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(72) **Inventeurs/Inventors:**
LI, PING, US;
YANG, SZU-SUNG, US;
BAREN, RANDALL EUGENE, US

(73) **Propriétaire/Owner:**
PHILIP MORRIS PRODUCTS S.A., CH

(74) **Agent:** RIDOUT & MAYBEE LLP

(54) **Titre : PAPIER D'EMBALLAGE A MOTIFS AVEC AGENT ANTI-PLISSEMENT**
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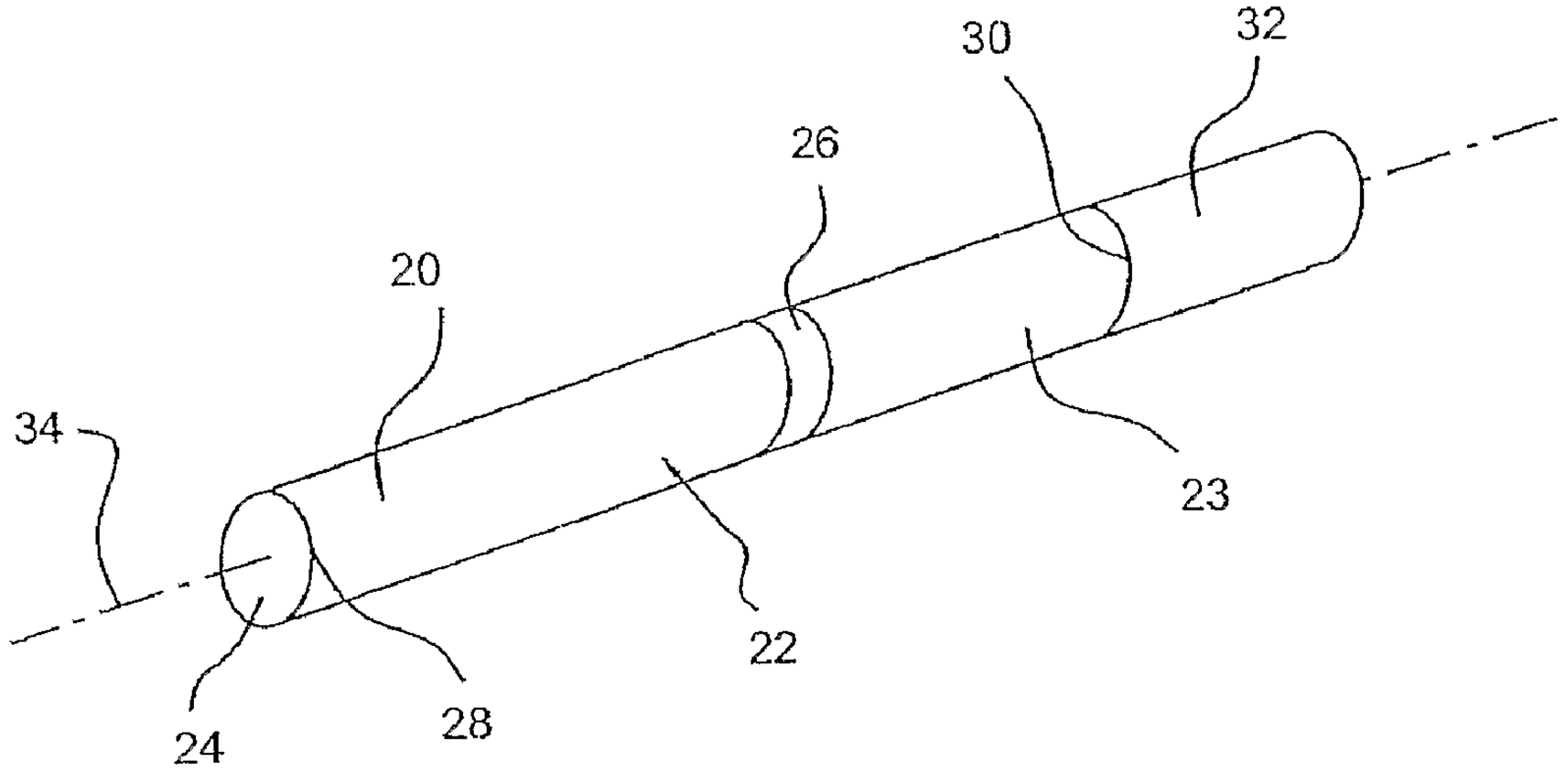

(57) **Abrégé/Abstract:**
Wrapper paper (23) for cigarette manufacture includes transversely extending band regions (26) applied by a printing technique, such as gravure printing. The band regions (26) comprise starch, an anti-wrinkling agent, and optionally calcium carbonate. The anti-wrinkling agent may be selected from the group consisting of 1,2 propylene glycol and glycerin.

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(71) Applicant *(for all designated States except US)*: **PHILIP MORRIS PRODUCTS S.A.** [CH/CH]; Quai Jeanrenaud 3, CH-2000 Neuchâtel (CH).

(72) Inventors: **LI, Ping**; 5525 Summer Creek Way, Glen Allen, VA 23059 (US). **YANG, Szu-Sung**; 2831 Cove View Lane, Midlothian, Virginia 23112 (US). **BAREN, Randall, Eugene**; 11412 Sutton Park Court, Glen Allen, VA 23059 (US).

(74) Agent: **MILLBURN, Julie, Elizabeth**; Reddie & Grose, 16 Theobalds Road, London WC1X 8PL (GB).

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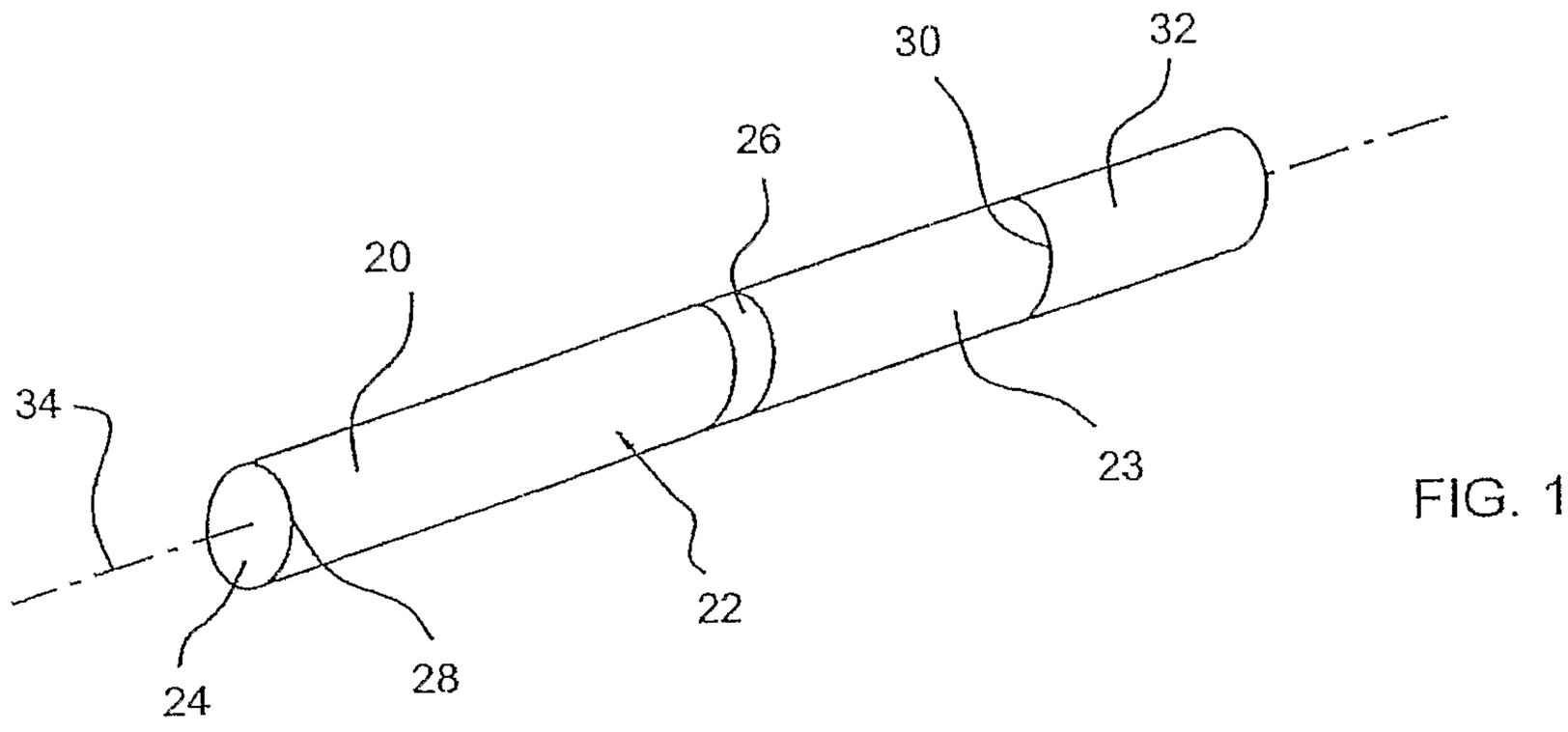

FIG. 1

(57) Abstract: Wrapper paper (23) for cigarette manufacture includes transversely extending band regions (26) applied by a printing technique, such as gravure printing. The band regions (26) comprise starch, an anti-wrinkling agent, and optionally calcium carbonate. The anti-wrinkling agent may be selected from the group consisting of 1,2 propylene glycol and glycerin.

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PATTERNED WRAPPER PAPER WITH AN ANTI-WRINKLING AGENT

FIELD OF THE DISCLOSURE

This disclosure relates generally to a smoking article and, more particularly, a banded wrapper paper for use in cigarette manufacturing that incorporates an anti-wrinkling agent.

Heretofore, multilayer banded regions on cigarette wrapper paper have been employed to effect local reductions in permeability relative to nominal permeability of the base paper so that ignition propensity targets imposed by various jurisdictions could be met. Materials used for those multilayer banded regions have been applied in various proportions, coat weights, and compositions to attain desired objectives. Many times, however, the resulting wrapper paper experienced wrinkling in the region between adjacent banded regions.

SUMMARY

A smoking article includes a tobacco rod with a wrapper paper formed from a base web having a nominal permeability. Zones of add-on material are preferably applied to the base web such that the zones extend transversely of the base web and are spaced from one another in the longitudinal direction of the base web. Each zone, in addition to comprising starch or a mixture of starch and calcium carbonate, preferably includes an anti-wrinkling agent.

Addition of an anti-wrinkling agent in the zones of add-on material on a wrapper paper yields improvements in a smoking article fashioned from that wrapper paper including, without limitation: (1) reduction of free-burn self-extinguishment (SE) while maintaining satisfactory ignition propensity (IP) performance; (2) improved rheological properties for a solution used to form the zones of add-on material; (3) quality improvement (*i.e.*, more flexibility, less wrinkling, etc.) of the add-on material zone with the anti-wrinkling agent present; (4) reduced infiltration of add-on material into the base web; (5) applicability to high Coresta base paper; and/or (6) suitability to single-pass printing application of the add-on material.

BRIEF DESCRIPTION OF THE DRAWINGS

Many objects and advantages of the present disclosure will be apparent to those skilled in the art when this specification is read in conjunction with the accompanying drawings, wherein like reference numerals are applied to like elements and wherein:

FIG. 1 is a schematic perspective view of a smoking article according to this disclosure;

FIG. 2 is a schematic view of wrapping paper according to one embodiment of this disclosure;

FIG. 3 is a schematic view of wrapping paper according to a second embodiment of this disclosure;

FIG. 4 is a schematic view of wrapping paper according to a third embodiment of this disclosure;

FIG. 5 is a schematic view of wrapping paper according to a fourth embodiment of this disclosure;

FIG. 6 is a schematic cross-sectional view taken along the line 6-6 of FIG. 2;

FIG. 7 is a schematic cross-sectional view, similar to FIG. 6, of a multi-layer band construction; and

FIG. 8 is a schematic view of an exemplary multiple stage printing apparatus.

DETAILED DESCRIPTION

In accordance with this description, a smoking article 20 (see FIG. 1) may include a tobacco rod 22 formed from a wrapper paper 23. The wrapper paper 23 surrounds a quantity of tobacco 24 so as to make a generally circularly cylindrical tobacco rod 22, although the tobacco rod 22 may be oval or another cross-sectional shape. One end 28 of the tobacco rod 22 is lightable and sometimes called the "lit end" for reference purposes. A second end 30 of the tobacco rod 22 is sometimes called the "tipped end" or "mouth end" for reference purposes. If desired, a filter 32 may be provided at the mouth end 30 of the tobacco rod 22 to remove certain constituents from tobacco smoke during smoking of the smoking article 20. Typically, the filter 32 is attached to the tobacco rod 22 by tipping paper 32 which surrounds the filter 32.

Between the first and second ends 28, 30 of the tobacco rod 22, the wrapper paper 23 has at least one zone or region 26 of add-on material. The zone 26 of add-on material preferably extends in the circumferential direction at one or more spaced locations along the axis 34, extending around the tobacco rod 22 of the smoking article 20. While the zone 26 of add-on material is depicted in this disclosure as being substantially continuous in its circumferential direction, other configurations for the add-on material are within the spirit and scope of this disclosure.

For purposes of this description, the zone 26 of add-on material is applied to the wrapper paper 23 to obtain satisfactory or improved Ignition Propensity ("IP") characteristics and also to obtain improved Self-Extinguishment ("SE") characteristics.

Ignition Propensity is a standard test conducted as set forth in ASTM E2187-04, "Standard Test Method for Measuring the Ignition Strength of Smoking articles". Ignition propensity measures the probability that a smoking article, when smoldering and placed on a substrate, will generate sufficient heat to maintain smoldering of the tobacco rod. Low values for IP are desirable as such values correlate with a reduced likelihood that a smoldering smoking article, when inadvertently left unattended, will cause combustion in an underlying substrate.

Self-Extinguishment herein is a reference to smoldering characteristics of a smoking article under free-burn conditions. To evaluate SE, a laboratory test is conducted at a temperature of 23°C ± 3°C and relative humidity of 55% ± 5%, both of which should be monitored by a recording hygrothermograph. Exhaust hood(s) remove combustion products formed during testing. Prior to testing, smoking articles to be tested are conditioned at 55% ± 5% relative humidity and 23°C ± 3°C for 24 hours. Just prior to testing, the smoking articles are placed in glass beakers to assure free air access.

SE testing takes place within an enclosure or test box. A single port smoking machine or an electric lighter is used to ignite the smoking articles for the test. During testing, an apparatus or "angle holder" holds the smoking articles to be tested by holding an end at angles of 0° (horizontal), 45°, and/or 90° (vertical). Preferably, twenty (20) smoking articles are tested at each of the 0°, 45°, and 90° positions. If more than one apparatus is used, the apparatuses are preferably positioned such that the smoking articles face away from each other to avoid cross interference. If a smoking article goes out before the front line of the smoldering coal reaches the tipping paper, the outcome is scored as "self-extinguishment"; on the other hand, if the smoking article continues smoldering until the front line of the smoldering coal reaches the tipping paper, then the outcome is scored as "non-extinguishment". Thus, for example, an SE value of 95% indicates that 95% of the smoking articles tested exhibited self-extinguishment under free-burn conditions; while an SE value of 20% indicates that only 20% of the smoking articles tested exhibited self-extinguishment under such free-burn conditions.

The SE value may be referred to in terms of "Self-Extinction at 0° value", "Self-Extinction at 45° value", or "Self-Extinction at 90° value", each of which refers to the value of SE at the specified tested angle. In addition, the SE value may be referred to in terms of "Self-Extinction Average value", which refers to an average of the three angular positions: namely, an average of (i) the "Self-Extinction at 0° value", (ii) the "Self-Extinction at 45° value", and (iii) the "Self-Extinction at 90° value". A reference to "Self-Extinction value" or "SE value" does not distinguish between SE at 0°, SE at 45°, SE at 90°, or SE average values and may refer to any one of them.

The phrases "self-extinguish under free-burn conditions" or "self-extinguishment under free-burn conditions" as used herein, refer to the extinguishment of a smoldering cigarette without puffing, i.e., free-burn conditions.

The zones 26 of add-on material determine and regulate the IP and SE characteristics of the smoking article 20. Those zones 26 of add-on material are applied to a base web 40 (see FIG. 2) of the wrapper paper 23 and then formed into a tobacco rod in conventional cigarette making equipment. Nominal permeability of the base web 40 may be in the range of about 25 to about 100 Coresta. Currently, the preferred nominal permeability of the base web lies in the

range of about 33 to about 65 Coresta, with the most preferred nominal permeabilities being about 33 and about 60. The base web 40 has a longitudinal direction 42 extending along the length of the wrapper paper 23 and a transverse direction 44 extending transversely across the width of the wrapper paper 23 so as to be generally perpendicular or transverse to the longitudinal direction 42.

Those zones 26 of add-on material may be applied to the base web 40 preferably by a printing technique. While one or more printing technique (selected from the group consisting of direct printing, offset printing, inkjet printing, gravure printing, and the like) may be used to apply the zone 26, preferably a gravure printing process will be used. Gravure printing provides ample control over deposition rates, deposition patterns, and the like, and is suitable for high-speed printing on the base web 40. For purposes of this disclosure, "high-speed" printing refers to printing processes where the base web 40 advances through the printing process at a linear speed greater than about 300 feet/min. For cigarette manufacturing purposes, base web printing speeds greater than 450 feet/min. are preferred, and speeds greater than 500 feet/minute or more are even more preferred. In this regard, the rates of deposition for add-on material, as well as the quality of the pattern of deposited add-on material, can vary considerably when wrapper paper prepared by high-speed printing processes is compared with wrapper paper prepared by low-speed printing processes. Higher-speed printing operations can achieve both desirable IP values (performance) and desired SE values (performance).

One object of this description is to provide wrapper papers 23 (see FIG. 2) produced at commercial-scale high-speed which, when formed into a tobacco rod 22, exhibit IP values no greater than 25% and SE values no greater than 50%. Accordingly, deposit rates and characteristics of the resulting printed regions are important features of high-speed printing here. While those IP and SE values are considered to be adequate at this time, even more preferred is an IP value for the resulting smoking article no greater than about 15%; and the most preferred IP value for the resulting smoking article is no greater than about 10%. Lower SE values are also desired. In this connection, a more preferred SE value is less than about 25%; while the most preferred SE value is less than about 10%.

The materials used for the zones of add-on material can be important in the IP and SE performance of a smoking article manufactured using the wrapper paper discussed herein. In one embodiment, the zones of add-on material may be printed with a starch solution that includes an anti-wrinkling agent. While an aqueous starch solution is presently preferred as the aqueous component is readily dried, use of a non-aqueous starch solution is also within the spirit and scope of this disclosure. In another embodiment, the zones of add-on material may be printed with a solution comprising a mixture of calcium carbonate (or chalk) particles, starch, and an anti-wrinkling agent. As with the starch and anti-wrinkling agent solution, the solution

comprising a mixture of calcium carbonate (or chalk) particles, starch, and an anti-wrinkling agent preferably is applied as an aqueous solution, but a non-aqueous solution also falls within the spirit and scope of this disclosure.

While many types of starch are contemplated, tapioca starch is presently preferred for the starch component. A suitable commercially available starch is FLO-MAX8 available from National Starch & Chemical Co.

Similarly, many types of calcium carbonate particles are contemplated as falling within the spirit and scope of this disclosure. Presently, however, calcium carbonate available from Solvay Chemicals, Inc., as SOCAL 31 is a suitable commercially available calcium carbonate. SOCAL 31 is an ultrafine, precipitated form of calcium carbonate having an average particle size of about 70 nm (nanometers). Larger particles of calcium carbonate have been observed to not function as well in this application when compared to the ultrafine, precipitated form of calcium carbonate, due at least in part to the tendency of larger particles to precipitate from solution more quickly and due at least in part to the need for greater quantities to attain the beneficial characteristics discussed herein.

This disclosure contemplates that various anti-wrinkling agents are suitable to attain the desired characteristics described herein. In particular, the anti-wrinkling agent is selected from the group consisting of glycerin, propylene glycol, and 1,2 propylene glycol. Glycerin is a preferred member of the anti-wrinkling agent group. Presently, however, 1,2 propylene glycol is the most preferred member of the anti-wrinkling agent group.

Generally speaking, this disclosure contemplates that either (i) an anti-wrinkling agent or (i) a combination of anti-wrinkling agent and calcium carbonate will be added to a nominal aqueous starch solution to obtain the add-on solution to be used for printing. For the nominal aqueous starch solutions used in this description, the starch may comprise from about 10% to about 28%, by weight, of the nominal solution. Preferably, the starch may comprise from about 20% to about 24%, by weight of the nominal solution. Most preferably, starch may comprise about 22%, by weight, of the nominal solution.

An anti-wrinkling agent is preferably added to the nominal starch solution, with the weight of the anti-wrinkling agent being in the range of about 10% to about 120% of the weight of the starch in the nominal starch solution. When the anti-wrinkling agent is 1,2 propylene glycol, the weight of the anti-wrinkling agent is more preferably in the range of about 50% to about 120% of the weight of the starch in the nominal starch solution; even more preferably in the range of about 60% to about 110%; and most preferably in the range of about 90% to about 110%. Where the anti-wrinkling agent is glycerin, the weight of the anti-wrinkling agent is more preferably in the range of about 10% to about 45% of the weight of the starch in the nominal starch solution; even more preferably in the range of about 20% to about 40%; and most

preferably about 20% to about 30%. Where glycerin is used as the anti-wrinkling agent at about 40 to about 45%, the glycerin appears to adversely affect the drying quality of the add-on solution.

If calcium carbonate, or chalk, is added to the nominal starch solution in addition to the anti-wrinkling agent, the weight of chalk may lie in the range of 0% to about 100% of the weight of starch in the nominal solution; preferably in the range of about 40% to about 100%; and most preferably in the range of about 60% to less than about 80%. Chalk may be added to the nominal starch solution to adjust the reflectance of the resulting add-on material so as to be comparable to the reflectance of the uncoated base web material. With such reflectance, banded regions constructed from the add-on material are less visible to the casual observer.

The $CaCO_3$-to-starch ratio may also be a significant factor in determining IP and SE performance of a smoking article fashioned from the wrapper paper of this disclosure, when prepared by high-speed printing. The $CaCO_3$-to-starch ratio is determined as the ratio, by weight, of calcium carbonate to starch for the zone of add-on material. More specifically, a $CaCO_3$-to-starch ratio of less than about 0.8 is preferred to obtain IP and SE (at 0°) performance less than about 25%.

From the foregoing description and the attached drawings, those skilled in the art will understand that a method of manufacturing a banded wrapper paper for smoking articles has been described. In that process, banded regions 26 (see FIG. 2) of add-on material are established as spaced locations on one surface of the base web 23. Spacing of those banded regions 26 may be selected so as to be substantially greater than the width of those banded regions 26 in the longitudinal direction 42 of the base web 40. The width of the banded regions 26 may be selected to lie in the range of about 5 mm to about 10 mm (millimeters); and the spacing between those banded regions 26 (that spacing being measured as the distance from the trailing edge of one banded region to the leading edge of the next adjacent banded region) may be in the range of about 12 mm to about 40 mm.

The base web 40 with the banded regions 26 may be supplied as a roll, the base web 40 may be slit in its longitudinal direction into portions having a transverse width corresponding to the circumference of a tobacco rod plus the width of a glue seam. After splitting individual portions of the web, those portions may each be wound on a corresponding bobbin. Using conventional equipment, such as a cigarette making machine, the base web 40 is fed from a bobbin into the machine where cut tobacco filler is deposited along the side of the paper web 40 to which the banded regions 26 have been applied so that the banded regions 26 are on the inside of the resulting tobacco rod 22. Also in conventional manner, the wrapper paper is wrapped around the cut tobacco filler and sealed with a longitudinal seam to form a tobacco rod 22 (see FIG. 1).

Accordingly, a method of making banded paper comprises establishing a supply of add-on solution at a printing station and passing a base web through the printing station while repetitively applying the solution to portions of the base web at the printing station. Establishing the supply of add-on solution includes adding an anti-wrinkling agent to the add-on solution.

FIG. 8 is a schematic view of a multiple stage printing apparatus. FIG. 8 illustrates a reel 41 of paper, first gravure printing station 43, second gravure printing station 45, third gravure printing station 46, collection reel 48, rollers 50, impression cylinder 52, backing roller 54, nips 56, reservoir 58, pump 60, heat exchanger 62, applicator 64, bath 66, collector 67, drain 68, doctor blade 70, adjustment cylinders 72, and idler roller 74. In FIG. 8, features of a first gravure printing station 43 contain reference numerals with the suffix "a", corresponding features of a second gravure printing station 45 contain the same reference numeral with the suffix "b", and corresponding features of a third gravure printing station 46 contain the same reference numeral with the suffix "c". When zones of add-on material are applied in a single pass, only one printing station is needed. Other printing stations may, however, be used to apply indexing or reference marks, logos, and the like.

The typical reservoir 58 contains the mixture of add-on material for forming banded regions on the wrapper discussed above. The reservoir 58 communicates with a suitable pump 60 which is capable of handling the viscous add-on material. The add-on material may then flow to a suitable heat exchanger 62 where the temperature of the add-on material is elevated so that the viscosity of the add-on material is adjusted to a level which is suitable for printing. The viscosity of the add-on material may increase over time (*e.g.*, upon remaining in the reservoir), to a level where the viscosity of the add-on material is no longer suitable for printing. Due to its rheological properties, the add-on material has a finite shelf life, or pot-life, after which the material loses its usefulness. However, the addition of an anti-wrinkling agent to the add-on material formulation, has been shown to: (1) reduce the initial viscosity of add-on material; and (2) increase the shelf life, or pot-life, of the add-on material compared to material not having an anti-wrinkling agent.

EXAMPLES

The following illustrative, non-limiting examples are intended to provide further explanation. The results provided in Tables I and II compare the initial viscosity and time stability of a printing solution without an anti-wrinkling agent additive and to the initial viscosity and time stability of a printing solution with an anti-wrinkling agent additive. The observations recorded in Table I (for 1,2 propylene glycol) and Table II (for glycerin) show that a printing solution containing an anti-wrinkling agent such as 1,2 propylene glycol or glycerin is less viscous initially and more stable in that it has a lower viscosity for a much longer period of time.

Table I

	Viscosity of 24% starch solution + 80% $CaCO_3$[1]	Viscosity of 24% starch solution + 80% $CaCO_3$ + 100% 1,2 propylene glycol[2]
Day 1	65 centipoise (cp)	50
Day 2	71	51
Day 3	77	50
Day 4	88	--
Day 6	--	52
Day 7	147	58
Day 8	--	61
Day 9	--	66
Day 10	225	70
Day 16	--	114

[1]$CaCO_3$ added to a solution of 24% dry starch in water; ratio by weight of added $CaCO_3$ to dry starch present in the solution is 0.8:1.0.

[2]$CaCO_3$ added to a solution of 24% dry starch in water; ratio by weight of added 1,2 propylene glycol to added $CaCO_3$ to dry starch present in the solution is 1.0 : 0.8 : 1.0.

Table II

	Viscosity of 20% starch solution + $CaCO_3$[1]	Viscosity of 20% starch solution + $CaCO_3$ + glycerin[2]
Day 1	51 centipoise (cp)	41 cp
Day 2	50 cp	---
Day 5	66 cp	52 cp
Day 6	78 cp	---
Day 7	102 cp	---
Day 8	---	55 cp
Day 12	---	62 cp
Day 14	---	72 cp

[1]$CaCO_3$ added to a solution of 20% dry starch in water; ratio by weight of added $CaCO_3$ to dry starch present in the solution is 1 : 1.

[2]$CaCO_3$ and glycerin added to a solution of 20% dry starch in water; the ratio by weight of added glycerin to added $CaCO_3$ to dry starch present in the solution is 1 : 5 : 5.

The foregoing Tables demonstrate that the useful shelf-life of the printing solution using an anti-wrinkling agent, as measured by its viscosity, essentially doubles the shelf-life of a printing solution without the anti-wrinkling agent. The addition of an anti-wrinkling agent in the material applied to the add-on zones thus improves rheological properties of the printing solution used to form the zones of add-on material.

When the add-on material is applied with a printing technique, viscosity of the applied material is important. Where the viscosity of the applied material increases over time, the add-on material has a finite shelf life, or pot life, after which the material loses its usefulness. As Table I demonstrates, with the addition of an anti-wrinkling agent to the applied material formulation, the initial viscosity of add-on material can be reduced by about 20%. Moreover, the shelf life, or pot life, of the add-on material increases by a factor of at least two or more compared to material not having an anti-wrinkling agent.

The results provided in Tables III and IV indicate that addition of an anti-wrinkling agent to the printing solution reduces free-burn SE without affecting IP, i.e., while maintaining an acceptable IP level. For purposes of the information presented in Table III, batches of 40 cigarettes were tested to obtain the IP performance, while batches of 20 cigarettes were tested at each angular position to obtain the SE performance.

Table III

Print solution with 22% Starch + 100% 1,2 propylene Glycol[1] + $CaCO_3$

$CaCO_3$ %	Width, mm	IP%	SE(0°)	SE(45°)	SE(90°)	SE(Avg)
40	7	0	40	85	100	75
	7	0	35	90	100	75
	6	0	75	100	100	92
	6	5	0	60	100	53
60	7	0	10	80	100	63
	7	0	10	75	95	60
	6	5	25	85	100	70
	6	10	5	40	50	32
80	7	7.5	5	60	90	51
	7	5	0	65	85	50
	6	25	0	45	50	32

[1]1,2 propylene glycol added to a solution of 22% dry starch in water; 1,2 propylene glycol added to the starch solution with the ratio of 1,2 propylene glycol to dry starch being 1.0:1.0; and $CaCO_3$ being added to the starch solution in the weight percentage stated, measured relative to the weight of dry starch used in the solution.

From Table III, certain conclusions can be drawn. For example, the IP stayed well under the 25% target value for 7mm zones or bands. In addition the IP stayed well under the 25% target value when $CaCO_3$ weight was less than 80% of the starch weight. Further, the average SE values was less than or equal to 70% when $CaCO_3$ weight was greater than 40% of the starch weight; and SE at 0° was less than or equal to 25 when $CaCO_3$ weight was greater than 40% of the starch weight.

For purposes of the information presented in Table IV, smaller groups of cigarettes were tested, namely groups of five. The cigarettes tested for the results in Table IV were prepared with two hand-brushed bands using the add-on material solution as indicated in Table IV.

Table IV

Solution	**IP**	**SE (at 0°)**
20% starch solution	0 out of 5	3 out of 5
20% starch solution + glycerin[1] Weight ratio of glycerin to dry starch = 1 : 5	0 out of 5	1 out of 5

[1] Glycerin added to a solution of 20% dry starch in water; ratio by weight of added glycerin to dry starch present in the solution is 1 : 5.

For both solutions containing an anti-wrinkling agent, all of the cigarettes self-extinguished before the coal reached the filter line in the IP test. However, in the SE test (at 0°), for the solution without an anti-wrinkling agent, 60% of the cigarettes self-extinguished before the filter line, whereas for the solution containing an anti-wrinkling agent, only 20% of the cigarettes self-extinguished before the filter line. The self-extinguishment thus remains below a common target of 25%. The ignition propensity performance was excellent, with the resulting value of 0% being well below target values of 10%, 15%, or 25% often used. Thus, the addition or inclusion of an anti-wrinkling agent in the zones of add-on material reduces free-burn self-extinguishment (SE) without negatively affecting ignition propensity (IP) performance.

Inclusion of an anti-wrinkling agent in the add-on material also enhances characteristics of the resulting banded wrapper paper. More particularly, an anti-wrinkling agent has been found to increase flexibility of add-on material when dried on the wrapper paper (i.e., it acts as a plasticizer). As a result, bands of add-on material are less prone to separate from the base web during handling and use than bands on wrapper paper where an anti-wrinkling agent is not used in the formulation. Furthermore, as noted above, incorporation of an anti-wrinkling agent in the add-on material gives rise to improved SE performance in a smoking article fabricated from

wrapper paper having bands of add-on material including an anti-wrinkling agent – but without degradation of IP performance.

While the operation of the anti-wrinkling agent in the starch solution is not fully understood, it appears that the anti-wrinkling agent also functions as a plasticizer in the starch solution. A starch solution without an anti-wrinkling agent capable of also functioning as a plasticizer tends to infiltrate the top surface of the paper structure. Moreover, the starch solution tends shrink or contract when it dries. That shrinkage and/or contraction causes the underlying web to also shrink or contract, i.e., in the area underlying the banded region. By way of example, observations have shown that the width of a 91 cm (36 inch) wide paper web may shrink by as much as about 1.3 cm to about 1.9 cm (about 0.5 inches to about 0.75 inches) in the banded region -- in other words by about 1 to about 2%. Such shrinkage may create difficulties, as in maintaining proper registration among multiple print stations when using multipass printing, among others.

Since the underlying web, between banded regions, does not experience the shrinkage, the region between the banded regions exhibits waviness, where the waves extend in the longitudinal direction of the underlying web and the undulations of the waves occur in the cross-web or transverse direction of the underlying web. After the underlying web is slit longitudinally into portions sized to manufacture cigarettes, each of those longitudinal portions of the paper web is wound tightly on a corresponding bobbin. Accordingly, the undulations described above sometimes result in creases in the unbanded regions where the paper folds on itself to adjust to the width reduction caused by shrinkage in the banded regions. Such creases in the wrapper paper are generally unacceptable for tobacco rod production.

Thus, the shrinkage of the banded regions appears to be a cause of wrinkling in the unbanded, or unprinted, area of the wrapper paper. Again, the mechanisms are not fully understood, but the addition of an anti-wrinkling agent to the starch solution appears to cause the printed layer or banded zone to be more flexible. That flexibility may result from the printed starch layer being more elastic. That flexibility may also result from the printed layer having reduced infiltration into the paper structure such that the printed layer lies more on the surface of the paper web. Regardless of whether those mechanisms, a combination of those mechanisms, or some other mechanism is active, observations indicate that, when the wrapper paper flexes, the enhanced elasticity of the layer or banded zone reduces the likelihood that the layer or banded zone will separate from the wrapper paper. Moreover, the elasticity of the layer or banded zone appears to allow the layer or banded zone to dimensionally conform to the underlying paper as the applied solution dries -- hence shrinkage in the banded region is reduced and, simultaneously, wrinkling and/or puckering between the banded regions is also

reduced. Accordingly, incorporating the anti-wrinkling agent in the starch solution counteracts the wrinkling described above.

A further advantage of the anti-wrinkling agent herein disclosed concerns the film-forming attributes of the solution. More particularly, inclusion of the anti-wrinkling agent in the add-on material seems to enhance the film-forming characteristic of the add-on material with respect to the surface of the base web to which the add-on material is applied. That improved film-forming characteristic is believed to enhance the IP performance of banded wrapper papers constructed from the add-on material. Moreover, the film-forming characteristic enhances the desired occlusive effect of the layer sufficiently that the desired reduction in permeability in the banded region can be effected with a single printing application of the add-on material, thereby effectively eliminating multi-pass applications that may have been needed with solutions not having the anti-wrinkling agent.

Some further advantage has been observed when 1,2 propylene glycol is used as the anti-wrinkling agent. Specifically, 1,2 propylene glycol can be effectively used where the ratio of 1,2 propylene glycol weight to starch weight in the solution is about 100%. By contrast, glycerin can be effectively used when the ratio of glycerin weight to starch weight in the solution is less than 40% because at that ratio the drying time for the starch-and-starch-plasticizer solution becomes unacceptable. That difference in drying time may result from the difference in boiling point for glycerin (290°C) and the boiling point for 1,2 propylene glycol (187.3°C) -- a difference of about 100°C. For 1,2 propylene glycol, the boiling point is closer to the boiling point of an aqueous solvent than is the boiling point of glycerin.

With the addition of an anti-wrinkling agent to the starch solution, permeability of the banded region is improved, i.e., the permeability is more uniform and is lower than permeability for a band that does not use plasticizer. This phenomenon is significant because it permits the required quantity of starch solution to be applied or printed in a single printing step. Those skilled in the art will appreciate that, in the past, multiple printing steps were typically needed to effect the necessary permeability reduction in the banded regions. Of course, it may still be desirable -- for other reasons -- to continue use of multilayer printing operations.

Referring to Table V, wrapper A comprises a slit band arrangement, having three zones of about 2 mm each, for a total width of about 6 mm for the printed banded region with add-on rates in the various zones ranging from about 3.5x to about 5.5x. An add-on rate of 5.5x results in about 8 g/m^2 to about 9 g/m^2 of add-on material on a dry weight basis, where the wrapper has a nominal basis weight of about 26.5 g/m^2. Lower add-on rates would be expected to provide proportionally adjusted values for the weight of the add-on material, measured on a dry weight basis. The width of the banded regions and the zones are typically measured in the longitudinal

direction, and have a 27 mm phase (*i.e.,* the spacing from the leading edge of a banded region to the leading edge of the next or subsequent banded region).

Table V

Wrapper	Banded Region Configuration	Total Banded Region Width	Base Web Permeability
A	2-2-2	6 mm	33 Coresta
B	2.5-2-2.5	7 mm	33 Coresta
C	2.5-2-2.5	7 mm	60 Coresta
D	3-2-3	8 mm	60 Coresta

In Table V, the "banded region configuration" is a shorthand description of the width of portions of the band, viewed in the direction which the coal advances in a burning tobacco rod. Thus, the 2.5-2-2.5 configuration means that the first portion of the total banded region width is 2.5 mm, the second portion of the total banded region width is 2 mm, and the third portion of the total banded region width is 2.5 mm. Here, the first portion would be encountered first by the advance coal of a burning tobacco rod, the second portion would be encountered next by the coal advance, and the third portion would be encountered last by the coal advance.

Table VI – Details of Wrapper A

	Zone 1	Zone 2	Zone 3
Width	2 mm	2 mm	2 mm
Layers of Add-on Material	1	1	1
Add-on Rate Per Layer	5x	3.5-4x	5x
Total Add-on Material	5x	3.5-4x	5x

Table VII – Details of Wrapper B

	Zone 1	Zone 2	Zone 3
Width	2.5 mm	2 mm	2.5 mm
Layers of Add-on Material	1	1	1
Add-on Rate Per Layer	5x	3.5-4x	5x
Total Add-on Material	5x	3.5-4x	5x

Table VIII – Details of Wrapper C

	Zone 1	Zone 2	Zone 3
Width	2.5 mm	2 mm	2.5 mm
Layers of Add-on Material	1	1	1
Add-on Rate Per Layer	5x	3.5-4x	5x
Total Add-on Material	5x	3.5-4x	5x

Table IX – Details of Wrapper D

	Zone 1	Zone 2	Zone 3
Width	3 mm	2 mm	3 mm
Layers of Add-on Material	1	1	1
Add-on Rate Per Layer	5x	3.5-4x	5x
Total Add-on Material	5x	3.5-4x	5x

Tables VI-IX show that the multizone banded region may be fashioned in a single pass printing operation with the application rates indicated in those tables. In each of wrappers A through D, the add-on material preferably included an aqueous solution containing starch, chalk or calcium carbonate, and 1,2 propylene glycol. A presently preferred mixture for that aqueous solution includes starch, chalk, and 1,2 propylene glycol in a weight ratio of about 100 (for starch), to about 40 to about 80 (for chalk), to about 100 (for 1,2 propylene glycol), in weight percent. The starch alone may be in the range of about 20% to about 24% in the aqueous solution.

We note that some changes in the relative proportions of constituents of the add-on material may change when the aqueous solution is applied to a base web and dried. For example, it has been observed that when 1,2 propylene glycol is used as the anti-wrinkling agent, about 50% to about 60% of the propylene glycol added to the solution remains in the add-on material when it has dried on the paper web. Some weight loss may also occur in other anti-wrinkling agents during the drying process. However, such weight loss has not been observed with respect to the starch and calcium carbonate constituents of the add-on material during the drying process.

The zone 26 of add-on material may be substantially continuous transverse of the paper web, as shown (see FIG. 2), or may have one or more longitudinally extending separations so as to define a C-shaped zone when formed into a wrapper for a tobacco rod (see FIG. 4), or may have several arcuately-shaped portions generally symmetrically positioned around the

tobacco rod when viewed in cross section transverse to the longitudinal axis 34 of the tobacco rod 22 (see FIG. 5).

In addition, the zone 26 of add-on material on the wrapper paper 23 may be divided into two or more substantially ring-shaped portions (see FIG. 3) that are spaced from one another along the axis 34 by a distance, *w*, that typically does not exceed the width of the rings 26, when measured in a direction generally parallel to the axis 34 of the tobacco rod 22. Such a spacing feature provides a "slit" in the band structure.

It is also within the contemplation of this disclosure that the zone 26 on the wrapper paper 23 may comprise a plurality of patches 27 (see FIG. 5) disposed circumferentially around the tobacco rod 22, with patches 27' of an adjacent zone 26 being circumferentially displaced from patches of other adjacent zones 26. In addition, the patches 27, 27' may be arranged according to a predetermined pattern such as taught in commonly assigned U.S. Patent Application Serial No. 60/924,666.

The zones of add-on material are preferably applied in a single layer 80 (see FIG. 6). It should be noted that the representation of the base web cross section in FIG. 6 is schematic. The actual cross section of a base web is a slice through the myriad of fibers which form the base web. In the case of cigarette wrapper paper, that thickness may be on the order of about 30 microns (*i.e.*, 30 x 10^{-6} meters or 30 μm). Actual thickness of the add-on material ≤ 2 μm, and the add-on material tends to infiltrate and conform to the surface presented by the fibers of the base web. As a result, material build-up in the zones of add-on material can be schematically shown as boxes (as in FIGs. 6 and 7), but actually are nearly imperceptible to the unaided eye. To that end, it will be appreciated that, if multiple layers are used to form the zones of add-on material, the resulting structure is nearly impossible to resolve into the individual layers. That resolution into individual, or separate, layers is further complicated when aqueous solutions are applied because subsequent layers tend to re-wet the previous layer and allow components such as chalk to settle through the material of the prior layer.

The application rate of the material in the preferred single layer (see FIG. 6) may be in the range of about 4x to about 6x. For these purposes, the "x" is a nominal value conventionally used in gravure printing to describe the relative quantity of material being deposited, relative to a basic minimal application rate. Where the base web has a nominal Coresta value of about 33, a presently preferred application rate of about 5X is believed to be appropriate. Where the base web has a nominal Coresta value of about 60, a presently preferred application rate of about 5.5X is believed to be appropriate.

Although the zones of add-on material are preferably applied in a single pass, application, or layer, this description also contemplates application of the add-on material in multiple applications steps, or layers (see FIG. 7). In this embodiment, after a first layer 80 is applied to the surface of the base web 23 at a first gravure printing station 43 (see FIG. 8) and

dried, a second layer 82 (see FIG. 7) of add-on material may be applied to the wrapper paper, for example at a second printing station 45 (see FIG. 8). If desired, a third or subsequent layer 84 (see FIG. 7) can be applied at further printing stations, e.g., 46 (see FIG. 8). The second layer 82 may be arranged so as to be superposed on, and substantially co-extensive with, the first layer 80. Alternatively, the second layer 82 may cover only one or more portions of the first layer 80. The relative application rate of the layers need not be the same, and preferably is different. For example, one layer may be at least about 1.5 times to about 3 times the thickness of the other layer.

When the phrase "weight ratio" is used herein with respect to the starch component of a starch solution, the "weight ratio" is the ratio of the weight of the additional material compared to the weight of starch used to prepare the starch solution. Moreover, for purposes of this disclosure, references to an "X% starch solution" refer to an aqueous starch solution in which the starch weight is X% of the solution weight (e.g., weight of starch divided by the sum of starch weight and aqueous component weight).

When the word "about" is used herein in connection with a numerical value, the intent is to include not only that numerical value but also values within in a tolerance or range of ±5% of the precise numerical value associated with the word "about".

It will now be apparent to those skilled in the art that this specification describes a new, useful, and nonobvious smoking article, wrapper paper, and material composition for bands of add-on material. It will also be apparent to those skilled in the art that numerous modifications, variations, substitutes, and equivalents exist for various aspects of the such articles, paper and/or composition 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 scope of the invention, as defined by the appended claims, be embraced thereby.

CLAIMS:

1. A wrapper paper (23) for a smoking article (20) having an ignition propensity no greater than 25%, and average self-extinction no greater than 50%, comprising:

a base web of paper (40), having a longitudinal direction and a transverse direction, and including at least one banded region (26) extending in the transverse direction while being spaced from one another in the longitudinal direction;

wherein the at least one banded region (26) includes starch and an anti-wrinkling agent of either, glycerin having a weight ratio of glycerin to starch in material added to the at least one banded region in the range of about 10% to about 45%, or propylene glycol having a weight ratio of propylene glycol to starch in material added to the at least one banded region is in the range of about 50% to about 120%.

2. A wrapper according to claim 1 wherein material added to the at least one banded region (26) includes about 40 weight % to about 100 weight % starch.

3. A wrapper according to claim 1 or 2 wherein material added to the banded region (26) includes about 40 weight % to less than about 60 weight % starch.

4. A wrapper according to any one of claims 1 to 3 wherein the banded region (26) further includes calcium carbonate.

5. A wrapper according to claim 4 wherein the weight ratio of calcium carbonate to starch in material added to the at least one banded region (26) is in the range of about 0.4 to about 1.0.

6. A wrapper according to claim 5 wherein the weight ratio of calcium carbonate to starch is about 0.8.

7. A smoking article (20) having an ignition propensity no greater than 25%, and average self-extinction no greater than 50% comprising a quantity of tobacco (24) and the wrapper according to any one of claims 1-6 surrounding the quantity of tobacco (24) and defining a tobacco rod (22) having a pair of ends, the at least one banded region (26) of reduced static burn rate being between the ends of the tobacco rod (22).

8. A smoking article according to claim 7 having average Self-Extinction at 0° of no greater than about 25%.

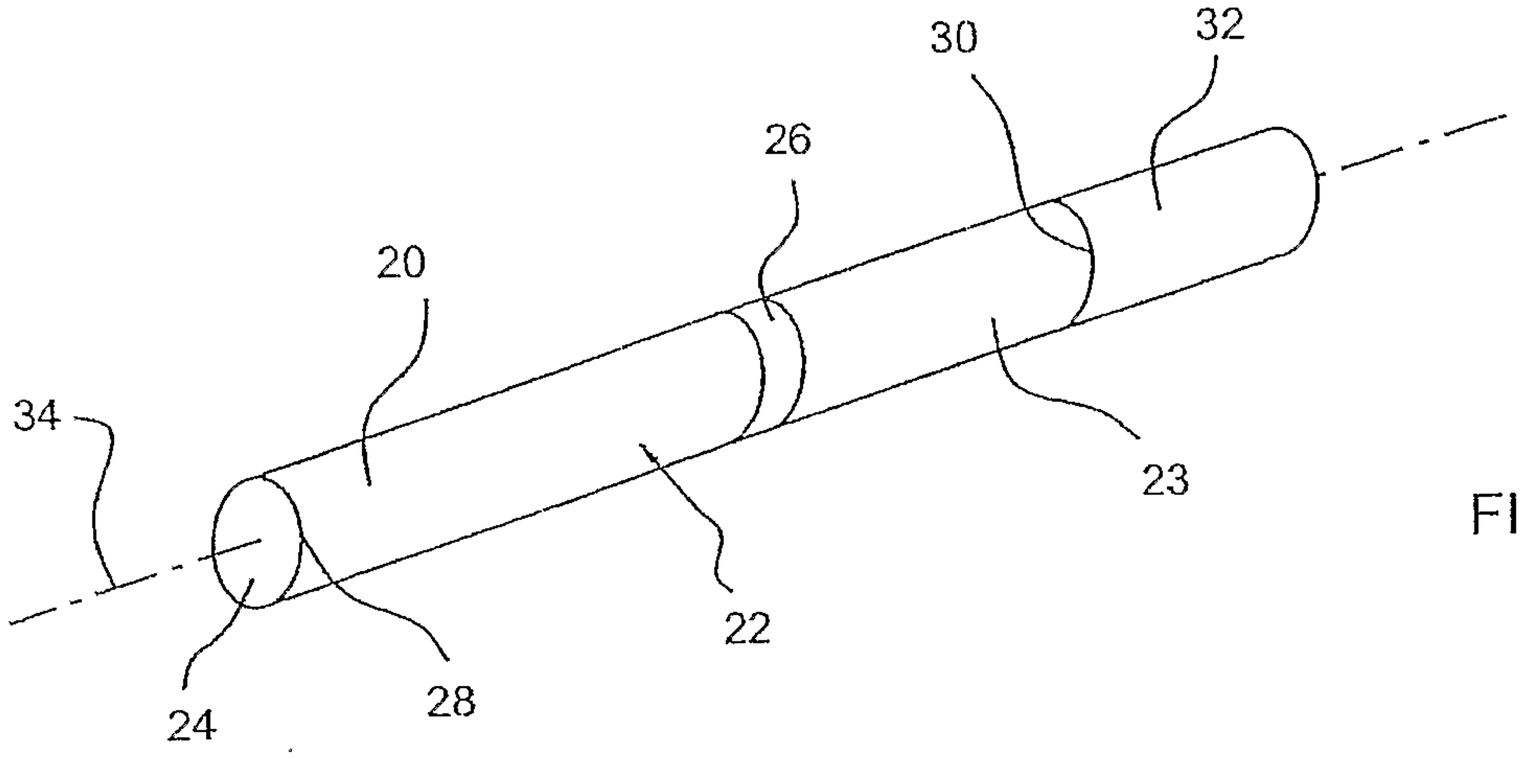


FIG. 1

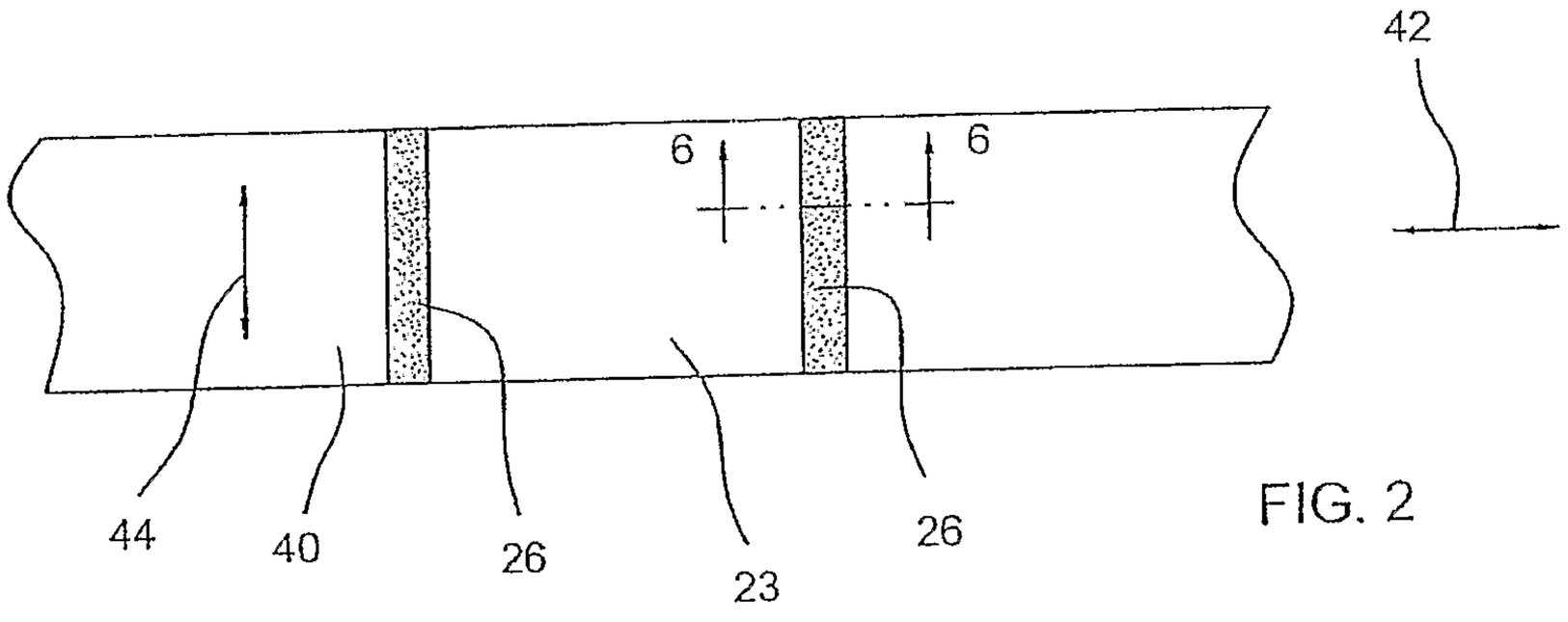


FIG. 2

FIG. 3

FIG. 4

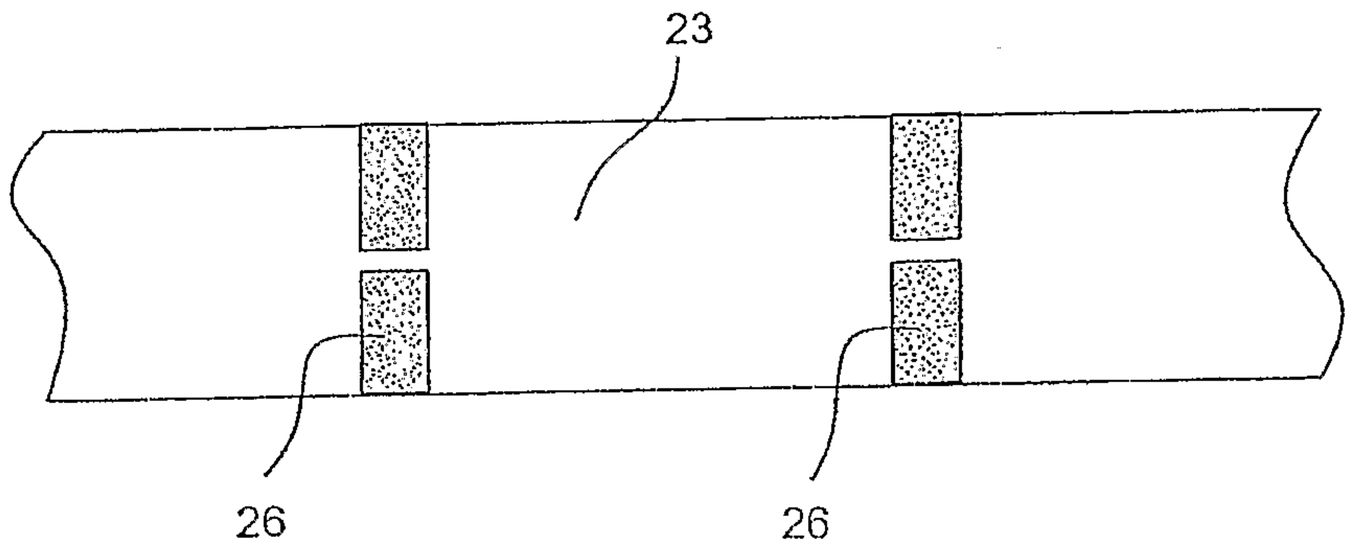


FIG. 5

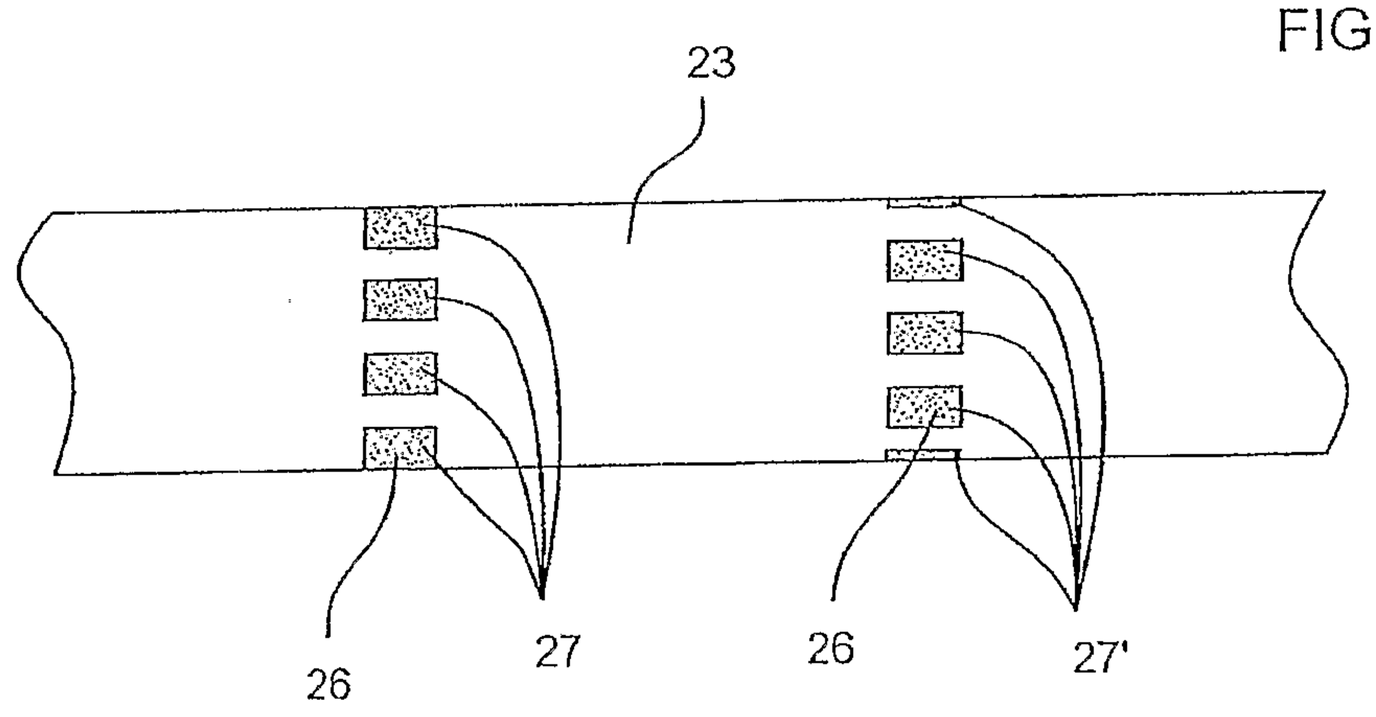


FIG. 6

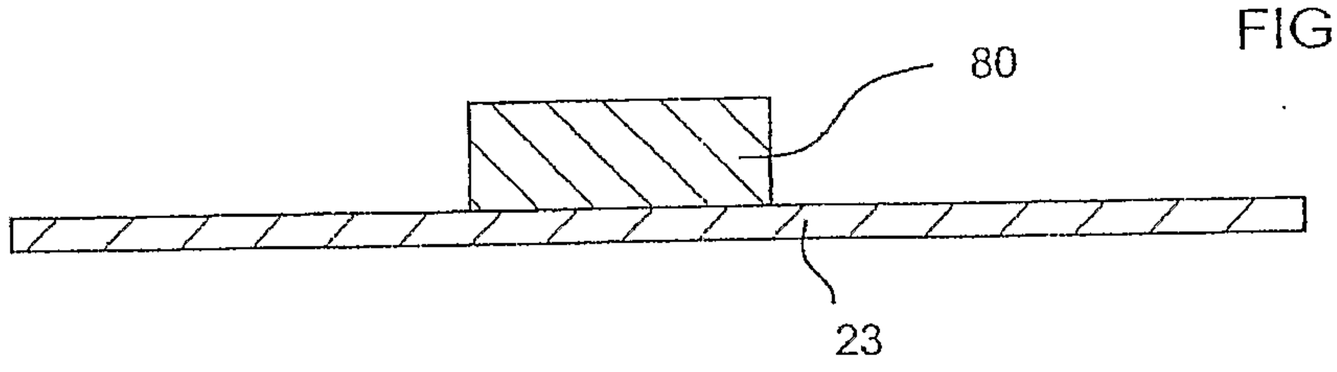
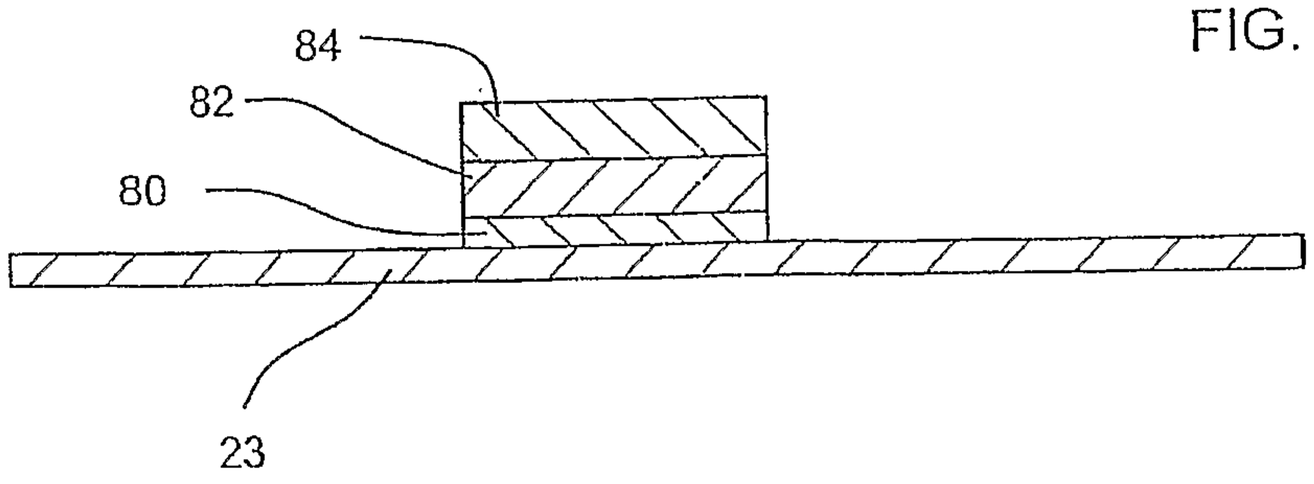
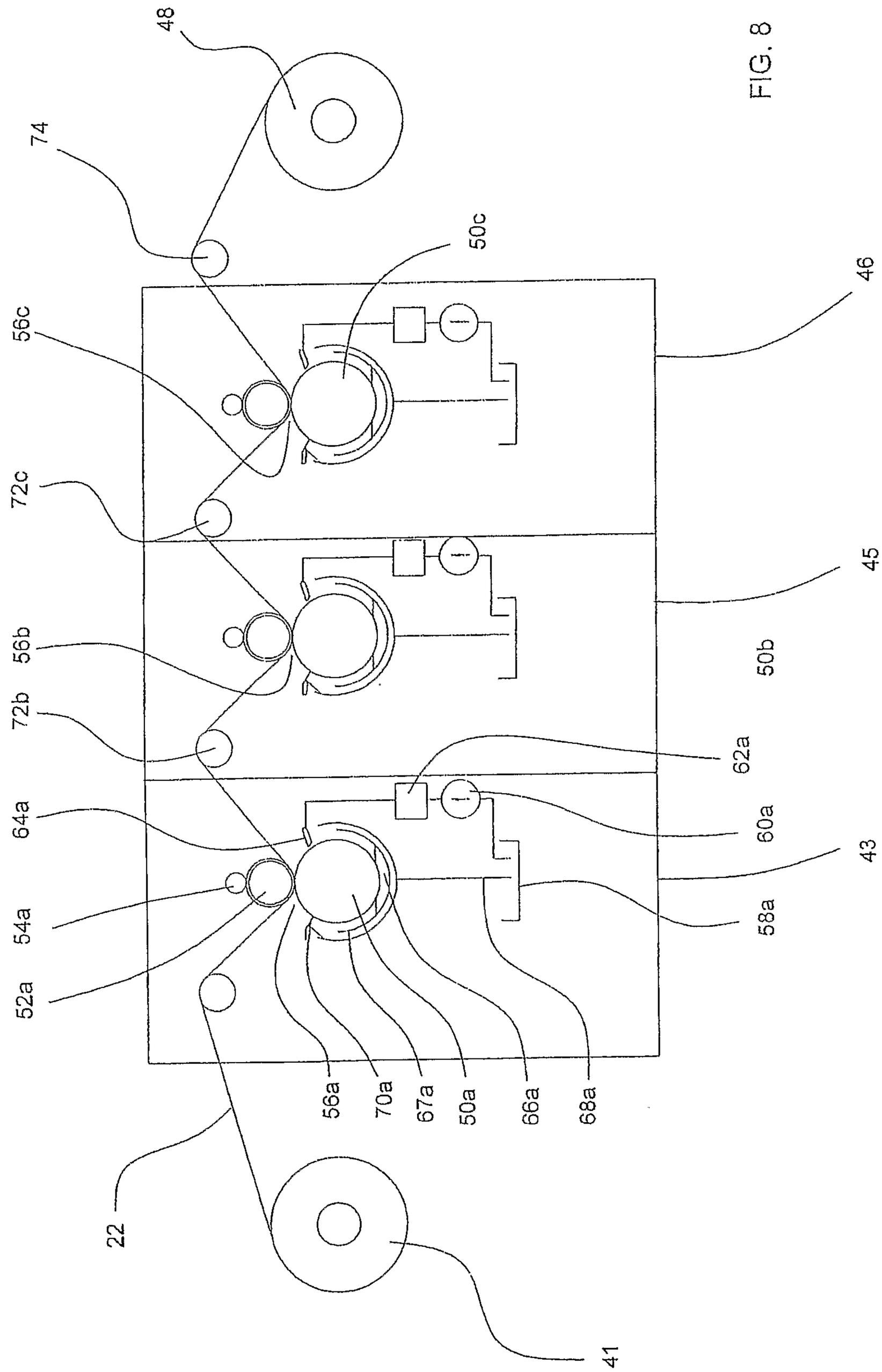


FIG. 7

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74
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56c
72c
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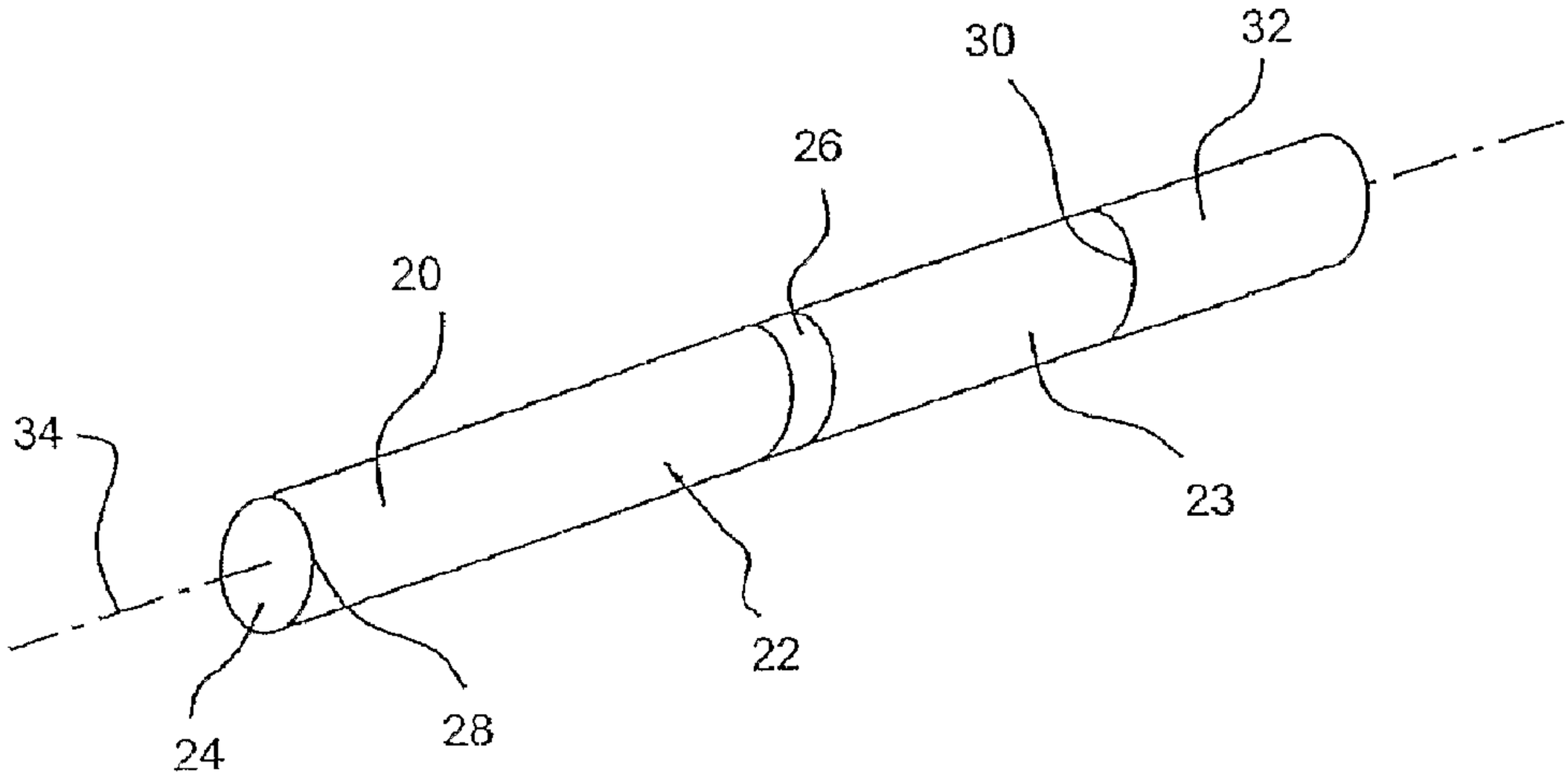
FIG. 8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