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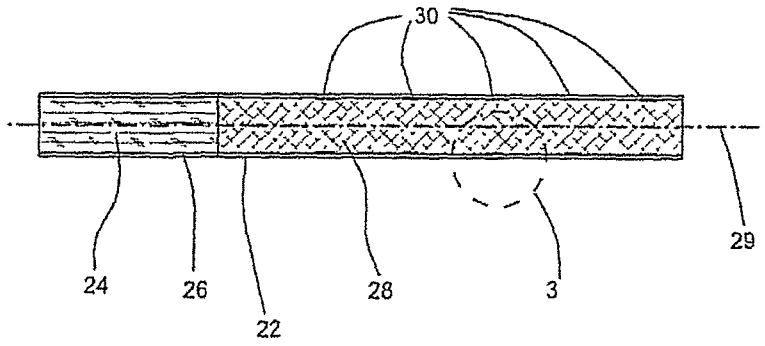
(54) **Title:** GRAVURE PRINTED BANDED CIGARETTE PAPER



(57) **Abstract:** A cigarette (20) and cigarette paper (22) have a plurality of multilayer bands (30) formed by pπnting a highly viscous aqueous film forming composition After heating the composition to lower its viscosity, the bands are applied to the cigarette paper by gravure printing the composition The composition is quenched and gelatinized by contact with the cool cigarette paper reducing absorption of water by the paper and reducing wrinkling, cockling, and waviness Multiple gravure printed layers may be used to form the bands

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GRAVURE-PRINTED BANDED CIGARETTE PAPER

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority from U.S. provisional Application No. 60/707,964, filed on August 15, 2005, the entire content of which is incorporated herein by reference.

FIELD OF THE DISCLOSURE

This disclosure relates generally to banded paper for use in manufacturing cigarettes. More particularly, it concerns print banded paper made with a gravure printing process using an aqueous composition of highly viscous material.

SUMMARY

A cigarette according to one embodiment includes cigarette paper with a plurality of bands, each of which is effective to substantially reduce permeability of cigarette paper in its vicinity to control ignition propensity and inhibit unattended burning when the cigarette is left on a substrate. Each band may be formed by one or more layers, each of which may be applied by gravure printing. Moreover, the first layer (or layers) of each band is (or are) preferably formed using an aqueous film-forming composition having a viscosity not well-suited for gravure printing. The subsequent layer (or layers) of each band is (are) preferably formed by using the same aqueous film forming composition or other aqueous compositions containing fillers, burn inhibitors, burn promoters, flavors and the like.

During the gravure printing steps, the viscous film-forming composition is heated to a temperature where its viscosity lies within the range of viscosities suitable for gravure printing. When the heated film-forming composition is applied to the cigarette paper, the film-forming composition is cooled or quenched and may be gelatinized. Thus, a portion of the free water in the film-forming composition becomes bound and unavailable to soak or migrate into underlying fibers of the cigarette paper. That binding of free water inhibits formation of waviness, cockling, and/or wrinkling in the cigarette paper. Total coat weight for the band preferably lies in the range of 0.5 grams per square meter (g/m^2) to $15g/m^2$ and most preferably about

2g/m^2 or 5g/m^2. Permeability of the cigarette paper normally exceeds 20 Coresta units. However, permeability through the bands and the underlying cigarette paper preferably lies in the range of 0 to 15 Coresta units. The reduction in permeability preferably restricts air flow needed to support combustion of the cigarette coal in the vicinity of the band.

The invention also provides a printing composition for cigarette paper comprising water and about 20% to about 50% by weight of a film-forming compound, wherein the printing composition has a viscosity less than about 0.1Pa*s (lOOcP) at a temperature in the range of 40^{0}C to 90^{0}c, and a viscosity exceeding about 0.2Pa«s (20OcP) at a temperature of about 23°C.

In a preferred embodiment, the film- forming composition used for printing comprises as a film-forming compound at least one of starch, an oxidised starch, tapioca, alginate, carrageenan, guar gum, pectin, calcium carbonate, and citrates. At higher concentrations of the film-forming compound in the composition, the composition may experience gelatinization when its temperature is rapidly reduced. Thus, the binding of free water into the printed band may occur.

Also according to the invention there is provided a method of making banded cigarette paper by gelatinizing an aqueous film- forming composition on a surface of the paper. Preferably, the film-forming composition is printed in a heated condition and cooled upon contact with the surface of the paper. Preferably, the cooling comprises quenching the film-forming composition on the surface of the paper.

According to a preferred method of manufacturing cigarette paper with bands, the cigarette paper advances to a first printing station. At that first printing station, the film-forming composition is heated so that its viscosity is decreased to a predetermined value useful for gravure printing. The heated film-forming composition is applied to the patterned surface of a rotating gravure cylinder. The rotating gravure cylinder may be heated to prevent premature cooling of the composition. The rotating gravure cylinder cooperates with a parallel impression roller to define a nip through which the cigarette paper advances. As the gravure cylinder rotates, its patterned surface contacts the cigarette paper and applies the first layer of the bands to the cigarette paper.

The film-forming composition is believed to cool and gel on contact with the cigarette paper, but preferably, the cooling step includes cooling a nip roller. Thus, the water content of the film-forming composition is not appreciably absorbed into the cigarette paper and planarity of the cigarette paper is preserved.

It is preferred that the film-forming composition is heated to a temperature in the range of 40°C to 90°c.

Advantageously, the upper limit of the temperature of the heating step is selected to avoid scorching the film-forming composition.

Preferably, the film-forming compound is at least one of starch, an oxidised starch, tapioca, alginate, carrageenan, guar gum, pectin, calcium carbonate and citrates.

Preferably, the gravure cylinder is patterned by engraving, chemical engraving, electronic engraving and/or photo etching.

After the first layer is applied to the cigarette paper it is allowed to dry thereon. The paper may then advance to a second gravure printing station where a second layer may be applied to the first layer of each band. Preferably, this optional second layer is coextensive with the first layer in both width and length; however, the second layer may be thicker than the first layer. The film-forming composition of the second layer gels on the cooler first layer and free water does not get absorbed by the paper.

Preferably, the second layer is printed with a coat weight about 50% greater than the coat weight of the first layer.

Optional third and successive layers may be applied on top of the second layer, and on underlying layers in the same way, preferably using the same film-forming composition, or different compositions containing fillers, burn inhibitors, burn promoters, flavors, and the like, as may be desired.

Preferably, the third layer is printed with a coat weight about 150% greater than the coat weight of the first layer.

Another embodiment provides a process of applying only the first layer utilizing a heated gelatinizable film-forming solution, with one or more additional layers comprising a different add-on material such as a starch that is printable in an unheated state.

Preferably, at least one printing step includes using a cooled impression cylinder to accelerate gelatinization.

The resulting banded cigarette is collected on a reel that is subsequently cut into bobbins and used as cigarette paper to make cigarettes .

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings depict a print banded paper where the bands are printed in multiple successive layers and apparatus for making such paper. In the accompanying drawings, like reference numerals are applied to like elements.

FIG. 1 is a perspective view of a cigarette made with paper having multilayer bands.

FIG. 2 is a cross-sectional view taken along the line 2-2 of FIG. 1 .

FIG. 3 is an enlarged scale portion of FIG. 2 circumscribed by the line 3 with the thickness of the multilayer band exaggerated for purposes of clarity.

FIG. 4 is a schematic view of apparatus for preparing multi-layer print banded paper.

DETAILED DESCRIPTION

In accordance with this disclosure (see FIG. 1), a cigarette 20 includes a tobacco rod including cut filler, covered by cigarette paper 22. One end of the cigarette 20 may include a suitable filter 24 surrounded by suitable filter tipping paper 26.

The cigarette paper 22 (see FIG. 2) surrounds a column of tobacco 28 made from cut filler tobacco. The tobacco rod 28 has a nominal length measured along the longitudinal axis 29 which nominal length is the difference between the overall length and the length of the filter 24.

Conventional cigarette paper is permeable, with the permeability commonly designated in Coresta units. A Coresta unit measures paper permeability in terms of volumetric flow rate (i.e., cm^3/sec) per unit area (i.e., cm^2) per unit pressure drop (i.e., cm of water). Conventional cigarette papers also have well-known basis weights, measured in grams per square meter, abbreviated as g/m^2. The permeability and basis weight for typical cigarette papers commonly used in the industry are set out in the table below:

Permeability, Coresta units	Basis Weight, g/m^2
24	25
33	25
46	25
60	26

For purposes of this disclosure, unhanded regions of a preferred cigarette paper have a permeability of at least 20 Coresta units, Most preferably, the cigarette paper has a permeability of about 33 to about 46 Coresta and a basis weight of about 25g/m^2.

To regulate the ignition propensity of the cigarette and to inhibit unattended burning of the cigarette, the cigarette paper 22 has a plurality of bands 30 spaced axially along the tobacco rod 28. Permeability of the cigarette paper 22 through the area covered by the bands 30 preferably lies in the range of 0 to about 15 Coresta units. Typically, at least two bands 30 are disposed along the tobacco rod 28. Adjacent bands 30 are spaced from one another along the tobacco rod 28 by a nominal distance which preferably exceeds the width of the bands 30. However, that nominal distance is less than the nominal length of the tobacco rod 28. Each band 30 extends circumferentially around the tobacco rod 28 preferably on the inside of the cigarette paper 22. Accordingly, the presence of the bands 30 is essentially invisible from the outside of the cigarette.

Each band 30 (see FIG. 3) may comprise a plurality of layers. Two or three layers 32, 34, 36 may be provided. The first layer 32 rests directly on the inside (or alternatively, the outside) of the cigarette paper 22 and has a corresponding first-layer thickness. The optional second layer 34 lies on the first layer 32 and, preferably extends coextensively with the first layer both in width and length. The second layer 34 has a corresponding second-layer thickness. The optional third layer 36, lies on the second layer and, preferably extends coextensively with the second layer both in width and length. The third layer 36 has a third-layer thickness. Thicknesses of the various layers 32, 34, 36 are measured perpendicularly to the surface of the cigarette paper 22.

The first layer 32 is applied to the cigarette paper 22 to seal the paper surface from water penetration and thereby minimize resultant distortion of the cigarette paper 22 by way of wrinkling,

cockling, and waviness . Such distortions can occur when paper fibers absorb water, then stretch and warp, and fail to return to their original position and state in the paper web. The first-layer thickness is selected such that aqueous solvent does not penetrate deeply into the paper 22. Thickness of the layers 32, 34, 36 is a direct function of coat weight. Accordingly, relative thicknesses of the layers correspond to relative coat weights, and vice versa.

In accordance a preferred embodiment, each band 30 is printed on the cigarette paper 22 by sequential gravure printing steps using an aqueous film-forming composition or other aqueous compositions as desired. The film-forming composition preferably includes water and a high concentration of a film-forming compound. For example, the film-forming compound preferably comprises about 20% to about 50%, by weight, of the film-forming composition. At room temperature (about 23^{0}C), the high-solid-content film-forming composition has a viscosity exceeding about 0.2 pascal seconds (Pa»s) (200 centipoise (cP)) and is unsuitable for gravure printing; however, at a temperature in the range of about 40^{0}C to about 90^{0}C, the viscosity of the film-forming composition is decreased sufficiently for use as a gravure printing composition. For gravure printing, the upper limit of suitable viscosity is about 0.2Pa»s (20OcP). Most preferably, the film-forming composition has a viscosity of about 0.1Pa»s (lOOcP) at a temperature in the range of 40^{0}C to 90^{0}C so that the composition can be quenched on contact with the paper after gravure printing at that temperature. The viscosity of the composition at room temperature is also important. The high viscosity at room temperature is needed so that the film-forming composition gels at room temperature.

The film-forming compound used in the film-forming composition may be selected from the group consisting of alginate, carrageenan, guar gum, pectin, calcium carbonate, and citrates. Preferably, the film-forming compound is selected from the group consisting of an oxidized starch, such as tapioca.

Preferably, the bands 30 are applied to the cigarette paper 22 using a sequential gravure printing process (see FIG. 4). Gravure printing operations are capable of precise registry of successive printing operations. Accordingly, gravure printing can be used to effectively print not only the first layer 32 of the bands 30, but

also the second layer 34 substantially coextensive with the first layer, and the third layer 36 substantially coextensive with the second layer.

With the first layer 32 sealing the surface of the cigarette paper 22, the optional second layer can be applied with a heavier coat weight, i.e., coat thickness. If desired, the second layer 34 may be thicker than the first layer 32 by a factor of at least about 1.5 times the first-layer thickness, or at least a 50% increase in coat weight. Moreover, the optional third layer 36 may be thicker than the second layer 34 and may also be thicker than the first layer 32 by a factor of at least about 2.5 times the first-layer thickness i.e., an increase of at least about 150% in coat weight.

The gravure printing process can be used immediately following paper manufacture, i.e., at the end of the paper making machine. Alternatively, the gravure printing process can be used in connection with reels carrying the cigarette paper onto which the bands are to be printed. For example, a reel 40 of cigarette paper having a selected permeability and a selected basis weight is mounted so that the cigarette paper 22 can be unspooled from the reel 40 as a continuous paper web .

The web of cigarette paper 22 advances or passes through a first gravure printing station 42 where the base layer 32 of each band 30 is printed on the paper 22 . The printing process may be applied to the felt side or the wire side of the paper, or both. Next, the cigarette paper 22 passes through a second gravure printing station 44 where the second layer 34 of each band 30 is printed on the corresponding base layer 32. The cigarette paper 22 then passes through a third gravure printing station 46 where the third layer 36 of each band 30 is printed on the corresponding second layer 34. Additional layers are applied in a similar manner as described. Finally, the cigarette paper 22 with the printed bands is wound up on a collection reel 48. The collection reel 48 is then slit into bobbins. The bobbins are used for wrapping tobacco rods during manufacture of cigarettes in an otherwise conventional way.

The apparatus at each of the three gravure printing stations 42, 44, 46 is essentially the same in its material aspects. Accordingly, it will suffice to describe one of the gravure printing stations in

detail, it being understood that the other gravure printing stations have common features, unless otherwise noted. Thus, features of the first gravure printing station 42 will use reference numerals with the suffix 'a'. Corresponding features of the second gravure printing station 44 will use the same reference numeral but will use the suffix 'b'. Likewise, corresponding features of the third gravure printing station 46 will use the same reference numeral but will use the suffix 'C .

At the first gravure printing station 42, the apparatus includes a gravure cylinder or roller 50a generally mounted for rotation (clockwise in the embodiment shown in FIG. 4) around a horizontal axis. The generally cylindrical surface of the roller 50a is patterned in a suitable process to define a negative of the first layer 32 of bands 30. Conventional engraving, chemical engraving, electronic engraving, and photo etching can be used to pattern the surface of the gravure cylinder. The circumference of the roller 50a is determined such that it is an integral multiple of the sum of the nominal distance between bands plus the band width. Thus, for each revolution of the roller 50a, that integral number of first layers of the bands is printed on the cigarette paper.

An impression cylinder 52a is mounted for counter-rotation on an axis parallel to the axis of the roller 50a. In some applications, the impression cylinder 52a includes a nonmetallic resilient surface. The impression cylinder 52a is positioned between the roller 50a and a backing roller 54a, which is also mounted for rotation on an axis parallel to the axis of the roller 50a and which counter-rotates relative to the impression cylinder 52a. One of the functions provided by the backing roller 54a is stiffening the central portions of the impression cylinder 52a so that the uniform printing pressure is attained between the roller 50a and the impression cylinder 52a. The gravure cylinder or roller 50a and the impression cylinder 52a cooperate to define a nip 56a through which the paper web 22 advances during the printing process. That nip 56a is sized to pinch the paper web 22 as it moves between the gravure cylinder 50a and the impression cylinder 52a. The nip pressure on the paper web is critical to ensure the correct transfer of the composition from the cylinder to the paper.

A reservoir 58a contains the film-forming composition discussed above for forming bands on the cigarette paper. The reservoir 58a communicates with a suitable pump 60a which is capable of handling the viscous film-forming composition. The film-forming composition may then flow to a suitable heat exchanger 62a where the temperature of the film-forming composition is elevated so that it lies in the range of about 40°C to about 90°C so that the viscosity of the film-forming composition is adjusted to a level which is suitable for gravure printing. As discussed above, viscosity for gravure printing needs to be less than about 0.2Pa»s (200cP). Preferably, the temperature of the film-forming composition is selected so that the viscosity is less than about 0.1Pa«s (100cP).

While a separate heat exchanger 62a is disclosed, it may be desirable to provide thermal conditioning of the film-forming composition in the reservoir 58a itself. For example, heating elements and stirring apparatus may be included in the reservoir 58a to maintain the elevated temperature for the film-forming composition. Placement of the thermal conditioning in the reservoir 58a has the advantage of making pump selection and operating requirements simpler since the pump 60a need not handle the film-forming composition at the higher viscosity associated with lower temperatures because the film-forming composition would already be heated and, therefore, at the lower viscosity. Whether thermal conditioning occurs in the reservoir 58a or in a separate heat exchanger 62a, it is important that the thermal conditioning step occur at a temperature selected to avoid scorching the film-forming composition. Scorching can cause discoloration of the film-forming composition, and can affect the film-forming characteristics of the composition. Thus, scorching is to be avoided while the film-forming composition is subjected to thermal conditioning.

Regardless of where the thermal conditioning step occurs, the heated film-forming composition is delivered to a suitable applicator 64a that spreads the film-forming composition along the length of the gravure cylinder 50a. That spreading step may be effected by pouring or spraying the film-forming composition onto the gravure cylinder 50a, or simply by delivering the liquid film-forming composition to a bath 66a of film-forming composition that collects at the bottom of

the gravure cylinder 50a, between the gravure cylinder 50a and a collector 67a. The cylinder may be heated to prevent premature cooling of the composition.

Generally, the collector 67a extends vertically around the gravure roller 50a to a height sufficient to collect the bath 66a, but to a height well below the top of the gravure cylinder 50a. When the bath 66a reaches the top of the collector 67a, film-forming composition can flow through a drain 68a at the bottom of the apparatus back into the reservoir 58a. Thus, the film-forming composition circulates through the printing station and can be maintained at suitable printing viscosity by the thermal conditioning apparatus discussed above.

As the gravure cylinder 50a rotates clockwise through the applicator 64a and/or the bath 66a, the film-forming composition adheres to the surface of the gravure cylinder 50a, including in the impressions provided therein to define the bands. Further rotation of the gravure cylinder 50a toward the nip 56a moves the cylinder surface past a suitable doctor blade 70a. The doctor blade 70a extends along the length of the gravure cylinder and is positioned so that is wipes the surface of the gravure cylinder 50a. In this way, those portions of the gravure cylinder 50a that define the nominal spacing between adjacent bands is essentially wiped clean of the film-forming composition, while engraved portions of the gravure cylinder that define the bands themselves advance toward the nip 56a full of the film-forming composition.

As the cigarette paper 22 and the surface of the gravure cylinder 50a move through the nip 56a, the film-forming composition is transferred to the surface of the cigarette paper 22. The linear speed or velocity of the cigarette paper 22 matches the tangential surface speed of both the gravure cylinder 50a and the impression cylinder 52a as the cigarette paper 22 passes through the nip 56a. In that way, slippage and/or smearing of the film-forming composition on the cigarette paper 22 are avoided.

When the bands are printed on the cigarette paper 22 at the first printing stations 42, the heated film-forming composition encounters cigarette paper 22 at room temperature of about 23°C which is considerably cooler than the temperature of the film-forming

composition, i.e., about 40°C to about 90°C. Upon contact with the paper 22, the temperature of the film-forming composition is quenched to the temperature of the paper 22. That quenching occurs through several heat transfer processes or mechanisms. The paper 22 has a sufficiently large thermal mass when compared to the thickness and width of the first layer of the band, that the film-forming material in the band equilibrates to a temperature near to the temperature of the paper rapidly, if not immediately. The temperature of air near the paper 22 and the gravure cylinder 50a is also well below the temperature of the film-forming material on the surface of the gravure cylinder 50a so cooling to ambient air also occurs. In addition, movement of the surface of the gravure cylinder 50a, as well as movement of the cigarette paper 22 after printing, contributes to convective cooling of the film-forming material.

The combined cooling effect of those heat transfer mechanisms causes the film-forming material to gel on the surface of the cigarette paper 22. That gelling of the first layer of the band tends to bind water in the film-forming composition so that the water does not penetrate deeply into, and possibly saturate, the cigarette paper 22. As a result, fibers of the cigarette paper 22 typically are not wetted by water to such an extent that the fibers warp and stretch in a way that leads to waviness, wrinkling, and/or cockling in the cigarette paper 22. The impression cylinder 52a can optionally be cooled to further accelerate gelatinization of the film-forming composition on the cigarette paper. Additional techniques may be used to reduce water absorption. For example, acceleration of solidification of the film forming material may be effected by mixing alginate with a calcium sale, such as calcium chloride, *in situ* or by exposure to ultraviolet light.

As the cigarette paper 22 leaves the first printing station 42, moisture in the film-forming composition is permitted to dry. To this end, suitable arrangements (not shown) may be employed.

Cigarette paper with the first layer of the bands printed at the first gravure printing station 42 then pass over an adjustment cylinder 72b of the second gravure printing station 44. The gravure cylinder 50b of the second printing station has a patterned surface that is designed to print the second layer of the bands. The depth of

the pattern on the surface of the gravure cylinder 50b is selected to be about 1.5 times the depth of the pattern on the first gravure cylinder 50a. Preferably, the second layer of the bands will be coextensive in width (in the direction of paper movement) and coextensive in length (in the direction transverse to paper movement) with the first layer of the band. The gravure cylinder 50b of the second printing station 44 must therefore be registered with the gravure cylinder 50a of the first printing station 42. While various techniques for assuring that registration are known to those skilled in the art, the adjustment cylinder 72b can be used to assure correct registration. More particularly, the length of the cigarette paper 22 between the nip 56a of the first printing station 42 and the nip 56b of the second printing station 44 depends on the vertical position of the adjustment cylinder 72b. By adjusting the position of the cylinder 72b, proper registration between the first and second print stations 42, 44 can be achieved and, if necessary, adjusted.

As the cigarette paper 22 moves from the second printing station 44 to the third printing station 46, the film-forming composition applied at the second printing station 44 has sufficient time to dry. After passing over the adjustment roller 72c of the third printing station 46, the cigarette paper 22 enters the nip 56c of the third printing station 46 where the third layer of the bands is applied.

The gravure cylinder 50c of the third printing station 46 has a patterned surface that is designed to print the third layer of the bands. The depth of the pattern on the surface of the gravure cylinder 50c is selected to be about 2.5 times the depth of the pattern on the first gravure cylinder 50a. Preferably, the second layer of the bands will be coextensive in width (in the direction of paper movement) and coextensive in length (in the direction transverse to paper movement) with both the first layer and the second layer of the band. The gravure cylinder 50c of the third printing station 44 must therefore be registered with the gravure cylinder 50b of the second printing station 44. As described above, the adjustment cylinder 72c can provide that registration function.

After leaving the third printing station 46, the third layer of the band is allowed to dry before encountering the idler roller 74. Additional printing stations (not shown) may be used, as desired. The

cigarette paper 22 with the multi-layer bands is then collected on the collection reel 48.

The bands 30 are applied with a low coat weight. For example, the total coat weight may lie in the range of about 0.5g/m^2 to about 15g/m^2 for the multiple layers of the bands 30. Preferably, the coat weight may be about 2g/m^2. With those coat weights, the thickness of the multilayer bands 30 (FIG. 3) preferably is less than about 20% of the thickness of the cigarette paper, and may be less than 5% of the thickness of the cigarette paper. The thickness of the first layer 32 of the band 30 applied in the first gravure printing station, preferably is less than 4% of the cigarette paper thickness, and may be less than 1% of the cigarette paper thickness. Thus, it is seen that the thickness of the first layer is small in relation to the thickness of the underlying cigarette paper.

By heating the film-forming composition, gelatinization of the film-forming compound upon cooling is enhanced. Accordingly, when the film-forming composition is quenched at the surface of the cigarette paper 22, a gel forms. Formation of the gel binds some of the water from the composition and prevents that water from entering fibers of the cigarette paper. This effect further reduces the possibility that printing of the aqueous film-forming composition will lead to waviness or other imperfections in the resulting banded cigarette paper.

While the process for making banded cigarette paper according to this disclosure will be apparent to those skilled in the art from the foregoing description, the process will nevertheless be summarized below.

Cigarette paper mounted on a reel 40 (see FIG. 4), advances as a paper web 22 to a first printing station 42. At that first printing station 42, gravure printing apparatus prints a first layer of the film-forming composition on the cigarette paper 22. That printing step includes heating the film-forming composition to temperature where viscosity of the film-forming composition drops below the threshold for gravure printing while avoiding temperatures that could scorch the film-forming material. The heating step reduces viscosity of the film-forming material below about 0.2Pa«s (20OcP), and most preferably to around 0.1Pa«s (lOOcP) or less.

The heated film-forming composition is applied to the patterned surface of a rotating gravure cylinder 50a. Application of the composition to the patterned surface may be accomplished by pouring or spraying the composition on the patterned surface or by moving the patterned surface through a bath of heated composition. Regardless of the application technique used, excess composition is wiped from the patterned surface of the gravure cylinder 50a with a doctor blade.

Thereafter, the rotating surface of the gravure roller 50a contacts the advancing cigarette paper as it moves through the nip 56a. There, the film-forming composition transfers from the patterned surface of the gravure cylinder 50a to the cigarette paper 22 and is quenched by contact with the cigarette paper surface. Gelatinization of the film-forming composition on the surface of the cigarette paper 22 binds at least a portion of the free water in the film-forming composition so that the water content of the composition does not disrupt planarity of the cigarette paper and cause cockling, waviness, and/or wrinkling.

The first layer 32 of the bands 30 then dries as the cigarette paper 22 continues to advance through the printing operations. When the first layer 32 has dried, it enters a second gravure printing station 44 where a second layer of the bands 34 is applied. The gravure printing at the second station 44 and the film-forming composition used are processed in the same way as described above in connection with the first printing station 42. However, the patterned surface of the second gravure cylinder 50b is prepared so that the thickness of bands it applies exceeds the thickness of the first layer. The second layer of each band is printed on the first layer so as to be coextensive with the first layer, both in width and in length.

After the second layer of the bands dries, the cigarette paper advances to the third gravure printing station 46 where a third layer may be printed on the second layer in the manner just described. At the third station 46, the patterned surface of the gravure cylinder is prepared so that the thickness of bands it applies exceeds the thickness of the second layer.

When all the desired layers have been printed on the cigarette paper 22, the paper is wound on a collection reel 48 for subsequent use in manufacture of cigarettes .

The terms and phases used herein are not to be interpreted with mathematical or geometric precision, rather geometric terminology is to be interpreted as meaning approximating or similar to the geometric terms and concepts. Where the term 'about' is used in relation to a number, it is intended that such number has a tolerance of plus or minus 5%. Similarly, such terms as 'generally' and 'substantially' are intended to encompass both precise meanings of the associated terms and concepts as well as to provide reasonable latitude which is consistent with form, function, and/or meaning.

It will now be apparent to those skilled in the art that this specification describes a new, useful, and nonobvious progressive multi-pass print banded paper. It will also be apparent to those skilled in the art that numerous modifications, variations, substitutes, and equivalents exist for various aspects of the invention that have been described in the detailed description above. Accordingly, it is expressly intended that all such modifications, variations, substitutions, and equivalents that fall within the spirit and scope of the invention, as defined by the appended claims, be embraced thereby.

CLAIMS :

1. A cigarette comprising:

a tobacco rod having a longitudinal axis;

a paper wrapper surrounding the tobacco rod, having a porosity of at least 20 Coresta units, having a plurality of bands spaced along the tobacco rod, each band having at least one layer printed with a gelatinized film-forming composition that gels when cooled to room temperature, wherein paper porosity through the band lies in the range of 0 to about 15 Coresta units .

2. A cigarette according to claim 1 wherein the film-forming material is selected from the group consisting of starch, alginate, carrageenan, guar gum, pectin, calcium carbonate, and citrates.

3. A cigarette wrapper paper comprising:

a paper web having a porosity exceeding about 20 Coresta units;

a plurality of bands on the web, the bands being generally parallel and spaced from one another by a nominal distance exceeding the width of the bands but less than the nominal length of a cigarette tobacco rod, each band including a gelatinized film-forming composition that gels when cooled to room temperature and which comprises at least two layers, and the porosity through the band and underlying paper being in the range of 0 to 15 Coresta units .

4. A cigarette wrapper paper according to claim 3 wherein the layers of each band comprise a water-soluble, film-forming compound.

5. A cigarette wrapper paper according to claim 3 or 4 wherein the film-forming compound is selected from the group consisting of starch, alginate, carrageenan, guar gum, pectin, calcium carbonate, and citrates .

6. A cigarette wrapper paper according to claim 3, 4 or 5 wherein the layers of each band have a composite coat weight in the range of 0.5g/m^2 to 15g/m^2.

7. A cigarette wrapper paper according to claim 6 wherein the composite coat weight is about 5g/m^2.

8. A cigarette wrapper paper according to any of claims 3 to 7 wherein a first layer contacts the paper, and a second layer is on the first layer.

9. A cigarette wrapper paper according to claim 8 wherein a third layer is on the second layer.

10. A cigarette wrapper comprising:

a base web; and

a plurality of bands disposed at spaced locations along said base web, said bands including at least one application of a gelled film-forming agent that is in a condition of having been printed upon said spaced locations while in a fluid heated state, said agent having gelled upon contact with the base web.

11. A smoking article comprising a tobacco rod and optionally a filter, said tobacco rod including the cigarette wrapper of claim 10.

12. A printing composition for cigarette paper comprising:

water; and

about 20% to about 50% by weight of a film-forming compound,

wherein the printing composition has a viscosity less than about 0.1Pa*s (lOOcP) at a temperature in the range of 40^{0}C to 90^{0}c, and a viscosity exceeding about 0.2Pa»s (20OcP) at a temperature of about 23°C.

13. A printing composition according to claim 12 wherein the film-forming compound is selected from the group consisting of starch, alginate, carrageenan, guar gum, pectin, calcium carbonate, and citrates .

14. A method of making banded cigarette paper comprising the steps of:

advancing cigarette paper to a first printing station;

printing a first layer of a film-forming composition comprising a viscous aqueous solution of 20 to 50% by weight of a film-forming compound, including:

heating the film-forming composition;

applying the heated film-forming composition to a patterned gravure cylinder;

contacting the advancing cigarette paper with the patterned gravure cylinder; and

gelling the film-forming composition by contact with the cigarette paper surface so that the film-forming composition does not disrupt planarity of the cigarette paper; and

printing at least a second layer of the film-forming composition on the first layer.

15. A method of making banded cigarette paper by gelatinizing an aqueous film-forming composition on a surface of the paper.

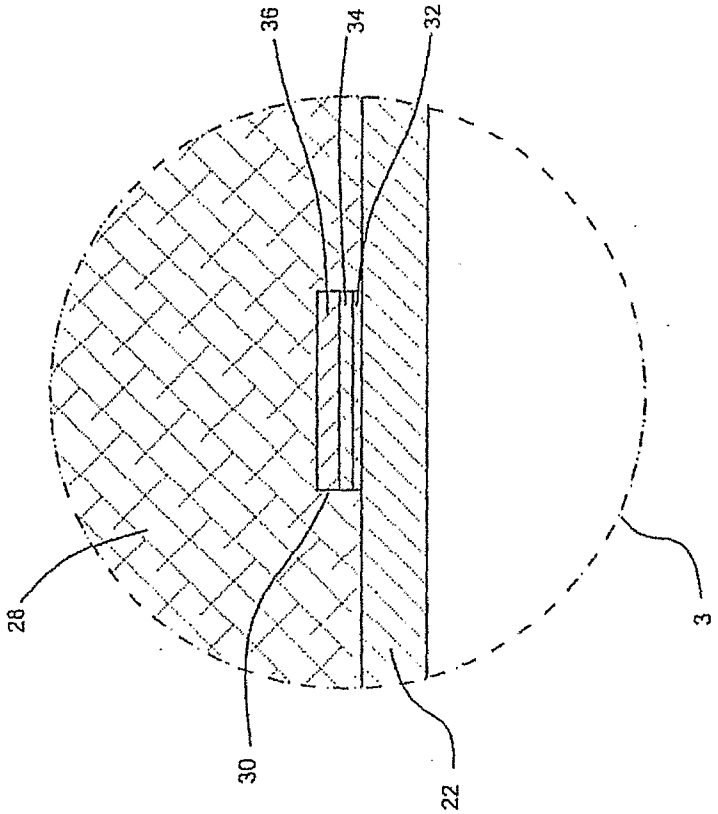

FIG. 3

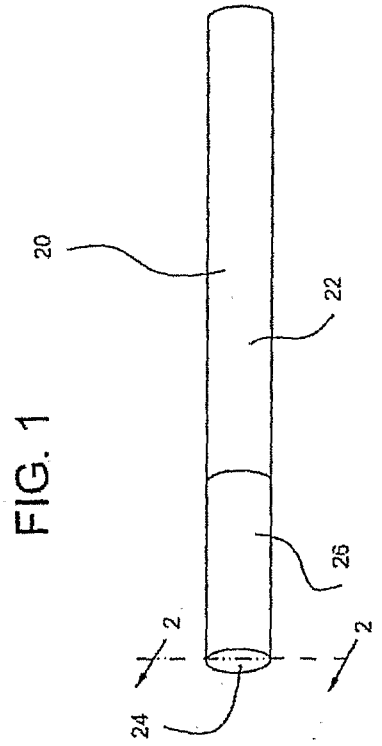

FIG. 1

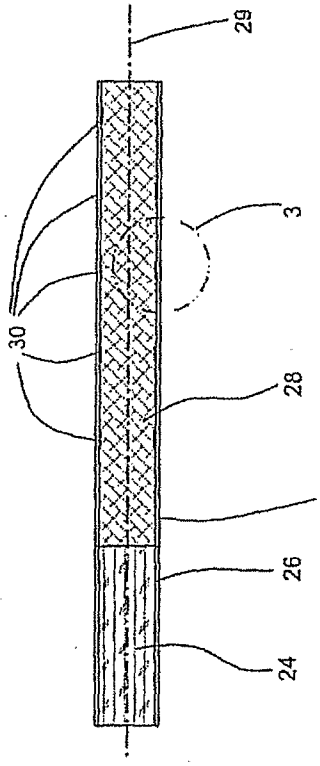

FIG. 2

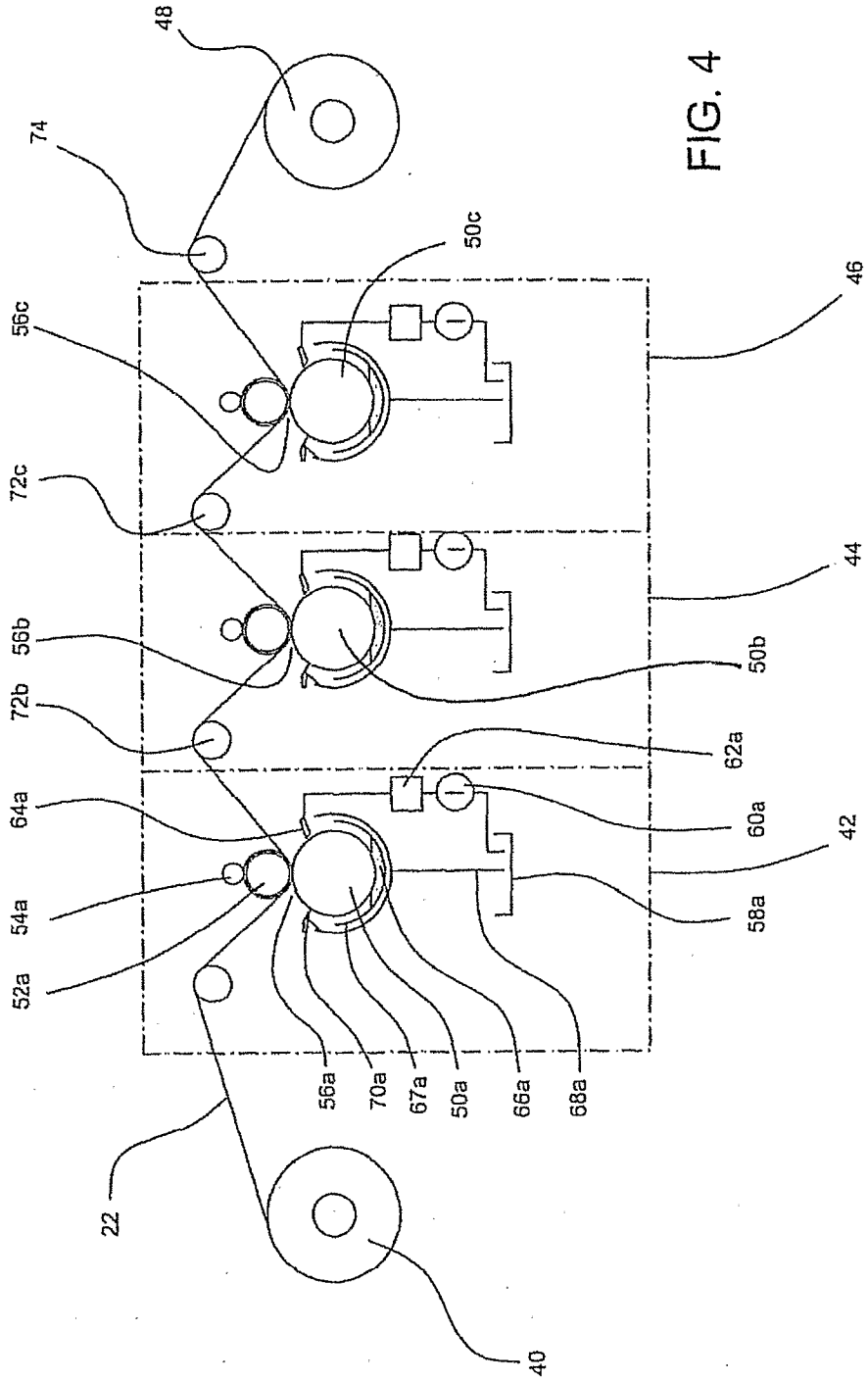
48
74
50c
46
56c
72c
44
56b
50b
72b
62a
64a
60a
42
54a
58a
52a
56a
70a
67a
50a
66a
68a
22
40

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2006/002653

A. CLASSIFICATION OF SUBJECT MATTER
INV. A24D1/02 A24C5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A24D A24C D21H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed In the continuation of Box C

[X] See patent family annex

* Special categones of cited documents

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O' document referring to an oral disclosure, use, exhibition or other means

P' document published prior to the international filing date but later than the priority date claimed

T' later document published after the international filing date or priority date and not in conflict with the application but cited to understand the pnnciple or theory underlying the invention

'X document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

ŸY document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

'&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 December 2006	05/01/2007

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
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