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(54) **Thermal indicators for smoking articles.**

(57) Thermal indicators (16) for non-combustion smoking articles (10) which visibly change when heated to provide visual indications of temperature changes are disclosed. The indicators may chemically react when heated. Such indicators comprise organic acids, sugars, or amines combined with sugars. Alternative indicators comprise waxes or other compounds which melt away to reveal colored sub-

strates, or comprise microencapsulated chemicals which are released when heated to cause inking or dyeing. The thermal indicators are printed in a variety of patterns extending along the length of the smoking articles to show temperature changes and to indicate whether the smoking article is finished and should be discarded.

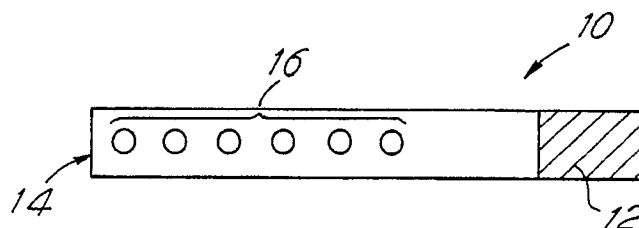


FIG. 1

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THERMAL INDICATORS FOR SMOKING ARTICLES

Background Of The Invention

The present invention relates to thermal indicators used on smoking articles. More particularly, this invention relates to thermal indicators which change visually to indicate a predetermined temperature within the smoking article.

There are non-combustion smoking articles currently on the market that provide an alternative to conventional tobacco-burning smoking articles. Non-combustion smoking articles include smoking articles heated by electrical or chemical means, or by burning some type of heat source other than the tobacco itself. The tobacco or flavor source is heated, but is not burned. If the heat source is contained within the non-combustion smoking article, it provides no visual indication, such as a burning end, of the temperature gradient along the article. A smoker is unable to determine which portion of the smoking article is hot.

A person smoking a non-combustion smoking article must be informed that the device has begun to work. The smoker also needs information about the on-going operation of the device, for example, whether the heat source is still operating. Finally, the smoker must know when to stop puffing because the flavour or heat source is expended. Unless the smoker knows this, the smoker may try to use the device longer than is intended by the manufacturer, possibly resulting in customer dissatisfaction.

The thermal indicators used on smoking articles must not affect the flavor or safety of the smoking articles. The indicator materials must be non-toxic both prior to and after heating.

In view of the foregoing, it is an object of this invention to provide non-toxic thermal indicators for use on non-combustion smoking articles.

It is another object of this invention to provide a method for showing the internal thermal status of a non-combustion smoking article along its length.

Summary of The Invention

These and other objects of the invention are accomplished in accordance with the principles of the invention by providing along the length of the article a pattern of thermal indicator material which changes at a predetermined temperature to cause a visible change. The thermal indicator means of the present invention may be of various types.

In one aspect of the invention the thermal indicators are substances which react chemically at

a predetermined temperature to cause a visible color change. The thermal indicator substances of this embodiment include organic acids, sugars, or amines combined with sugars, which are applied to a surface of the smoking article to be monitored. The compounds used for the indicators may be of a variety of concentrations and may be applied to the surface of the smoking article in different quantities.

In a second aspect of the invention, the thermal indicator comprise a colored material which is covered or masked by a fusible or otherwise thermally labile substance.

In a preferred embodiment the indicator may include a colored substrate applied to the surface of the smoking article to be monitored. This substrate is covered by an opaque, low melting point wax or other similar compound. In this embodiment, the wax coating melts away to reveal the colored substrate beneath. In an equally preferred embodiment, the thermal indicator may include microencapsulated chemicals which cause a color change by inking or dyeing the surface of the smoking article. These chemicals are released when the heat from the article melts the encapsulating material.

The thermal indicators may be applied to a smoking article in a variety of patterns using conventional printing techniques. The indicators are printed along the longitudinal length of the smoking article. As the internal temperature gradient of the smoking article moves down the length of the article, the indicators gradually reveal a color indication in response to the increased heat.

Further features of the invention, its nature and various advantages will be more apparent from the detailed description of the invention and the accompanying drawings.

Brief Description of The Drawings

FIG. 1 shows a non-combustion smoking article with an illustrative pattern of thermal indicators in accordance with the principles of this invention.

FIG. 2 is the smoking article of FIG. 1 showing two indicators that have changed visibly in response to the internal heating of the smoking article.

FIG. 3 is the smoking article of FIG. 1 showing an illustrative marking used to indicate when the smoking article is finished.

Detailed Description Of The Preferred Embodi-

ments

Referring to FIG. 1, as the smoker draws on the proximal end of smoking article 10, air is drawn though distal end 14, past the internal heat source of the smoking article, causing the air to become heated. The heated air and flavored aerosol (which is released from the flavor source disposed within smoking article 10) are drawn down the length of the smoking article, through the filter 12, and into the smoker's mouth. Often, non-combustion smoking articles (to which the thermal indicators of this invention may be applied) are lined with foil. The foil conducts heat, gradually, back toward filter 12. As smoking progresses, an internal temperature gradient is created within smoking article 10. By placing the thermal indicators of this invention along the length of article 10, the internal temperature gradient of the smoking article may be detected. The smoking article is hottest at distal end 14 where the device is lit or otherwise initially heated, and cooler toward filter 12. The heated aerosol, heat-conducting foil, and possibly the heat source itself (e.g., a carbon rod burning toward filter 12) cause the temperature to increase down the length of article 10 as smoking continues. It is this temperature gradient which causes certain indicators to heat sufficiently to cause a color change, while indicators located on cooler portions of the smoking article remain invisible (i.e., they have not been sufficiently heated to cause a visible change).

FIG. 1 shows a smoking article 10 imprinted with thermal indicators collectively indicated by reference numeral 16. In an illustrative embodiment of this invention, the thermal indicators are printed in a series of small dots. Indicators 16 are printed at distal end 14 and down the length of smoking article 10. In alternative embodiments of the invention, indicators 16 may be printed or sprayed onto the outer surface of smoking article 10 as lines or letters, or in any of a variety of patterns.

FIG. 2 shows the smoking article of FIG. 1 after the device has begun to operate. Before article 10 is smoked, all of the indicators 16 are invisible (as shown in FIG. 1). At the beginning of smoking, distal end 14 is the first portion of article 10 to experience a temperature rise. Therefore, the indicator 18 closest to distal end 14 begins to color first. As smoking progresses, indicator 20 colors. Thermal indicator 22 will be the next to color, as the internal temperature gradient progressively moves toward the proximal end. In this way, the smoker is alerted that smoking article 10 is still hot and is still operating.

FIG. 3 shows the smoking article of FIG. 1, having means for indicating when smoking article 10 is finished. This embodiment is particularly suit-

ed for smoking articles comprising a heat source which extends longitudinally down the length of the article and heats gradually from distal end 14 toward filter 12 (such as a burning carbon rod).

In FIG. 3, a marking 24 is printed on the surface of smoking article 10 of FIG. 1. Marking 24 is preferably printed in ink, but may also be printed with the same compound as indicators 16. Marking 24 is disposed before the thermal indicator closest to filter 12, i.e., between indicators 26 and 28. Thermal indicator 28, located beyond marking 24, changes color when the area surrounding the proximal end of article 10 becomes hot. This may occur, for example, when a heat source, such a burning rod of carbon, burns to the end of article 10. Indicator 28 alerts the smoker that smoking article 10 is finished and should be discarded.

In another embodiment, indicators 26 and 28 include greater chemical concentrations, and therefore become darker when heated, than the indicators closer to distal end 14. In this embodiment, marking 24 is unnecessary; the darker color of indicators 26 and 28 alert the smoker that the device is finished.

Thermal indicators in accordance with this invention may be applied to smoking articles using standard methods of printing on cigarette wrappers. Preferably, the indicators are applied to the smoking article by means of a print wheel. In an alternative embodiment, spray jets are used to apply the thermal indicators.

Use of a print wheel or spray jet requires a solid content of at least 30 percent solids in the material to be applied. It is preferable to combine an indicator compound with a high viscosity agent, such as corn syrup, prior to printing. The high viscosity additive makes the indicator compound more suitable for printing on paper, because the indicator will be less likely to run or streak. The viscosity agent allows the indicators of this invention to be printed on the cigarette paper at high speeds. Viscosity agents such as corn syrup may also provide additional sugars, which may participate in the chemical reactions that cause the indicators to change color.

Thermal indicators of the first embodiment are chemical compounds in the form of solutions or slurries (in water) of organic acids, sugars, or amines combined with sugars. Heat from the operation of the smoking article causes the indicators disposed on the outer surfaces of the device to react chemically, and to change color. Prior to heating, and the subsequent chemical reaction, the indicators remain invisible, and thus do not affect the appearance of the smoking article. The chemical reactions creating the color changes are substantially independent of the paper and the materials which may be present on the paper to prevent

the paper from being burned or charred. However, the surface properties of the paper may affect the chemical reactions.

Organic acids, applied in a solution, are the first class of chemicals which react when heated to cause a distinctive tanning or browning of the surface to which they are applied. Solutions of between five percent and 85 percent organic acids by weight may be used. As the concentration of organic acids is increased, the color intensity upon heating is increased. Thus, the indicator color can be regulated, and the appearance of the cigarette wrapper can be controlled.

In the preferred embodiment, a saturated solution or a concentration solution of approximately 50 percent organic acid by weight is used for the indicator. Although color intensity generally increases as the indicator solutions become more concentrated, solutions of 50 percent organic acid produce color indications substantially similar to solutions of greater concentrations. It is therefore more cost effective to use solutions of 50 percent concentration. In an alternative embodiment, the indicator is a slurry of an organic acid in water.

Examples of organic acids which may be used as indicators include ascorbic acid and citric acid. For example, ascorbic acid will cause a substantially tan color indication when heated to approximately 135 to 155 degrees Centigrade, a brown color indication when heated to approximately 155 to 180 degrees Centigrade, and a dark brown color indication when heated to approximately 180 to 200 degrees Centigrade. The indicator color is continuously variable with temperature over these temperature ranges.

Sugars are a second class of chemical compounds which may be used as thermal indicators on smoking articles. Examples of compounds from this class which react when heated to create color changes include solutions of sucrose, dextrose, or fructose. The preferred solvent for these solutions is alcohol. Other solvents that may be used include water, ketone, and aldehyde. When heated, indicators composed of these compounds caramelize and turn brown in an elimination reaction. At high temperatures, the sugars carbonize and turn black.

Solutions of at least five percent sugar by weight are required to create a visible color change. Similar to the organic acid indicators, the intensity of the color change increases as the concentration of sugar in the solution increases. It is preferable to use sugar concentrations of at least 40 percent by weight, because at higher sugar concentrations, such indicators give off a "caramel type" odor as an additional indication of high temperatures. This odor is emitted by the sugar thermal indicators both during caramelization and carbonization.

The third class of chemicals suitable for use on smoking articles which cause a color change when heated are amines combined with sugars. A solution of asparagine and fructose is an example of compounds in this class which react to cause a color change when heated. This combination of compounds causes a tan-brown color indication at temperatures of approximately 140 degrees Centigrade. The amine (asparagine) reacts with the sugar (fructose) when heat is applied in a "browning" or "Amadori" reaction. Indicators of this type cause surface browning and release volatile compounds thereby providing both visual and olfactory signals to indicate that the smoking article is hot.

Thermal indicators in accordance with the second aspect of this invention are comprised of compounds which physically change to either reveal a colored substrate or create a color change as an indication of temperature change. The indicators are applied directly to the surface whose temperature is to be monitored.

In a preferred embodiment of this aspect, low melting point waxes, gums (e.g. gum arabic), pectins, or fatty acid esters (e.g. bees wax) are applied to a colored substrate. The coating material is initially opaque, and remains as such until the surface whose temperature is being monitored reaches a predetermined temperature. At or near the predetermined temperature, the coating wicks and becomes clear. The coating thins and is absorbed into the surface (i.e. into the paper cigarette wrapper). The substrate, previously hidden beneath the opaque coating, becomes visible as an indication of temperature change.

The preferred coating materials include hydrocarbon waxes in the hydrocarbon range of C16 to C30. Compounds such as polyvinyl alcohol or polyvinyl acetate, or long chain fatty acids, such as stearic acid, may be added to the coating materials as hardening agents. The coating materials may be selected and combined such that the coating will melt to reveal a color indication when subjected to a predetermined temperature within the range of 40 degrees to 220 degrees Centigrade.

The substrate may be printed in a wide variety of colors and may be printed in a variety of patterns or letters. More than one color ink may be used on a single smoking article. The thermal indicator's substrate may be selected to enhance the appearance of the smoking article to which it is applied. The substrate used for cigarettes may comprise conventional print ink, or any other non-toxic colorant, applied directly to the cigarette wrapper. The preferred coloring agent of the ink is carbon

In an alternative embodiment of the invention, the thermal indicators comprise microencapsulated chemicals. The microencapsulated chemicals in-

clude inks and dyes, color producing materials, solvents for the inks, water, or alcohols. Precursors to inks or dyes (i.e., selected components of multiple-component inks or dyes) may also be micro encapsulated. When the monitored surface reaches a predetermined temperature, the encapsulating materials melt and release the encased chemicals, resulting in the inking or dyeing of the smoking article. In this embodiment, a solution comprising microencapsulated chemicals is printed directly on the smoking article. There is no colored substrate beneath the microencapsulated chemical solution.

Thermal indicators in accordance with this invention may be applied to smoking articles using standard methods of printing on cigarette wrappers. Preferably, the indicators are applied to the smoking article by means of a print wheel. This method is suitable for applying indicators comprising microencapsulated chemicals.

Where the thermal indicator includes a colored substrate beneath a waxy coating, a more complicated printing procedure is required. The substrate, preferably printed with conventional print ink, is first applied to the cigarette wrapper by a first print wheel. The opaque wax coating is superimposed upon the substrate by a second print wheel. In an alternative embodiment, the substrate of the indicator is imprinted on the cigarette wrapper by means of spray jets, in lieu of using the first print wheel. The opaque wax coating is again superimposed upon the substrate by a print wheel.

In embodiments utilizing a colored substrate and opaque wax coating, the wax may be applied to the smoking article either hot or cold. The wax is preferably applied when cold. Solvents are added to the wax to obtain the desired wax viscosity for proper bonding of the cold wax to the substrate and cigarette paper. Food-grade vegetable oil is a solvent suitable for this application.

It will be understood that the foregoing is merely illustrative of the principles of the invention, and that various modifications can be made by those skilled in the art of the invention. For example, the indicator material may be printed in a continuous line down the length of smoking article 10, in place of the pattern of dots, in the embodiment of FIG. 1.

Claims

1. A method for detecting temperature changes in a non-combustion smoking article, comprising the steps of:
applying an indicator material that gives a visual indication at a predetermined temperature in a predetermined pattern along the longitudinal length of the outer surface of the smoking article during

manufacture; and

monitoring the outer surface of the smoking article during smoking for visible changes in the indicator material along the smoking article indicating a temperature change.

2. The method defined in claim 1 including:

applying the indicator material in said predetermined pattern from a distal end of said article to a first predetermined point along the outer surface of the smoking article; and

marking the smoking article at a second predetermined point, said second predetermined point being disposed between said distal end and said first predetermined point during manufacture.

3. The method defined in claim 2 including printing said marking at said second predetermined point is printed with ink.

4. The method defined in claim 1, 2 or 3 wherein:

a non-toxic fluid that changes colour at a predetermined temperature is applied in said predetermined pattern; and

the portion of the length of said smoking article that contains the temperature-sensitive fluid is monitored during smoking for colour changes.

5. The method defined in claim 4 wherein said fluid is applied in liquid form and then dried to a solid form.

6. The method defined in claim 5 wherein the applied fluid comprises a slurry of solid organic acids in a solvent.

7. The method defined in any of claims 1 to 6 wherein said fluid is applied with a print wheel.

8. The method defined in claim 7 further comprising the step of adding a high viscosity agent to the fluid prior to applying said fluid to the print wheel.

9. The method defined in claim 7 wherein said fluid comprises at least 30 percent solids.

10. The method defined in any of claims 1 to 6 wherein said fluid is applied with a spray jet.

11. The method defined in claim 1, 2 or 3 wherein: a non-toxic colorant is applied in said predetermined pattern;

a low melting point material is applied to the smoking article such that it covers said colorant, during manufacture; and

the outer surface of the smoking article is monitored during smoking for changes in color that indicate that the low melting point material has been heated to a predetermined temperature and has melted to reveal said colored fluid.

12. The method defined in claim 11 wherein said low melting point material is selected from hydrocarbon waxes, gum arabic, pectin, and fatty acid esters.

13. The method defined in claim 11 or 12 wherein said low melting point material is applied with a print wheel.

14. The method defined in claim 11, 12 or 13

wherein said colorant includes a carbon coloring agent.

15. The method defined in claim 1, 2 or 3 wherein: a non-toxic fluid comprising microencapsulated chemicals is applied to said outer surface of the smoking article; and

the outer surface of the smoking article is monitored during smoking for changes in color that indicate that the microencapsulated chemicals have been heated to a predetermined temperature and have released the chemicals to dye the outer surface of the smoking article, indicating a temperature increase.

16. The method defined in claim 15 wherein said fluid comprising microencapsulated chemicals is applied with a print wheel.

17. A non-combustion smoking article having means for visually indicating internal temperature changes, comprising:

a cylindrical member forming an outer surface of the smoking article; and

a thermal indicator that gives a visual indication at a predetermined temperature that is disposed on the outer surface of the smoking article in a predetermined pattern that extends from the distal end of said smoking article to a predetermined point along said article.

18. The smoking article of claim 17 wherein said predetermined pattern comprises a series of dots.

19. The smoking article of claim 17 or 18 further comprising means for indicating that the smoking article is finished.

20. The smoking article of claim 17, 18 or 19 further comprising:

a marking for indicating when the article has reached a predetermined operating state, disposed at a second predetermined point between said distal end and said first predetermined point.

21. The smoking article of claim 20 wherein said marking is an ink print.

22. The smoking article of any of claims 17 to 21 wherein:

said thermal indicator comprises a non-toxic fluid that changes color at a predetermined temperature.

23. The smoking article of claim 22 wherein said fluid comprises a solution of a solvent and an organic acid.

24. The smoking article of claim 23 wherein said acid is ascorbic acid or citric acid.

25. The smoking article of claim 22 wherein said fluid comprises a solution of a solvent and a sugar.

26. The smoking article of claim 25 wherein said sugar is sucrose, dextrose or fructose.

27. The smoking article of claim 22 wherein said fluid comprises a solution of a solvent and the combination of an amine with a sugar.

28. The smoking article of claim 27 wherein said amine and said sugar are asparagine and fructose,

respectively.

29. The smoking article of claim 22 wherein said fluid comprises a slurry of a solid organic acid in a solvent.

5 30. The smoking article of any of claims 22 to 29 wherein said solvent is a compound selected from alcohols, water, ketone, and aldehyde.

31. The smoking article of any of claims 17 to 21 wherein said thermal indicator comprises:

10 a non-toxic substrate visible against and printed on the outer surface of the smoking article in said predetermined pattern; and

15 a low melting point material capable of melting at a predetermined temperature, disposed on the outer surface of said smoking article, over at least the substrate.

32. The smoking article of claim 31 wherein said substrate comprises a conventional printing ink using carbon as a coloring agent.

20 33. The smoking article of claim 31 wherein said colored substrate includes a plurality of colors.

25 34. The smoking article of claims 31 to 33 wherein said low melting point material is selected from hydrocarbon waxes, gum arabic, pectin, and fatty acid esters.

35. The smoking article of claim 34 wherein said hydrocarbon wax comprises a wax in the hydrocarbon range of C16 to C30.

30 36. The smoking article of any of claims 31 to 35 wherein said low melting point material further comprises a hardening additive.

37. The smoking article of claim 36 wherein said hardening additive includes polyvinyl acetate or stearic acid.

35 38. The smoking article of any of claims 17 to 21 wherein said thermal indicator comprises: containment means disposed on the outer surface of the smoking article in said predetermined pattern; and

40 a non-toxic material disposed within said containment means, said material being released when heated to a predetermined temperature to dye the outer surface of said smoking article.

45 39. The smoking article of claim 38 wherein said containment means is microencapsulating material for microencapsulating said material.

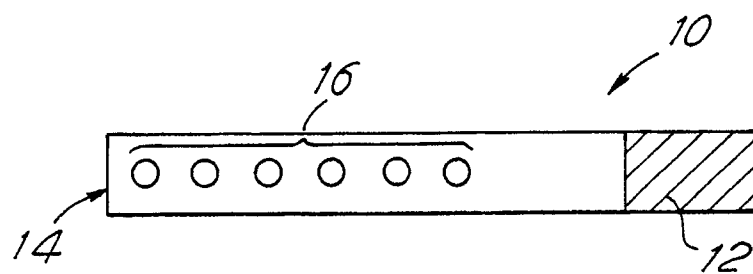


FIG. 1

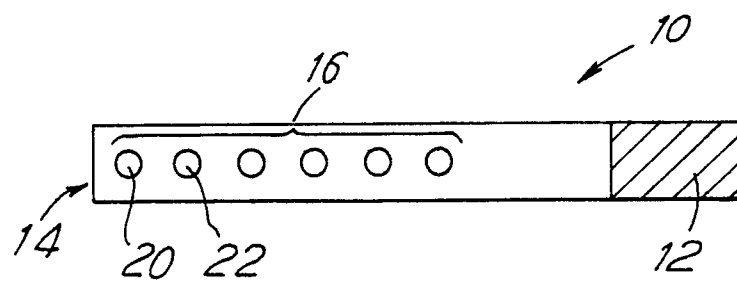


FIG. 2

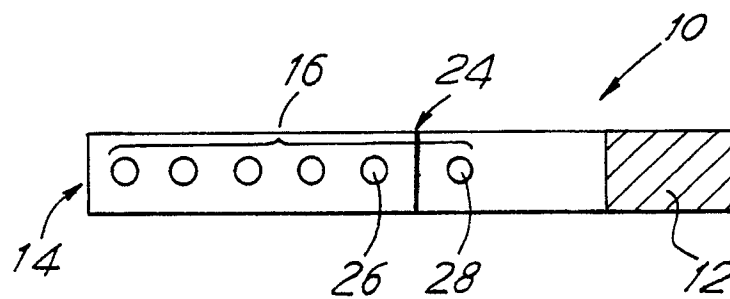


FIG. 3



European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 90 30 7808

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. CL.5)
A	FR-A-2176423 (TIMM) * the whole document * -----	1, 17	A24F47/00 A24D1/12
			TECHNICAL FIELDS SEARCHED (Int. CL.5)
			A24F A24D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25 OCTOBER 1990	Examiner RIEGEL R.E.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		I : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons R : member of the same patent family, corresponding document	