

[54] CONTROL OF SMOKING DELIVERY THROUGH CIGARETTE PAPER POROSITY 3,805,799 4/1974 Stewart et al. 131/15 B

[75] Inventors: Willie G. Houck, Jr., Richmond; Warren E. Clafin, Bon Air, both of Va.

Primary Examiner—Robert W. Michell
Assistant Examiner—V. Millin
Attorney, Agent, or Firm—Watson Leavenworth Kelton & Taggart

[73] Assignee: Phillip Morris Incorporated, New York, N.Y.

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[57] ABSTRACT

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A cigarette wrapper is provided with different levels of porosity therein, the porosity of the wrapper at the smoking end being lower than that along the remaining length and in the direction of the mouth end so that alteration of burn is achieved thereby to effect a leveling of the smoke delivery profile as smoking progresses.

[52] U.S. Cl. 131/15 B; 131/9; 131/10.3

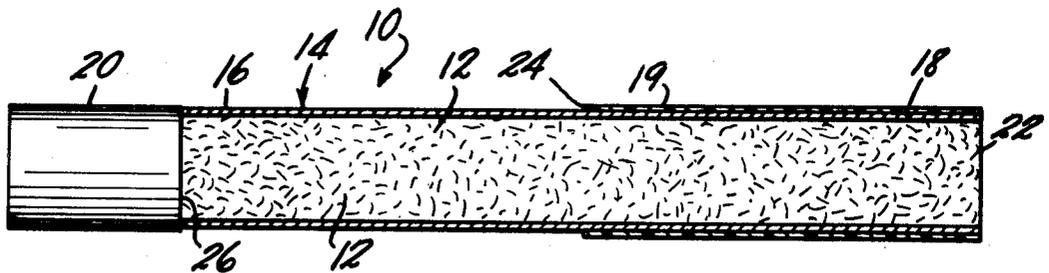
[51] Int. Cl.² A24D 1/02

[58] Field of Search 131/9, 8, 15 B

[56] References Cited
UNITED STATES PATENTS

3,667,479 6/1972 Sanford et al. 131/15 B

9 Claims, 5 Drawing Figures



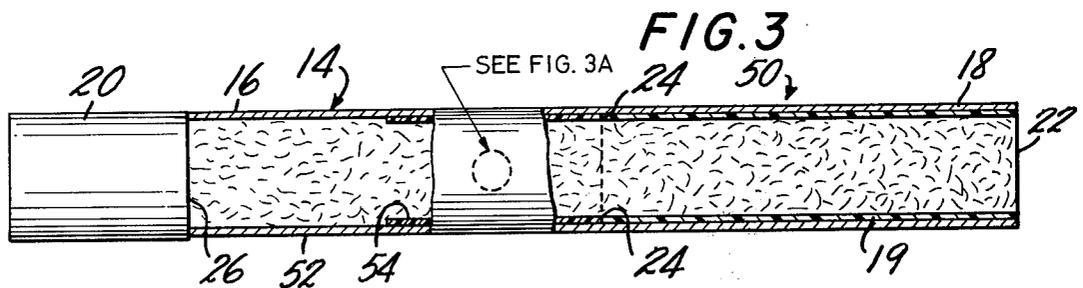
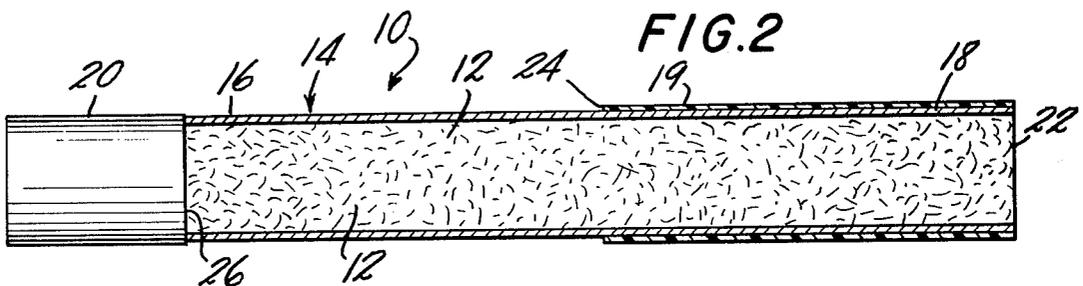
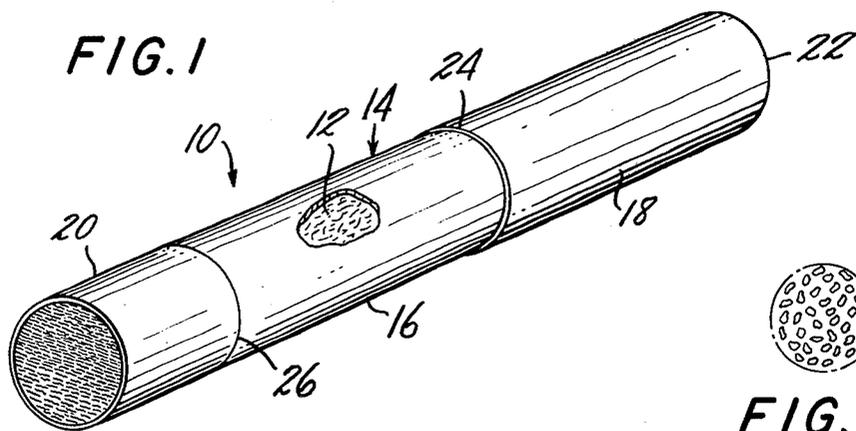
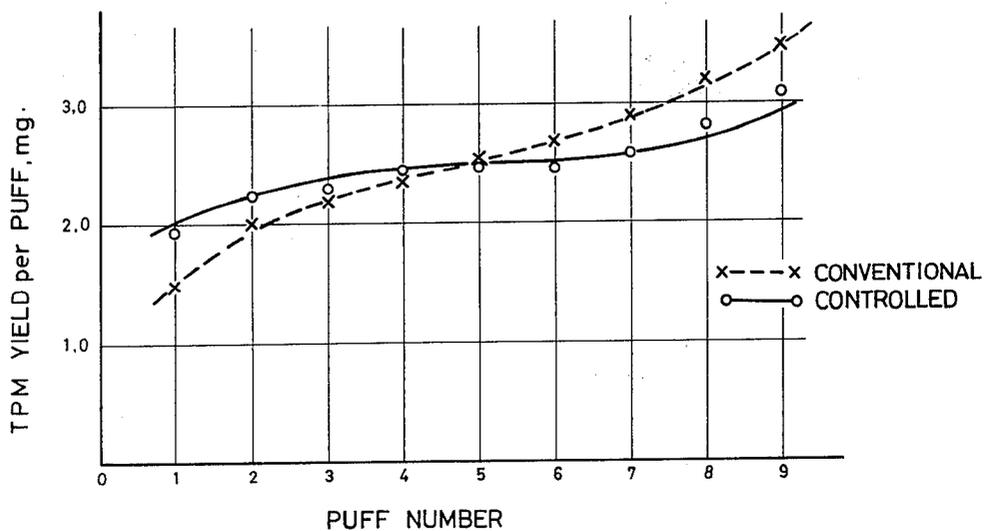


FIG. 4



CONTROL OF SMOKING DELIVERY THROUGH CIGARETTE PAPER POROSITY

BACKGROUND OF THE INVENTION

It is known to be desirable to provide a cigarette with a relatively level smoke delivery profile, that is, the yield in total particulate matter (TPM) measured in milligrams, of particulate material delivery to the smokestream, per puff, should be about equal for the later stage smoking puffs as for those of the initial stage smoking puffs. While the weight of total particulate matter delivered during the last stages of smoking may in actuality be somewhat higher than those for the initial stages, the variation is not unduly large. When the TPM yield is plotted against the puff number for a cigarette of this type, the resulting curve is relatively flat or at least flatter than that for a cigarette of conventional construction. Various ways of making cigarettes for the purpose of leveling or flattening the smoke delivery profile are known. For example, U.S. Pat. Nos. 2,992,657; 3,511,247; 3,526,904; 3,606,892; 3,667,479 and 3,805,799 describe various constructions of ventilated cigarettes. While the teachings of said patents are adequate for the intended purpose of ventilating cigarettes during smoking with attendant leveling of the smoke delivery profile, they do not adequately respond to the need for a practical way of economically making such cigarettes without resort to highly specialized manufacturing techniques and equipment. Additionally, these patents generally involve the use of apertures in the cigarette wrapper which become uncovered at some point in advance of the burning coal giving a visual indication of the occurrence of opening of the ventilation passages. From the standpoint of smoker satisfaction it would be advantageous if such visual phenomenon could be eliminated.

SUMMARY OF THE INVENTION

The present invention has for a purpose, the provision of burn-altering characteristics in a cigarette to achieve leveling of the cigarette smoke delivery profile during the course of smoking the cigarette so that the total particulate matter delivered near the end of smoking will be very close in measure with that delivered during the initial stages of smoking. This invention takes advantage of the ability to influence air flow into the coal region of the cigarette by changing paper porosity rather than introducing ventilation further down the rod as in the aforementioned patents. According to the invention, an elongated paper wrapper which in conventional manner closely encircles a cylinder of tobacco is provided with a character of lesser porosity therein along a predetermined length thereof adjacent the smoking end of the cigarette than the porosity of the wrapper along the remaining length. In this manner during initial stages of smoking, i.e., during the early smoking puffs, the air flow is more directly into the burning zone of the coal region, whereas, during the later stages of smoking, the wrapper section which has a higher porosity will allow relatively higher levels of air to bypass the burning zone to offset the increasing level of TPM delivery as attends progressive smoking of the cigarette. For the purposes of rendering the first-mentioned length of paper wrapper less porous than the remaining length, a porosity-reducing additive is coated on the first-mentioned length of the wrapper. Desirably, the coating will be effective to reduce the

wrapper porosity in the first-mentioned length to a predetermined value, e.g., to between about 120 to about 400 seconds Greiner (ASTM D726). The remaining length of the paper wrapper which has a higher porosity generally should have a porosity greater than the first-mentioned length, e.g., in the range of about 20 to about 60 seconds Greiner. If desired, a portion of the remaining length of the wrapper can have an intermediate value of porosity, e.g., in the range of about 60 seconds to about 120 seconds Greiner, such portion of course being more remote from the mouth end than the portion of the remaining length which has the 20 to 60 seconds porosity. If desirable, a burn additive (of if one is already present in the wrapper a higher level of such burn additive) can be embodied as for example, by being incorporated in the coating applied to the wrapper. The burn-promoting additive is provided to offset a lower burning rate in the wrapper which stems from the use of the porosity-reducing additive. Of course if the porosity-reducing additive has no effect on the burn rate of the wrapper, the burn-promoting additive need not be employed.

The coating of porosity-reducing additive which is applied to the paper wrapping can be a film-forming material selected from the group consisting of sodium carboxymethyl cellulose, methyl cellulose, enzyme coated starch, ethylated starch, ethyl cellulose and cellulose acetate. Other film forming materials that would function as porosity-reducing additives also could be used.

If a burn-promoting additive is required, the same can be any one of known materials employed for such use, sodium-potassium citrate being illustrative as well as the materials enumerated in U.S. Pat. No. 3,667,479.

As a result of the lower porosity of the paper wrapper at the start of smoking, a higher than normal puff delivery (as measured by total particulate matter of TPM) occurs; at later stages the normal tendency of the cigarette to deliver higher TPM is counteracted by the increased porosity so that nearly the same level of delivery is found as at the early stage. This level of puff-by-puff delivery may be higher, or lower, than the median delivery from a conventional filter cigarette, but this is readily compensated by proper selection of a filter component, in well-known manner. Thus, for example, the delivery can be maintained at the level of the first or second puff from a conventional cigarette by employing a relatively high efficiency filter, but the delivery toward the end of the smoke will remain at about the same level instead of rising sharply as happens where papers of constant porosity are used.

The invention, accordingly, comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWING

A fuller understanding of the nature and objects of the present invention will be had from the following detailed description taken in conjunction with the accompanying drawings showing by way of example preferred embodiments of the inventive concept and in which:

FIG. 1 is a perspective view of a cigarette provided with a wrapper having at least two zones therein of different porosity characteristics, the wrapper being made

in accordance with the principles of the present invention so as to provide that a greater amount of air can be drawn in through the wrapper during the later stages of smoking than in the earlier stages.

FIG. 2 is a longitudinal vertical sectional view of the cigarette shown in FIG. 1.

FIG. 3 is a longitudinal vertical sectional view of a somewhat different form of cigarette in which the paper wrapper is provided with three zones of differing porosities.

FIG. 3a is an enlarged fragmentary view of the wrapper section depicted in dashed lines in FIG. 3.

FIG. 4 is a graph depicting the TPM yield per puff plotted against puff number resulting when a cigarette provided with a wrapper in accordance with the present invention is smoked.

Throughout the following description like reference numerals are used to denote like parts in the drawing.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 of the drawings, there is depicted a cigarette 10 which includes an elongated cylinder of tobacco 12 enclosed in a paper wrapper 14, such paper being normally sufficiently porous to admit air-stream flow therethrough, the paper wrapper further having at least two zones 16, 18 of different porosities, a more elaborate description of such porosity difference to be given below. The cigarette can include a mouthpiece or filter element 20 in conventional manner.

In accordance with the invention, a length of wrapper 18 adjacent the smoking end 22, that is being defined as extending from the smoking end 22 to a location 24 intermediate (between $\frac{1}{4}$ to $\frac{3}{4}$ of the distance from) the smoking end and mouth end 26 of the cigarette, has a porosity which is lower than that of the remaining length 16 of the wrapper, the porosity of the length 18 being less than that of said remaining length and being in the range of about 120 to about 400 seconds Griener. As those skilled in the art will understand the higher the Griener number the lower the porosity. The remaining length 16 or at least a portion thereof closest to the mouth end 26 of the paper wrapper will have a higher porosity desirably one in a range of about 20 to about 60 seconds Griener. Normally the paper wrapper will be provided per se to have a porosity in the range of about 20 to about 60 seconds Griener and the decrease of porosity in section 18 can be achieved by treating such section with a coating of a porosity-reducing additive. Such materials, for example, may include sodium carboxymethyl cellulose, methyl cellulose, enzyme coated starch, or ethylated starch. If the aforementioned materials are used for coating purposes, they can be applied to the paper wrapper along the first-mentioned length in aqueous solution form to provide when the solvent dries, a film 19 of such material on wrapper length 18. Such film desirably will extend along the full length of the first-mentioned wrapper length and in a fully encircling course around the wrapper as best seen in FIG. 2.

It is also possible to use other materials such as ethyl cellulose and cellulose acetate as porosity-reducing additives except that since the last-mentioned two materials are not water soluble, they would be applied in film form with a suitable solvent therefor, e.g., alcohol.

Since the utilization of a porosity-reducing additive in the wrapper tends to reduce the burn rate of the paper wrapper, it may be desirable to embody a burn-promoting additive such as sodium-potassium citrate in the wrapper. Such burn-promoting additive if already employed in the wrapper, per se, can have the level thereof increased, for example, from a normally used level of about 0.6 to 1.5 percent to a level of about 1.5 to 5.0 percent in the treated part of the wrapper. Where water soluble porosity-reducing additives are employed, it is possible to incorporate the burn-promoting additive directly in said solutions. On the other hand, if a non-aqueous solution is employed for coating the wrapper, the burn-promoting additive advantageously would be applied to the wrapper first in a water solution thereof following which the porosity-reducing additive would be applied. In the cigarette depicted in FIGS. 1 and 2, the length 18 of paper wrapper 14 which is treated to have its porosity reduced can be about equal in length to that having the higher porosity, e.g., from the smoking end 22 to location 24, the section can measure about 30 millimeters with the remaining length 16 or untreated portion of the wrapper having about an equivalent length.

The cigarette 50 depicted in FIG. 3 is essentially the same as that already described with the first-mentioned length 18 of wrapper 14 between the smoking end 22 and the location 24 being coated with a porosity-reducing additive 19 to provide a porosity in that length of wrapper of between about 120 to about 400 seconds Griener, the film 19 being applied at the wrapper inner surface. At least a portion of the remaining length 16 of the wrapper as at 52 has a porosity of about 20 to about 60 seconds Griener, such portion 52 being that located closest to the mouth end 26. In order to provide a smoother transition from no or substantially no ventilation to full ventilation through the paper wrapper, the remainder portion of the said remaining length 16 can be coated with a porosity-reducing additive coating 54 which will provide the wrapper in said remainder portion with a porosity of between about 60 seconds to about 120 seconds Griener. The latter can be achieved quite suitably by employing a low concentration solution of the porosity-reducing additive to coat the wrapper so that upon drying of the solvent, such wrapper surface will not coat in a continuous but rather a discontinuous film pattern. On the other hand, where the lower porosity is desired as in applying the coating to length 18 of cigarette 50, a higher concentration solution will be employed to provide a substantially continuous film of the porosity-reducing additive on the surface of said length 18 of the wrapper.

As is shown in FIGS. 2 and 3, the porosity-reducing additive can be applied to either the inner or outer surfaces of the paper wrapper.

The following example will serve to illustrate the invention:

A conventional cigarette paper having as manufactured a Griener porosity of 41 seconds and 1.2% by weight of sodium-potassium citrate burn additive was treated in zones of 60 mm. length with an aqueous solution of sodium carboxymethyl cellulose containing additional citrate to produce, when dry, treated zones having a Griener reading of 188 seconds and a citrate content of 4.1%. These zones alternated with untreated zones 60 mm. long. The mid-point of each untreated zone was marked by an index line to facilitate cutter in-

dexing. The paper wrapper was fed to a rod-maker together with a commercial-type cigarette filler, and the rods were cut to 60 mm. lengths at the index lines and midway between. The product take-off alternated on two conveyor belts to maintain separation between the oppositely oriented rods. Filters of cellulose acetate tow, 2.9 den./41,000 total den. and 20 mm. long, were attached in the conventional manner at the rod end having the index line (untreated end). These cigarettes had the following characteristics:

Resistance to draw (RTD), in. water	
Filter 3.4	
Overall 4.5	
TPM delivery, total:	mg 19.0
"Tar" delivery, mg	15.6

These cigarettes were smoked by machine to record TPM delivery puff-by-puff; control filter cigarettes with similar characteristics but with conventional paper wrappers were smoked for comparison. The profiles of TPM delivery are shown in FIG. 4 from which it will be noted the cigarette of the present invention had a flatter profile than the control.

During the course of smoking the cigarette, the porosity-reducing additive or wrapper length prevents or substantially inhibits air bypass around the burning zone and causes a higher TPM delivery on the early puffs. However, as smoking progresses during later puffs, the uncoated high porosity length allows a measure of air bypass the coal and into the cigarette to effect flattening of the cigarette smoking profile.

While the present invention discloses in one embodiment thereof, the employment of a porosity-reducing additive for providing differing characteristics of porosity in the paper wrapper, it is possible to achieve variation in porosity in the wrapper in other manners. For example, two papers having different densities and, thus, porosities can be used to make the wrapper, such sections in desired lengths being spliced together to make up the cigarette wrapper strip.

What is claimed is:

1. A smoking article comprising an elongated cylinder of tobacco, and a paper wrapper closely encircling said cylinder of tobacco, said wrapper having inner and outer surfaces and being sufficiently porous to admit air stream flow therethrough into said cylinder of tobacco when said smoking article is puffed during smoking, said article having a mouth end and a smoking end, said paper wrapper being characterized by having a

porosity of about 20 to about 60 seconds Griener and further by a length thereof extending from the smoking end a predetermined distance to a location intermediate said smoking and mouth ends having a coating on one of said wrapper inner and outer surfaces of a material which is effective to reduce the wrapper porosity in said length to between about 120 to about 400 seconds Griener, whereby during smoking of said article air stream flow through said first-mentioned length of said wrapper is substantially inhibited relative to air flow through the remaining length of said wrapper.

2. The smoking article of claim 1 in which a portion of the remaining length of said wrapper has a porosity of less than about 20 to about 60 seconds Griener but greater than that of the first-mentioned wrapper length, said portion being disposed adjacent said first-mentioned wrapper length.

3. The smoking article of claim 1 in which said coating is present on said first-mentioned length of wrapper surface in a continuous film thereof along the full longitudinal and encircling expanse of said first-mentioned length.

4. The smoking article of claim 1 in which said coating comprises a film-forming material selected from the group consisting of sodium carboxymethyl cellulose, methyl cellulose, enzyme coated starch, ethylated starch, ethyl cellulose and cellulose acetate.

5. The smoking article of claim 4 in which said coating contains additionally a burn-promoting additive.

6. The smoking article of claim 5 in which said burn-promoting additive is sodium potassium citrate.

7. The smoking article of claim 2 in which said portion of said remaining length has a coating on one of said wrapper inner and outer surfaces of a material which is effective to reduce the wrapper porosity in said portion to between about 60 seconds to about 120 seconds Griener.

8. The smoking article of claim 7 in which the coating on said first-mentioned length of wrapper is present thereon in a continuous film thereof along the full longitudinal and encircling expanse of said first-mentioned length, the coating on said portion of said remaining length wrapper surface being present thereon in a discontinuous film thereof along the longitudinal and encircling expanse of said portion.

9. The smoking article of claim 1 further comprising a tobacco filtering element connected in alignment with said wrapper cylinder of tobacco at the mouth end thereof.

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