece filter segment 22 at downstream end portion 24 of the filter 14, and a flow restricting filter segment 26 situated between the first and mouthpiece filter segments 18 and 22. In this embodiment, filter segments 18 and 22 are low particulate efficiency filter segments

preferably constructed from cellulose acetate tow of 8.0 denier per filament and 35,000 total denier. In this embodiment, included is a relatively short flow restricting filter segment 26 (hereinafter, restrictor disc) adjacent the first upstream filter plug 18 of a length of approximately 3mm to 10mm, more preferably approximately 3mm to 7mm in length. In this embodiment, a cavity 46 within the filter 14 is defined at least in part by a cylindrical tubular filter segment 48. Preferably, the cavity 46 extends from the mouthpiece filter 22 to the ventilation zone 40 and preferably past zone 40 to flow restriction 30. The tubular filter segment 48 is preferably constructed from a relatively heavy filter plug, paper or other material such as cellulose acetate.

In this embodiment, the ventilation zone 40 comprises a plurality of ventilation holes which extend through the tipping paper 16 and through the tubular filter segment 48. This arrangement facilitates the use of online laser perforation techniques to provide ventilation holes during the manufacture of the smoking article 10.

Referring to Fig. 2, another embodiment provides a smoking article comprising a tobacco rod and a filter connected with the tobacco rod by a tipping paper. Preferably, the filter comprises a first filter segment 18 constructed from cellulose acetate tow at an upstream portion of the filter, a mouthpiece filter segment 22 constructed from cellulose acetate tow at a downstream end portion of the filter, and a restrictor disc 26 situated between the first and mouthpiece filter segments 18 and 22. In this embodiment, the cavity 46 within the filter is defined at least in part by a preferably spiral wound paper tube 48 that extends the whole length of the filter and is sufficiently strong to be self-sustaining, yet thin enough to accommodate on-line laser perforation. The outer annulus of the restrictor disc preferably has a sliding fit with the inner surface of paper tube 48. Preferably, the cavity 46 extends from the mouthpiece filter 22 to the ventilation zone 40 and preferably past zone 40 to the flow restriction 30. The tube 48 can be made using other materials or other forming techniques such as extruding the tube or forming a tube with a longitudinal seam.

Referring to Fig. 3, another embodiment provides a smoking article comprising a tobacco rod and a filter connected with the tobacco rod by a tipping paper. Preferably, the filter comprises a first filter segment 19 constructed from carbon on tow at an upstream portion of the filter, a second filter segment 18 constructed from cellulose acetate tow downstream of the first filter segment 19, a mouthpiece filter segment 22 constructed from cellulose acetate tow at a downstream end portion of the filter, and a restrictor disc 26 situated between the second and mouthpiece filter segments 18 and 22. In this embodiment, the outer annulus of restrictor disc 26 is preferably slightly frustoconical to facilitate plunging of restrictor disc 26 along tube 48 from left to right. Preferably, the cavity 46 extends from the mouthpiece filter 22 to the ventilation zone 40 and preferably beyond there to the flow restriction 30.

Referring to Fig. 4, another embodiment provides a smoking article comprising a tobacco rod and a filter connected with the tobacco rod by a tipping paper. Preferably, the filter comprises a first filter segment 19 constructed from carbon on tow at an upstream portion of the filter, a second filter segment 18 constructed from cellulose acetate tow downstream of the first filter segment 19, a mouthpiece filter segment 22 constructed from cellulose acetate tow at a downstream end portion of the filter, and a flow restricting filter comprising a restrictor disc 26 having a flow restriction orifice 30 situated between the second filter segment 18 and the mouthpiece filter segment 22. In this embodiment, restrictor disc 26 preferably is symmetrical or has end-to-end symmetry. Preferably, the cavity 46 extends from the mouthpiece filter 22 to the ventilation zone 40 and preferably beyond there to the flow restriction orifice 30.

Referring to Fig. 5, another embodiment provides a smoking article comprising a tobacco rod and a filter connected with the tobacco rod by a tipping paper. Preferably, the filter 14 comprises a segment 18 of filter tow material at an upstream portion of the filter 14 and a flow restricting filter segment comprising a restrictor disc 26 having a flow restriction orifice 30 situated downstream of the filter segment 18. Preferably, cavity 46 extends to the ventilation zone 40 and preferably beyond there to the flow restriction orifice 30.

Referring to Fig. 6, another embodiment provides a smoking article comprising a tobacco rod and a filter connected with the tobacco rod by a tipping paper. Preferably, the filter comprises a first filter segment 19 constructed from carbon on tow at an upstream portion of the filter, a second filter segment 18 constructed from cellulose acetate tow downstream of the first filter segment 19, and a flow restricting filter comprising a restrictor disc 26 having a flow restriction orifice 30 situated downstream of the second filter segment 18. Preferably, cavity 46 extends to the ventilation zone 40 and preferably beyond there to the flow restriction orifice 30.

Fig. 7 illustrates the process whereby the presently disclosed filter rods are formed into smoking articles. Fig. 7A illustrates a double length paper filter tube 48' and a double length (two-up) cellulose acetate segment 18'. The double length cellulose acetate segment 18' is plunged or otherwise placed centrally in the double length paper filter tube 48', as illustrated in Fig. 7B. Restrictor discs 26, 26 are plunged or otherwise placed into position by sliding into opposite ends of the tube 48', for example, using plungers 27, as illustrated in Fig. 7C. Mouth piece segments 22, 22 are then plunged or otherwise placed into place by sliding into opposite ends of the tube 48', for example, using plungers 27, as illustrated in Fig. 7D. The resulting double length filter rod is inserted between two spaced apart tobacco rods 12, 12 and secured with tipping paper 16, as illustrated in Fig. 7E. Laser perforation 40 takes place and then the 2-up cigarettes are severed. All of these operations can be carried out using high speed cigarette making machinery.

In manufacturing embodiments having a filter segment 19 (Figs. 3, 4 and 6), a two-up filter segment 19' is first disposed at the central location of the two-up tube 48' and single plugs 18 are then plunged or otherwise placed into place on opposite sides of the two-up plug 19'. Restrictor plugs 26 are then plunged or otherwise placed into place on opposite sides adjacent plugs 18 and mouthpiece plugs 22 are plunged or otherwise placed on opposite sides adjacent the restrictor plugs.

Preferred dimensions for an 83mm smoking article include, for example, a filter length of 27mm, a mouth end filter segment length of 7mm, vent holes 12mm from the mouth end of the smoking article, a restrictor disc length of 5mm, a cellulose acetate tow segment length of 2.5mm, and a carbon on tow filter segment length of 7mm.

The ventilation zone 40 is established with a first row (and optionally second and possibly third rows) of ventilation holes through the tipping paper 16 and filter tube 48'. Accordingly, air is preferably drawn through the ventilation holes of ventilation zone 40 and into the cavity 46 defined between the flow restriction 30 and the mouthpiece filter segment 22.

Preferably the ventilation zone 40 is located near or adjacent to the flow restriction 30 so that air drawn through the ventilation zone 40 is allowed to mix with the mainstream smoke before arriving at the mouthpiece filter 22.

Preferably, the distance between the ventilation zone 40 and the mouthpiece filter 22 is at least 5mm or in the range of 5mm - 12mm.

Preferably, the ventilation zone 40 achieves a ventilation level of the smoking article of at least 25% and more preferably at least 50% to 90%.

The restrictor disc 26 may comprise an annular partition (transverse wall having one or more orifices therein) that establishes the flow restriction 30, with the partition specifically in the form of an orifice of reduced diameter. The partition may be frustoconical and convergent either into or away from the direction of flow of mainstream smoke passing therethrough. Furthermore, a pair of partitions may be arranged internally within the restrictor disc 26 so as to provide end to end symmetry for the restrictor disc 26. A filter component having end to end symmetry facilitates high speed filter rod making in that the component works the same whether or not the rod making machine orients one end of the component first or reverses it.

A restrictor disc 26 having end to end symmetry has tubular body portions of equal length on opposite sides of a transverse wall (partition). By such arrangement manufacture of the filter is facilitated by the end to end symmetry of the restrictor disc 26.

Optionally, a second zone of ventilation may be located upstream of the flow restriction 30 in addition to or in lieu of ventilation zone 40 as provided above.

Manufacture of the smoking articles 10 in accordance with the present disclosure is facilitated with the use of pre-perforated tipping paper.

In all embodiments, preferably the flow restriction 30 is sized to contribute sufficient pressure drop such that the smoking article 10 presents a resistance to draw of at least 70mm water or greater, preferably in the range of 90mm - 120mm water. Preferably, the partition (transverse wall) has a diameter of approximately 7.0mm to 8.0mm and more preferably approximately 7.4mm to 7.8mm wherein the partition preferably has one or optionally, at least one orifice of a diameter of about 0.5mm to about 0.9mm and more preferably about 0.5mm to 0.7mm. Since the pressure drop of the restrictor component depends on the open area, multiple orifices can also be used. For example, in one embodiment there are two orifices in the partition of 0.5mm diameter each.

The restrictor disc 26 may be constructed of paper, a plastic, polymer or a metal and more preferably made of a paper product or a biodegradable plastic/polymer or other suitable material having degradability properties.

Preferably, the flow restriction 30 and the mouthpiece filter 22 are spaced by distance sufficient to reduce impaction of particulate smoke components upon the upstream face of the mouthpiece filter 22. Preferably, the flow restriction 30 is spaced approximately 4mm to 15mm from the mouthpiece filter 22, more preferably approximately 6mm to 10mm.

It is to be appreciated that in all embodiments, the filter may be constructed from simple combining techniques typically used in the industry for manufacturing cigarettes at high speeds. Additionally each embodiment includes tubular support about the cavity 46 so as to provide desired firmness throughout length of the filter 14. Furthermore, the embodiments provide the necessary amount of resistance to draw while maintaining the desired degree of high ventilation throughout the smoke. The latter attribute is achieved by placement of the ventilation zone 40 downstream of the flow restriction 30. Furthermore, placing the ventilation in ventilation zone 40 in spaced apart relation to the mouthpiece filter plug 22 assures mixing of air drawn into the filter 14 through the ventilation zone 40 with mainstream smoke drawn from the tobacco rod 12. In one tested embodiment, uniform stain patterns appeared at the buccal end of the mouthpiece filter 22, which is indicative of good mixing.

During smoking of a cigarette constructed in accordance with the present disclosure, a desired degree of ventilation (e.g., 50% to 90%, preferably about 70%) is preferably maintained throughout the smoke.

In contrast, when ventilation holes are placed upstream of the flow restriction 30, ventilation tends to drop as smoking progresses through the puff count.

It will be understood that the foregoing description is of the preferred embodiments, and is, therefore, merely representative of the article and methods of manufacturing the same. It can be appreciated that variations and modifications of the different embodiments in light of the above teachings will be readily apparent to those skilled in the art. Accordingly, the exemplary

embodiments, as well as alternative embodiments, may be made without departing from the spirit and scope of the articles and methods as set forth in the attached claims.

CLAIMS:

1. A smoking article comprising:
 - a tobacco rod adapted to produce mainstream smoke; and
 - a filter having an upstream end portion and a downstream end portion, said filter arranged to receive mainstream smoke at said upstream end portion, said filter comprising:
 - a first filter plug segment of low particulate efficiency at said upstream end portion;
 - a mouthpiece filter plug segment of low particulate efficiency at said downstream end portion;
 - a flow restricting filter segment at a location adjacent said first filter segment, said flow restricting filter segment including a restriction establishing a substantial portion of a predetermined resistance to draw of said smoking article;
 - tipping paper attaching said filter with said tobacco rod and including an air-admissible ventilating zone at a location along said filter between said restriction of said flow restricting filter segment and said mouthpiece filter;
 - said restriction of said flow restricting filter segment being spaced from said mouthpiece filter by a distance sufficient to reduce impaction of a mainstream smoke component upon an upstream end portion of said mouthpiece filter; and
 - a cylindrical segment superposed by said ventilating zone, said cylindrical segment at least partially defining a portion of a cavity between said mouthpiece filter and said restriction of said flow restricting filter segment, said cylindrical segment being air transmissible at said ventilation zone.
2. The smoking article of Claim 1, wherein the cylindrical segment comprises a discrete tubular filter segment and wherein a row of perforations extends through said tipping paper and tubular filter segment at said ventilation zone.
3. The smoking article of Claim 1, wherein the cylindrical segment comprises first and second integral tubular portions of said flow restricting filter segment, said first and second tubular portions being symmetrical with respect to said restriction.
4. The smoking article of Claim 1, wherein said ventilation zone is spaced from said mouthpiece filter by a distance sufficient to promote mixing of air drawn through said ventilation zone and mainstream smoke drawn from said tobacco rod.

5. The smoking article of Claim 1, wherein said flow restricting filter segment includes a frustoconical transverse wall.
6. The smoking article of Claim 5, wherein said flow restricting filter segment includes a transverse wall which is convergent downstream.
7. The smoking article of Claim 5, wherein said flow restricting filter segment includes a transverse wall which is convergent upstream.
8. A smoking article comprising a tobacco rod and a filter, said filter comprising:
 - a cylindrical tube attached to said tobacco rod with tipping paper;
 - a first filter segment at a location along said cylindrical tube adjacent and in a downstream relation to said tobacco rod;
 - a flow restricting filter segment at a location adjacent and in a downstream relation to said first filter segment;
 - said filter further including a cavity adjacent and in a downstream relation to said flow restricting filter segment; and
 - a ventilation zone at a location along said cavity comprising perforations through said tipping paper and said cylindrical tube, said ventilation zone in a downstream relation to said flow restricting filter segment.
9. The smoking article of Claim 8, wherein the flow restricting filter comprises a tubular segment having a transverse wall with one or more orifices therein.
10. The smoking article of Claim 9, wherein the transverse wall is centrally located between upstream and downstream ends of the tubular segment.
11. A method of making a filter for a smoking article comprising:
 - placing a first filter segment in a cylindrical filter tube;
 - placing a flow restricting filter segment in the filter tube adjacent to said first filter segment, such that said filter further includes a cavity adjacent to said flow restricting filter segment; and
 - establishing a ventilation zone at a location along said cavity, said ventilation zone comprising perforations through said filter tube.