United States Patent [19]

Stewart, Jr. et al.

[11] **3,805,799**

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[54] **CIGARETTE VENTILATION ACHIEVED WITH COATED WRAPPER**

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

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[52] **U.S. Cl.** ..... **131/9,** 131/10 A, 131/15 B

[51] **Int. Cl.** **A24d 01/02**

[58] **Field of Search** ..... 131/4 A, 15 R, 15 B, 8 R, 131/9, 10 A

[56] **References Cited**

UNITED STATES PATENTS

2,992,647	7/1961	Figge	131/15 B X
3,667,479	6/1972	Sanford et al.	131/15 B
2,746,890	5/1956	Legler	131/15 R X
3,395,714	8/1968	Kahane	131/8 R X

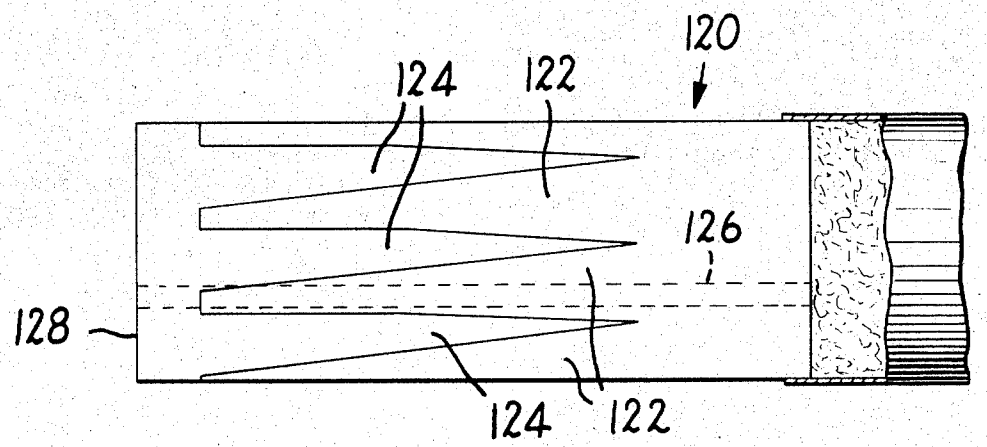
Primary Examiner—Robert W. Michell

Assistant Examiner—John F. Pitrelli

[57] **ABSTRACT**

A cigarette or smoking article is provided with ventilation or smoke dilution character by employing a wrapper which normally is sufficiently air-pervious to admit significant dilution air stream flow therethrough when the cigarette is puffed. The wrapper is coated on either of its inner or outer surface with an air-impervious material which is degradable in the presence of tobacco smoke, and a coating of a second air-impervious material which is non-degradable in the presence of smoke is embodied in the cigarette and extends a predetermined distance from the cigarette smoking end toward the mouth end to prohibit entry of air stream flow through the wrapper until the cigarette has been smoked said predetermined distance following which the degradable coating on the remaining length degrades to admit such air stream flow.

15 Claims, 8 Drawing Figures



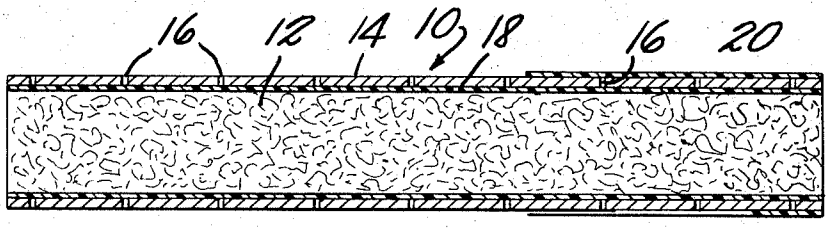


FIG. 1

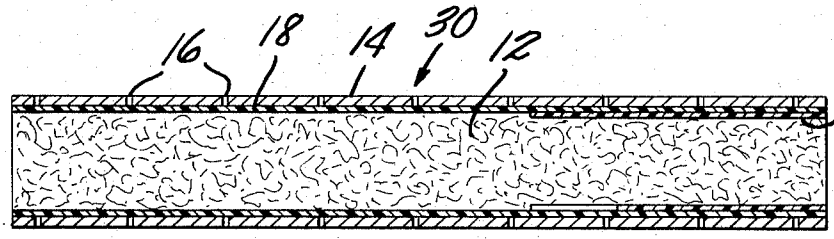


FIG. 2

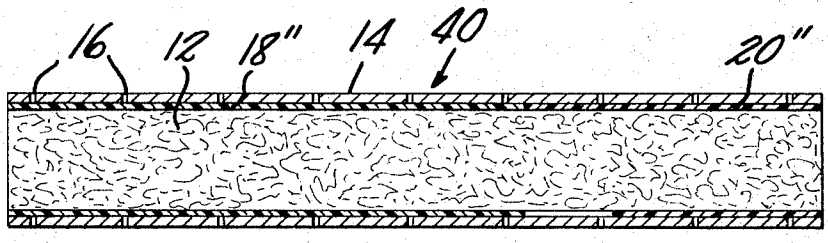


FIG. 3

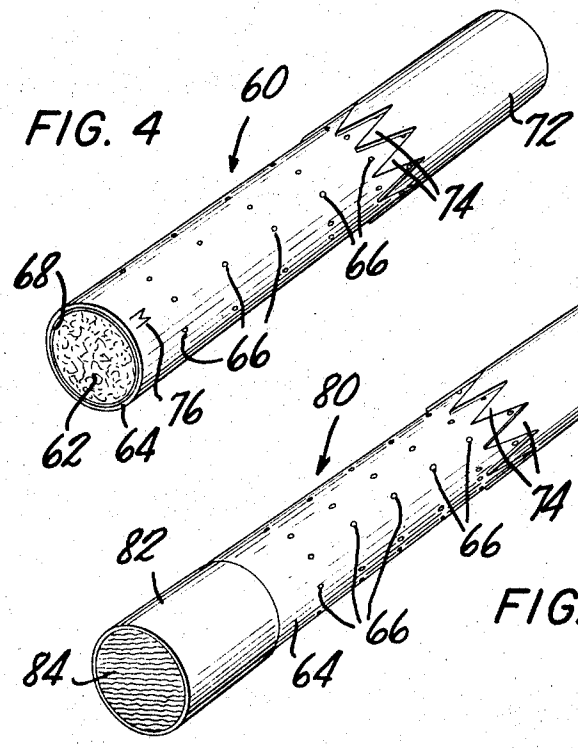


FIG. 4

FIG. 5

FIG. 6

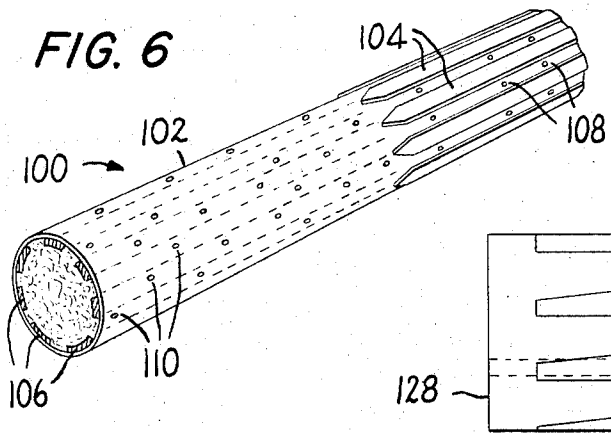
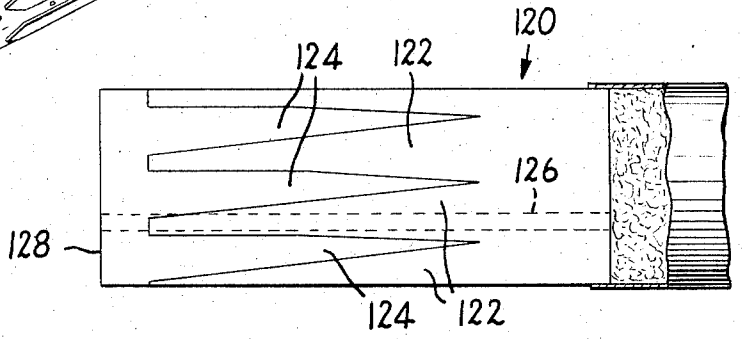


FIG. 7



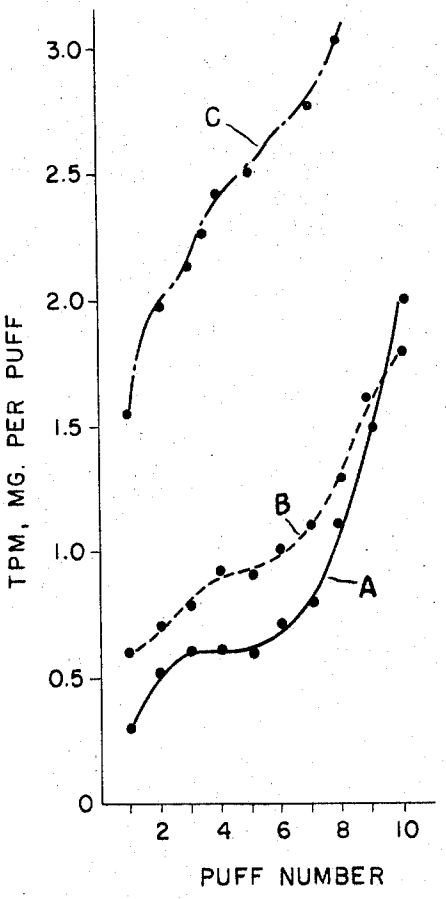


FIG. 8

CIGARETTE VENTILATION ACHIEVED WITH COATED WRAPPER

BACKGROUND OF THE INVENTION

Cigarette ventilation as a means of controlling cigarette TPM delivery profile is known. For example, holes can be provided in cigarette wrapper to admit air to dilute the smoke of the cigarette and thus reduce the delivery of each puff. U.S. Pat. No. 2,992,647 teaches that a covering of heat degradable material over the holes would provide means to give ventilation progressing with the advance of the burning coal, so that the ventilation would not decrease as the cigarette was smoked. U.S. Pat. Nos. 3,526,904 and 3,511,247 disclose improved means to accomplish this progressive opening. The delivery puff-by-puff, which taken as a whole is referred to as the profile, thus can be controlled so that there is less difference between the low TPM level early puffs and the higher TPM later ones; at the same time the total overall TPM delivery is less than for an unventilated cigarette. Cigarettes produced according to the aforementioned patents while quite effective for the intended purpose have certain drawbacks principally in respect of the difficulties associated with producing coated wrappers as prescribed on high speed machinery at economic production rates.

SUMMARY OF THE INVENTION

The present invention is concerned with a simplified manner of accomplishing leveling of the TPM delivery profile of a cigarette by ventilation wherein a smoke degradable material coating is degraded by tobacco smoke to admit significant dilution air stream flow through the wrapper to the cigarette. The cigarette wrapper is made exceptionally porous, either by its physical composition and structure or by virtue of perforations made in it and is coated on the outer or inner side with a thin layer of material which is stable under conditions of manufacture and storage, which material further is substantially impervious to air flow, but is degraded by concentrated tobacco smoke. This material can be of the type disclosed in the above mentioned U.S. patents. The wrapper is further coated on the inside or outside, in a selected area, with a thin layer of a second similarly stable and impervious material, but which is not degradable by concentrated smoke. The area of the paper coated with the second material is located at and adjacent to the end of the cigarette furthest from the smoker, that is, the smoking end. The portion of the cigarette so covered will deliver undiluted smoke during the early puffs since air cannot pass through the wrapper; as the smoke degrades the layer which coats that portion not covered by the second material, the porous paper will be uncovered to admit air and the later puffs will be diluted to counteract the trend toward higher TPM delivery. The pattern of coverage of the second material may be a simple one ending at a circumferential line, or it may be serrated to provide a gradual transition from non-ventilated to ventilated smoking condition. The non-degradable covering may be superimposed over a selected portion of the coating of degradable materials which has been previously applied, or the two materials may be applied exclusively of each other to separate areas of the paper.

It is also possible to apply either or both material coatings discontinuously to the wrapper, in such manner that some uncoated areas remain therein, so that from the beginning of smoking a positive but limited amount of dilution air flow can occur through the wrapper. This flow then is supplemented to give the required increasing ventilation as the degradable coating begins to be attacked. In such form, the coatings may be applied in separated longitudinal strips, or for "zero" porosity paper continuously except for one or two uncoated stripes, totalling 0.5 to 10 percent of the wrapper area.

The non-degradable material can be any suitable material which is non-degradable in the presence of smoke and which is otherwise stable at distances of about 3 mm and more beyond the burning coal of the cigarette. Particularly suited for this purpose are cellulose acetate and polystyrene.

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 DRAWINGS

A fuller understanding of the nature and objects of the invention will be had from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a longitudinal vertical sectional view of a ventilated cigarette made in accordance with the principles of the present invention, the smoke degradable coating being on the inner surface of the tobacco cylinder wrapper extending the full length thereof, and the non-degradable coating being on the outer surface of the wrapper extending from the smoking end a predetermined distance only in the direction of the mouth end.

FIG. 2 is a view similar to FIG. 1 except that the degradable coating is on the wrapper inner surface extending the full length thereof with the non-degradable coating being laid on the former.

FIG. 3 is a view similar to FIGS. 1 and 2 except that both the degradable and non-degradable coatings are on the wrapper inner surface extending only predetermined lengths in the wrapper to a common juncture closer to the smoking end than the mouth end of the cigarette.

FIG. 4 is a perspective view of a ventilated cigarette in which the degradable coating is on the wrapper inner surface extending the full length thereof and the non-degradable coating is on the outer surface, the latter including serrated segments remote from the cigarette smoking end to provide for a progressive transition from non-ventilated to ventilated smoking condition.

FIG. 5 is a perspective view of the cigarette shown in FIG. 4 being provided additionally with a filter element at the smoking end thereof.

FIG. 6 is a perspective view of a ventilated cigarette embodying a further form of materials coating arrangement in which certain areas of the wrapper inner and outer surfaces are left uncoated to provide a positive but limited dilution air inflow at all times during the course of smoking of the cigarette.

FIG. 7 is a side elevational view on enlarged scale partly in section of a cylinder embodying still a further

form of pattern in which the materials coatings can be applied to a cigarette wrapper.

FIG. 8 is a graph illustrating the TPM delivery profile of cigarettes made in accordance with the present invention and having in one form a degradable coating only, and in another form, both a degradable coating and a non-degradable coating.

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

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 of the drawings there is depicted a cigarette **10** made in accordance with the present invention, the cigarette including a cylinder of tobacco **12** and a wrapper **14** closely encircling the tobacco cylinder, the wrapper having inner and outer surfaces. Wrapper **14** is an air-pervious component provided either as a very porous air-pervious paper or an an air-impervious paper which has been perforated with openings such as at **16** to provide an air-pervious character thereto. In accordance with the present invention, the inner surface of wrapper **14** is coated with a layer **18** of a first air-impervious material which extends from one end of the wrapper in the direction of the other end, in the depicted embodiment such layer **18** extends the full length of the wrapper. The material in layer **18** additionally is degradable in the presence of tobacco smoke. Materials suited to that purpose include the types of materials disclosed in U.S. Pat. Nos. 2,992,647, 3,511,247 and 3,526,904. A particularly suitable material is a low molecular weight polyethylene oxide containing a peroxide, the peroxide functioning to partly degrade the coating subsequent to application to facilitate later complete degradation by tobacco smoke during smoking.

Wrapper **14** also is provided on the outer surface thereof with a layer or coating **20** of a second air-impervious material which extends from the smoking end of the cigarette a predetermined distance only in the direction of the mouth end. The material in layer **20** is further characterized by being non-degradable in the presence of tobacco smoke. Such material of course is consumable in the course of smoking, e.g., by the action of the burning coal causing disintegration of the same.

As taught in U.S. Pat. No. 2,992,647, there is a sharp temperature gradient behind the coal of a cigarette. Substances which melt at 316°C remain stable beyond 1 mm behind the coal, while those that melt at 260°C melt only at distances of 2 to 3 mm behind the coal. Accordingly, it is within the contemplation of the present invention that any material which is stable beyond 3 mm behind the coal can be employed as a non-degradable coating provided it is not materially degradable by tobacco smoke. Among the film forming materials which are suitable for layer **20** are cellulose acetate, other cellulose esters, polyoxyethylene with a molecular weight above 1,000,000, high-melting polyethylene, polypropylene and polystyrene. To be useful of course these materials must be formed into a non-porous film. Placing the non-degradable coating **20** outside of the degradable coating **18** as shown in FIG. **1**, gives some protection to the former in that it is shielded by the inner coating from the smoke action and heat. While the inner coating **18** is disintegrating it is protecting the outer coating **20** by absorbing heat energy in the melting or decomposition process. Thus materials which might not by themselves resist tobacco smoke as long as is required for the non-degradable film may serve the intended purpose.

When the cigarette **10** is smoked, initially the coating **20** will consume due to the action of the burning coal but will not degrade in advance of the coal at distances beyond about **3** mm so that the coating **10** will remain intact to prohibit air stream entry to the tobacco cylinder through wrapper openings **16** at least until the cigarette has been smoked the predetermined distance represented by the length of coating **20** notwithstanding that the coating **18** has over such distance been degraded. However once such coating **20** has been consumed, the coating **18** being degraded by the tobacco smoke allows for such dilution air stream inflow to the cigarette.

The cigarettes **30** and **40** shown in FIGS. **2** and **3** respectively are quite similar to that shown in FIG. **1.** Accordingly, the same reference numerals where applicable are used and where components are different these are designated by prime and double prime reference numerals, respectively. Thus the non-degradable coating **20'** of cigarette **30** instead of being on the outer surface of wrapper **14** is inside the wrapper and is laid over the degradable coating **18.** In FIG. **3,** the degradable coating **18''** instead of extending the full length of the wrapper terminates in common location with the non-degradable coating **20''** both being at the inner surface of the wrapper.

FIG. **4** shows a further modified form of cigarette **60** which includes a cylinder of tobacco **62** enclosed by wrapper **64,** the latter being provided with openings **66** and having on its inner surface a coating **68** of a smoke degradable material. A layer **72** of non-degradable material is coated on the outer wrapper surface at the smoking end like in the cigarette **10,** the layer **72** following a fully encircling course in respect of said wrapper and having segments **74** which terminate as a plurality of serration-like extensions to provide in cooperation with the coating **68** a region of gradual transition in the wrapper from non-degradable air stream flow prohibition to degradable air stream flow admission. Cigarette **60** is a non-filter type cigarette, and accordingly it may be desirable to incorporate means to denote to the smoker the mouth end thereof. Accordingly, an indicia **76,** e.g., a printed designation, can be marked on the wrapper for that purpose.

The cigarette **80** depicted in FIG. **5** is in all respects the same as the cigarette **60** shown in FIG. **4** and includes identical components, except, it includes a conventional smoke filter element **82** such as a wrapped cellulose acetate plug **84** joined to the cylinder of tobacco.

FIG. **6** depicts another form of cigarette in which the materials coatings applied to the wrapper **102** of cigarette **100** are of a discontinuous or interrupted nature so that a portion at least of the area of the wrapper remains uncoated. In this manner, a limited amount of dilution air flow can occur through the wrapper from the very start of smoking of the cigarette. Preferably, both the degradable and non-degradable coatings are applied in narrow bands extending longitudinally of the wrapper. Thus, the bands **104** of non-degradable material can be conveniently applied to the outer surface of the wrapper **102,** whereas the degradable coating

bands **106** conveniently can be applied at the inner surface of the wrapper. As smoking of the cigarette progresses, there will be initially supplied dilution air through openings **108** at the smoking end of the cigarette which dilution air flow will be supplemented later in the course of smoking when the degradable coating **106** uncovers the openings **110** to increase the measure of dilution.

FIG. 7 shows a still further form of cigarette in which so-called "zero" porosity paper is used for the wrapper. Zero porosity paper is understood by those skilled in the art as being a type of paper in which there is no time delay attending the passage of air flow through the paper. Conventional cigarette paper while porous has some time delay and accordingly would have a higher value in the grenier scale to indicate that condition. In the cigarette **120** depicted in FIG. **7**, the cigarette wrapper **122** of very high or zero porosity paper is coated on its outer surface with degradable polyethylene oxide except for a 0.2 mm wide continuous longitudinal area extending end to end of the wrapper that is left uncoated as at **126.** The purpose of the latter is to maintain the initial dilution that can be obtained in ordinary cigarettes by use of moderately porous paper.

The cigarette wrapper **122** is then overcoated with a non-degradable coating, cellulose acetate in the pattern **124** so that dilution due to porosity of the wrapper is essentially the same as a normal cigarette at the first puff and increases with succeeding puffs as larger areas of degradable coating are opened up by the smoke. The pattern is designed to limit the area of degradable coating "within reach" of degrading conditions for the first puffs, by applying non-degradable coating to the first 6 mm measured from the smoking end **128.** On the first and second puffs the dilution through the wrapper is the same as that of a normal cigarette and on succeeding puffs becomes progressively greater than in a normal cigarette to the extent that after the second puff, per puff delivery is limited to approximately that of the second puff.

The invention will be understood further by reference to the following examples.

EXAMPLE 1

Cigarette paper wrapper of very high porosity (zero grenier) but without any openings was coated with a solution of "Polyox" N-80 polyoxyethylene (Union Carbide) containing benzoyl peroxide (5% of the resin weight) to give an overall coating of 3 to 5 g/sq. m. Cigarettes were made with this paper using a conventional tobacco filler. Additionally, conventional acetate filter plugs were attached (Cigarette A). Then some of these cigarettes were coated by hand with a solution of cellulose acetate in acetone according to the pattern of FIG. **1,** the cellulose acetate forming a non-degradable coating (Cigarette B). When these cigarettes were smoked by machine according to the standard method (Wartman, Cogbill and Harlow, Analytical Chemistry 31, 1705–1709 (1958)) they gave significantly lower deliveries of particulate matter than did a cigarette (Cigarette C) with the same components but with conventional paper wrapper. FIG. **8** shows the comparative profiles of TPM versus puff number for these cigarettes. The ratio of last-to-first puff deliveries were about 6.7 for Cigarette A and about 3.0 for Cigarette B, such ratio being only about 2.0 for Cigarette C, but such ratio being a product of the expected significantly higher TPM delivery associated with a non-ventilated cigarette.

EXAMPLE 2

Cigarette paper of high porosity and coated with Polyox polyethylene oxide, as used in Example 1, was used to make conventional cigarettes with acetate filter plugs. Then some of these cigarettes were coated by hand with a solution of polystyrene dissolved in benzene according to the pattern of FIG. **1,** the polystyrene forming the non-degradable coating. When these cigarettes were smoked according to the standard method, as cited in Example 1, they gave significantly lower tar deliveries compared to cigarettes made with the same tobacco and filter but with ordinary paper. The ratio of the last puff to first puff deliveries was about 3.2 to 1.

What is claimed is:

1. A smoking article comprising

an elongated cylinder of tobacco, and

an air-pervious paper wrapper closely encircling said cylinder of tobacco, and having inner and outer surfaces, said wrapper normally being sufficiently air-pervious to admit air stream flow therethrough into said cylinder of tobacco when said smoking article is puffed, said article having a mouth end and a smoking end

a coating of a first air-impervious material disposed in a substantially fully encircling course on one of said wrapper surfaces and extending for a substantial length from the mouth end of said article in the direction of the smoking end, said first air-impervious material being characterized by being degraded by concentrated tobacco smoke during smoking of said article to dissipate said first material coating thereby to permit entry of air stream flow through said wrapper, and

a coating of second air-impervious material embodied with said smoking article and extending from a location at said smoking end of said article a predetermined distance in the direction of the mouth end thereof, said second air-impervious material being characterized by being consumable by the action of the burning coal during smoking but not degradable in the presence of concentrated tobacco smoke thereby to prohibit entry of air stream flow through at least portions of said wrapper at least until said smoking article has been smoked said predetermined distance.

2. The smoking article of claim **1** wherein said coating of first air-impervious material is on one of said wrapper surfaces, the coating of second air-impervious material being on the other of said wrapper surfaces.

3. The smoking article of claim **1** wherein said coating of first air-impervious material is on one of said wrapper surfaces and extends the full length of said one surface.

4. The smoking article of claim **3** wherein the coating of second air-impervious material is on said coating of first air-impervious material.

5. The smoking article of claim **1** wherein said coating of second air-impervious material is on one of said wrapper surfaces extending said predetermined length on said one surface, the coating of first air-impervious material being on the remaining length of said one wrapper surface.

6. The smoking article of claim 1 wherein said paper wrapper is an air-impervious paper and is provided with apertures extending therethrough to render said wrapper air-pervious.

7. The smoking article of claim 1 wherein said coating of second air-impervious material is embodied along the major portion of its length in a fully encircling course in respect of said wrapper and has segments thereof remote from said smoking end of said article provided as a plurality of serration-like extensions of said major portion, said first coating extending in a course intermediate and adjacent said serrations to provide therewith a region of gradual transition in said wrapper from non-degradable air stream flow prohibition to degradable coating air stream flow admission condition during the course of smoking said article.

8. The smoking article of claim 7 wherein said wrapper further includes a longitudinal extending area therein characterized by the absence of non-degradable and degradable coating thereon.

9. The smoking article of claim 1 wherein said first air-impervious material is a polyoxyethylene containing a peroxide.

10. The smoking article of claim 9 wherein the peroxide is present in up to about 5% of the weight of said first air-impervious material.

11. The smoking article of claim 10 wherein the peroxide is benzoyl peroxide.

12. The smoking article of claim 1 wherein said second air-impervious material is cellulose acetate.

13. The smoking article of claim 1 wherein said second air-impervious material is polystyrene.

14. The smoking article of claim 1 wherein said article is a cigarette and said wrapper is provided with indicia denoting the smoking end of said cigarette.

15. The smoking article of claim 1 wherein said smoking article is a cigarette and further comprises a filter component joined to said cylinder of tobacco at said mouth end of said article.

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