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(54) Title: PROCESS FOR SURFACE TREATMENT OF PAPER AND PAPERBOARDS

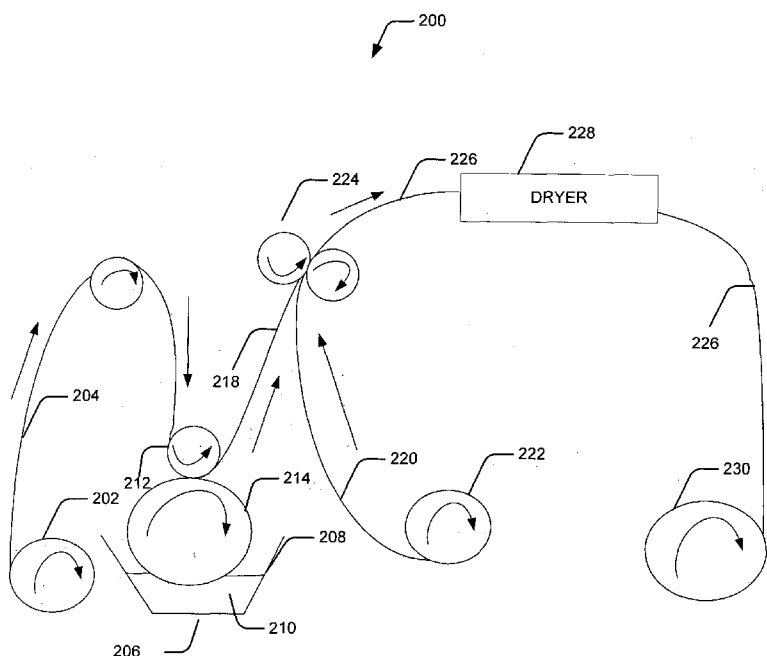


Fig. 2a

(57) Abstract: Process for transferring a surface treatment formulation (210) onto a base paper is described. In one embodiment, the process comprises applying at least one layer of the surface treatment formulation (210) on a non-absorbent film (204) to form a treated substrate (218). The process further comprises transferring the surface treatment formulation (210) from the treated substrate (218) to the base paper (220), to make a treated base paper (226). Surface energy of the surface treatment formulation (210) is less than surface energy of the non-absorbent film (204) and surface energy of the base paper (220).



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PROCESS FOR SURFACE TREATMENT OF PAPER AND PAPERBOARDS

TECHNICAL FIELD

[0001] The present subject matter relates, in general, to surface treatment of paper and paperboards.

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BACKGROUND

[0002] Nowadays, different techniques, either mechanical, such as calendering, or chemical, are used for surface treatment of paper and paperboard surfaces. The purpose of applying the surface treatment may be decorative, functional, or both. For example, a surface coating may be applied in order to improve printability, optical properties, and strength of papers and paperboards. For this, a surface treatment formulation, usually made of a mixture of minerals, colloidal particles and dissolved polymers, is applied onto a surface of a paper or a paperboard followed by optional chemical or thermal treatment to achieve the surface treatment and modify the physicochemical properties of the paper or the paperboard.

15 [0003] For example, there are ongoing efforts in the tobacco industry to manufacture self-extinguishing smoking articles, particularly cigarettes. In order to manufacture self-extinguishing cigarettes, low ignition propensity (LIP) cigarette papers are being produced. The LIP cigarette papers are wrapped around tobacco rods. Such LIP cigarette papers reduce ignition propensity of the cigarettes, i.e., the likelihood that the cigarette would continue to burn even when unattended. This reduces the tendency of the unattended cigarettes to ignite surfaces which come into contact with its burning end. The LIP cigarette paper restricts the entry of external air containing oxygen into the tobacco rod and can thus cause the cigarette to self-extinguish if it is not regularly drawn by a smoker. Conventionally, surface treatment methods such as those mentioned above are used to modify the ignition propensity of cigarette paper and produce LIP paper. Similarlry, surface treatment methods are used conventionally for producing paper for other industrial or consumer applications, such as for producing packaging paper, printing paper, etc.

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SUMMARY

[0004] This summary is provided to introduce concepts related to process for surface treatment of paper and paperboards. These concepts are further described below in the detailed description. This summary is not intended to identify essential features of the

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claimed subject matter nor is it intended for use in determining or limiting the scope of the claimed subject matter.

[0005] Process for transferring a surface treatment formulation onto a base paper is described. In one embodiment, the process comprises applying at least one layer of the surface treatment formulation on a non-absorbent film to form a treated substrate. The process further comprises transferring the surface treatment formulation from the treated substrate to the base paper, to make a treated base paper. Surface energy of the surface treatment formulation is less than surface energy of the non-absorbent film and surface energy of the base paper. In one embodiment, the surface treatment formulation may be applied at discrete locations on the non-absorbent film to form a similar pattern on the base paper after the transfer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The detailed description is described with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The same numbers are used throughout the figures to reference like features and components. Some embodiments of the processes in accordance with the present subject matter, are described, by way of example only, and with reference to the accompanying figures, in which:

[0007] Fig. 1a illustrates an example exploded view of a surface treated paper, in accordance with an embodiment of the present subject matter

[0008] Fig. 1b illustrates a perspective view of a smoking article with a low ignition propensity (LIP) paper, in accordance with an embodiment of the present subject matter.

[0009] Fig. 1c illustrates an exploded view of the smoking article, in accordance with an embodiment of the present subject matter.

[0010] Fig. 2a illustrates a schematic of a process of transferring a surface treatment formulation onto a base paper, in accordance with an embodiment of the present subject matter.

[0011] Fig. 2b illustrates a schematic of the process of transferring the surface treatment formulation onto the base paper, in accordance with another embodiment of the present subject matter.

[0012] Fig. 2c illustrates a schematic of the process of transferring the surface treatment formulation onto the base paper, in accordance with yet another embodiment of the present subject matter.

[0013] Fig. 2d illustrates a schematic of the process of transferring the surface treatment formulation onto the base paper, in accordance with yet another embodiment of the present subject matter.

[0014] It should be appreciated by those skilled in the art that any schematic diagrams herein represent conceptual views of illustrative surface treated paper and paperboards making process embodying the principles of the present subject matter.

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DETAILED DESCRIPTION

[0015] Conventionally, various techniques for surface treatment of paper and paperboard surfaces are available. For ease of description, paper and paperboard are collectively referred to as paper hereinafter. Typically, either aqueous or non-aqueous based surface treatment formulations are applied onto a paper and then dried. In most of the techniques, the surface treatment formulations are applied directly onto the paper. However, when the surface treatment formulation is applied on the paper, the strength of the paper could reduce because of the drop in tensile strength as the paper becomes wet. In case the paper is treated in discrete locations, the paper also tends to expand in the treated discrete locations because of its hygroscopic expansion property. As the surface treatment is typically done in a single pass, the sudden deposition of heavier coat of the surface treatment formulation at discrete locations additionally reduces the strength of the paper. Therefore, the paper web can break during the treatment process or after the treatment process. Furthermore, the conventional techniques result in shrinkage of the paper and deterioration in mechanical properties.

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[0016] In accordance with the present subject matter, processes of transferring surface treatment formulation onto a paper to make a coated or treated paper are described. In one implementation, the treated paper is produced by first transferring a surface treatment formulation onto a non-absorbent film. The non-absorbent film, also referred to as film, has an adsorbent surface that weakly adsorbs the surface treatment formulation. On the other hand, the base paper, which can be a paper or a paperboard, is highly absorbent. As a result, when the surface of the non-absorbent film with the surface

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treatment formulation is brought in contact with the base paper, the surface treatment formulation gets transferred effectively to the surface of the base paper. Such transfer can happen even without the use of any special additive, such as release agent, in the surface treatment formulation. This can be accomplished by selecting the non-absorbent film and the surface treatment formulation such that the surface energy of the surface treatment formulation is less than the surface energy of the non-absorbent film. Furthermore, the non-absorbent film is chosen such that the film has an adsorbent surface and surface energy of the non-absorbent film is substantially less than that of the base paper. As a result, the surface treatment formulation can be transferred easily to the base paper which is absorbent.

[0017] In one implementation, the material of the paper and of the non-absorbent film is selected such that they form a weak covalent bond with the surface treatment formulation, which further facilitates the transfer process. Such a surface treatment method can be used for application of both aqueous and non-aqueous formulations to the base paper. In one example, such a surface treatment method can be used to produce low ignition propensity (LIP) paper for a smoking article, such as a cigarette.

[0018] In one implementation, the surface treatment formulation may include a film forming substance, which forms a continuous film over a treated area of the non-absorbent film and the base paper. In another implementation, the surface treatment formulation may include a non-film forming substance, which gets deposited, for example, as particulate matter or non-uniform web over a treated area. In yet another implementation, the surface treatment formulation may include a combination of the film forming substance and the non-film forming substance. The film forming and the non-film forming substances may be deposited through an aqueous or a non-aqueous solvent based formulation.

[0019] In one implementation, the non-absorbent film, interchangeably referred to as film, may be a polymeric film, for example, a Poly ethylene terephthalate (PET) film, a Low Density Poly Ethylene (LDPE) film, a treated LDPE film, etc. The film may also be any commercially available non-absorbent polymeric film that is suitably surface treated to have surface energy in accordance with the present subject matter. Further, the thickness of the film can be selected based on its runnability in the transfer process and the thickness may not be a constraint for the transfer process to take place as long as it can have a smooth runnability in the transfer process. As mentioned earlier, the film has higher

surface energy than the surface energy of the surface treatment formulation to have a good wetting by the surface treatment formulation. Further, the film has a low surface energy as compared to the base paper to release the surface treatment formulation to a surface of the base paper, which comes in contact with the film during the transfer process. The surface energy of the film may be at least 38 dynes per centimeter for the surface treatment formulation to wet the surface without the layer of the surface treatment formulation splitting. In one implementation, the surface energy of the film may be in a range of 38 dynes per centimeter to 70 dynes per centimeter. Furthermore, the film may have low or no porosity to make it non-absorbent while at the same time it may be weakly adsorbent.

10 [0020] In one embodiment, the transfer process begins with the film being unwound from a film unwinder. The film then travels towards an apparatus interposed in the travel path of the film for transferring the surface treatment formulation in a predefined pattern over the film. In one implementation, the apparatus includes a formulation application device with a series of grooves cut on its surface to form the predefined pattern. For example, the series of grooves cut may be in the form of bands so that the surface treatment formulation is deposited in the form of bands on the film. The bands may be spaced apart from each other longitudinally along the circumference of the formulation application device so that the bands are spaced apart along the length of the film on transfer of the surface treatment formulation. In other implementations, application coating rods may be used or other suitable apparatus may be used as will be understood by a person skilled in the art.

[0021] In one implementation, the surface treatment formulation may be released once onto the surface of the film, thereby forming a single layer of coating onto the film. In another implementation, the surface treatment formulation may be released multiple times onto the surface of the film, thereby forming multiple layers of coating onto the film.

[0022] Furthermore, since the film has low or no porosity, the surface treatment formulation does not get absorbed into the surface of the film, but is weakly adsorbed on the surface. Once the film is coated with the surface treatment formulation, referred to as treated film, the treated film is brought into contact with a base paper, which is unwound from a paper unwinder. The base paper may be a conventionally available paper web or a cigarette paper.

[0023] The unwound base paper and the treated film travel towards nip rolls. At the nip rolls, the surface treatment formulation is transferred from the film to the base paper. Since the film and the surface treatment formulation have optimally chosen surface energies that are less than the surface energy of the base paper, the surface treatment formulation gets effectively transferred to the base paper. In one example, the transfer process can happen without requiring a release agent added to the surface treatment formulation.

[0024] In one implementation, the treated base paper along with the film is dried at a predefined temperature. For example, temperature range of about 90° C may be used. The temperature depends on the solid content of the surface treatment formulation and also the application process adopted, which can affect the thickness of the deposited surface treatment formulation. Upon drying, the treated base paper along with the film, hereinafter referred to as substrate, is taken up by a rewinder. Subsequently, before being slit into bobbins, the substrate, interchangeably referred to as treated substrate, is separated from the treated base paper. In another implementation, the film is separated from the treated base paper immediately after drying, but before the treated base paper is rewound onto the rewinder. The treated base paper can be then rewound and cut into bobbins. In yet another implementation, the film is separated from the treated base paper before the treated base paper is dried. The treated base paper can then be dried and cut into bobbins.

[0025] Since the base paper is supported by the film while the surface treatment formulation gets transferred, it prevents the base paper from forming creases, wrinkles, and web snaps as the base paper undergoes a change in its dimensions in the treated regions and also its strength properties.

[0026] In one implementation, the above described transfer process can be carried out as a part of a papermaking process, a printing process, and the like. For example, the transfer process can be carried out to manufacture low ignition propensity (LIP) cigarette paper. The LIP cigarette paper, hereinafter referred to as LIP paper, has low porosity where discrete bands are formed and it tends to cause a lit cigarette to extinguish upon non-smoking due to decrease in access to oxygen for combustion.

[0027] As described above, upon drying, the treated base paper along with the film is taken up by the rewinder. The base paper, before being treated, may exhibit an inherent porosity that can vary along the length and breadth of the paper. For example, the base

paper can exhibit an inherent porosity in a range of 50 Coresta units to 100 Coresta units and diffusivity in a range of 0.6 centimeter per second (cm/s) to 1.5 centimeter per second (cm/s).

[0028] In one example, the porosity of the LIP paper formed can get reduced from 50-120 Coresta units to about 3-20 Coresta units in the treated regions. Also, in one implementation, diffusivity of the LIP paper formed can get reduced from 0.6-1.5 centimeter per second (cm/s) to about 0-0.5 centimeter per second (cm/s) in the treated regions. In another implementation, diffusivity of the LIP paper can get reduced to 0-0.25 centimeter per second (cm/s). In yet another implementation, diffusivity of the LIP paper can get reduced to 0-0.1 centimeter per second (cm/s). Since the LIP paper has low porosity at the treated regions, it tends to cause a lit cigarette to extinguish upon non-smoking.

[0029] These and other advantages of the present subject matter would be described in a greater detail in conjunction with the following figures. It should be noted that the description and figures merely illustrate the principles of the present subject matter.

[0030] Fig. 1a illustrates an example exploded view of a surface treated paper 106, in accordance with an embodiment of the present subject matter.

[0031] As shown in Fig. 1a, the surface treated paper 106 comprises three bands 108-1, 108-2, and 108-3, which can be spaced apart, for example by 15-20 mm, from each other longitudinally along the length of the surface treated paper 106. Fig. 1a also depicts the width of each of the bands 108-1, 108-2, and 108-3, which can be, for example, 7mm. It will be appreciated that other patterns and dimensions can also be used.

[0032] In one implementation, the bands 108 are produced using an appropriate surface treatment formulation that is effective in reducing the inherent porosity of a paper or a paperboard, hereinafter referred to as base paper at the region where the bands 108 are produced. For example, the porosity of the base paper may get reduced from 50 Coresta units to about 12 Coresta units in the region where the bands 108 are produced. Further, in said example, diffusivity of the base paper gets reduced from 1.5 centimeter per second (cm/s) to about 0.1 centimeter per second (cm/s). To reduce the porosity of the base paper, in one implementation, the surface treatment formulation may include a film forming substance. In another implementation, the surface treatment formulation may include a non-film forming substance. In yet another implementation, the surface treatment

formulation may include a combination of the film forming substance and the non-film forming substance. The film forming substance and the non-film forming substance may be aqueous or non-aqueous based formulations.

[0033] For example, the film forming substance may be at least one of polysaccharides, poly vinyl acetates, alcohols, humectants, alginates, starch, and gums. The surface treatment formulation may include, for example, polyvinyl alcohol, Sodium alginate, Alkyd Resin, Ethylene Vinyl acetate, etc. The non-film forming substance may be at least one of synthetic substance and natural nanoparticle substance. The natural nanoparticle substance may include organic compounds, such as latexes, Styrene Maleic Anhydrides (SMA), Styrene Maleic Imides (SMI), inorganic sols (silicates, Aluminates), and laminar (clay) compounds. The surface treatment formulation may also include additives, that is, surfactants, flavor releasing compounds, temperature modifying compounds, such as citrate salts & zeolites. In one implementation, the additives can be added in both treated and non-treated regions of the base paper. For example, temperature modifying compounds may be added also in non-treated regions.

[0034] The bands 108 are produced on the base paper through transfer of the surface treatment formulation from a non-absorbent film having optimal surface energy onto the base paper. In one implementation, the non-absorbent film is preferably a polymeric film, such as a Low Density Poly Ethylene (LDPE) film, treated LDPE, Poly ethylene terephthalate (PET) film, etc. The non-absorbent film may also be any commercially available non-absorbent polymeric film that is suitably surface treated to have surface energy in accordance with the present subject matter. As mentioned above, the non-absorbent film may have optimal surface energy to have a good wetting by the surface treatment formulation on its surface. The surface energy of the non-absorbent film may be at least 38 dynes per centimeter for the surface treatment formulation to wet the surface without the layer of the surface treatment formulation splitting. In one implementation, the surface energy of the non-absorbent film may be in a range of 38 dynes per centimeter to 70 dynes per centimeter. Further, the transfer of the surface treatment formulation is performed such that the base paper is supported by the non-absorbent film during the transfer.

[0035] Fig. 1b illustrates a perspective view of a smoking article 100 with a low ignition propensity (LIP) paper 106, in accordance with an embodiment of the present subject matter. In said embodiment, the smoking article 100 is a cigarette, hereinafter

referred to as cigarette 100. The LIP paper 106 is an example of the surface treated paper 106.

[0036] According to said embodiment, the cigarette 100 includes a tobacco rod 102. One end of the tobacco rod 102 is a lighting end, and at the other end is a filter element 104. The filter element 104 and tobacco rod 102 are axially aligned in an end-to-end relationship, preferably adjoining one another. The filter element 104 generally has a cylindrical shape, and the diameter thereof is substantially equal to the diameter of the tobacco rod 102. The ends of the filter element 104 are open to permit the passage of air and smoke there through. The tobacco rod 102 may be overwrapped with a low ignition propensity (LIP) cigarette paper 106, hereinafter referred to as LIP paper 106. The LIP paper 106 has porosity in a range of 3 Coresta units to 20 Coresta units in the discrete locations. Further, in one implementation, diffusivity of the LIP paper 106 may be in a range of 0 centimeter per second (cm/s) to 0.5 centimeter per second (cm/s). In another implementation, the diffusivity of the LIP paper 106 may be in a range of 0 cm/s to 0.25 cm/s. In another implementation, the diffusivity of the LIP paper 106 may be in a range of 0 cm/s to 0.1 cm/s. Thus, cigarette 100 with the LIP paper 106 gets automatically extinguished upon non-smoking.

[0037] Fig. 1c illustrates an exploded view of the cigarette 100, according to an embodiment of the present subject matter. In said embodiment, Fig. 1c illustrates the LIP paper 106 wrapped around the tobacco rod 102 and the filter element 104 of the cigarette 100.

[0038] In an embodiment, the LIP paper 102 includes a base paper having at least one layer of coating in the form of a predefined pattern at discrete locations. In one example, the predefined pattern may include one or more bands 108, or any other pattern. The base paper may be any conventionally available cigarette paper or paper web made from a fibrous material. The base paper may exhibit an inherent porosity that can vary. In one implementation, the base paper exhibits an inherent porosity in a range of 50 Coresta units to 100 Coresta units and diffusivity in a range of 0.6 centimeter per second (cm/s) to 1.5 centimeter per second (cm/s).

[0039] According to an aspect of the present subject matter, the LIP paper 106 is composed of a base paper with at least one layer of coating in the form of one or more bands 108 spaced apart from each other longitudinally along the length of the LIP paper

106. The width and spacing of bands 108 can be changed based on a number of variables, such as the inherent porosity of base paper, density of tobacco rod 102, etc., and can be designed accordingly for different cigarettes in order to meet the required LIP standards, such as the ASTM LIP standard E2187-04. Further, as will be understood, the band pattern
5 can include various geometrical shapes and patterns known in the art.

[0040] The bands 108 are indicated in phantom in Fig. 1c. In one implementation, the bands 108 are essentially invisible in the formed cigarette 100 as shown in Fig. 1b. In another implementation, the bands 108 may be visible in the formed cigarette 100. Further, the bands 108 do not have to be parallel cylindrical bands in the circumference of
10 the formed cigarette 100, but can be of any suitable pattern. Also, although the cigarette 100 shown in Fig. 1c includes LIP paper 106 having one or more bands 108, the cigarette 100 also can include LIP paper 106 having base paper entirely treated with the surface treatment formulation. The bands 108 may be identical, or virtually identical, in terms of composition, weight, dimension, or the like. Further, the bands 108 may be produced
15 along the length of the LIP paper 106 based on ramp profile in molecular weight of the substance(s) in the surface treatment formulation. In one implementation, the bands 108 produced may be based on increasing ramp profile in molecular weight of the substance(s) in the surface treatment formulation. In another implementation, the bands 108 produced may be based on decreasing ramp profile in molecular weight of the substance(s) in the
20 surface treatment formulation.

[0041] Fig. 2a illustrates a schematic of a process 200 of transferring a surface treatment formulation onto a base paper, in accordance with an embodiment of the present subject matter.

[0042] According to an aspect of the present subject matter, the surface treatment
25 formulation is transferred using a transfer coating process. The transfer coating process is a process in which the surface treatment formulation is applied on a non-absorbent film having a higher surface energy, such that surface treatment formulation does not get absorbed and stays at the surface of the non-absorbent film due to weak adsorption. The surface treatment formulation is then transferred from the non-absorbent film to an
30 absorbent surface, such as a base paper. The base paper is made of an absorbent material. Once the surface treatment formulation is transferred, the non-absorbent film is removed, thereby forming a treated paper. In one implementation, the transfer coating process can

be used to manufacture a low ignition propensity (LIP) cigarette paper 106, interchangeably referred to as LIP paper 106.

[0043] According to an embodiment of the present subject matter, the process 200 uses a film unwinder 202. The film unwinder 202 can be understood as a device onto which a continuous web of non-absorbent film 204 is loaded. The non-absorbent film 204 may be, for example, a Poly ethylene terephthalate (PET) film, Low Density Poly Ethylene (LDPE) film with sufficient treatment, etc. Further, the thickness of the non-absorbent film 204 can be selected based on its runnability in the process 200 and the thickness may not be a constraint for the transfer process 200 to take place as long as it can have a smooth runnability in the transfer process 200. The continuous web of non-absorbent film 204 reeled out from the film unwinder 202 travels in the direction shown by arrow as shown in Fig. 2a.

[0044] An apparatus 206 is interposed in the travel path of the non-absorbent film 204. In one embodiment, the apparatus 206 is a cylindrical device and includes a liquid tank 208. The liquid tank 208 is filled with a surface treatment formulation 210. The surface treatment formulation 210 and the non-absorbent film 204 may have surface energies that are optimally chosen so that the surface treatment formulation 210 is not absorbed at the surface of the non-absorbent film 204 but gets transferred when in contact with an absorbent substrate. In one implementation, the surface treatment formulation 210 may include a film forming substance. In another implementation, the surface treatment formulation 210 may include a non-film forming substance. In yet another implementation, the surface treatment formulation 210 may include a combination of the film forming substance and the non-film forming substance. In the said implementations, the film forming and the non-film forming substances can be aqueous based or non-aqueous based substances. For example, the film forming substance, or the non-film forming substance, or combination of both can mixed be with water or alcohol to form the surface treatment formulation 210. In an example, the liquid tank 208 may be filled with an aqueous solution of 30 percent of precipitated calcium carbonate and 10 percent of Poly Vinyl Alcohol. In said example, median particle size of the precipitated calcium carbonate may be in a range of 0 micrometre (μm) to 5 micrometre (μm).

[0045] The apparatus 206 may further include an impression roller 212 and a formulation application device 214, which are rotatable in opposite directions to each other and situated so that the non-absorbent film 204 can pass through between the

impression roller 212 and the formulation application device 214. In one embodiment, the formulation application device 214 may be a cylindrical station. In one implementation, the formulation application device 214 has a series of grooves cut on its outer circumferential surface.

5 **[0046]** For example, in case, the transfer coating process is used to manufacture the LIP paper 106, the formulation application device 214 has a series of grooves arranged at the predefined intervals so as to form the series of spaced apart bands 108. The positioning, shape and number of grooves cut may vary, and typically, depend upon the pattern that is required. In an example, the series of spaced apart bands 108 may be
10 arranged at an interval of 15-20 mm. In said example, width of each of the bands 108 can be, for example, 7mm. width of each of bands 108 may be 7mm. Although, it has been described that formulation application device 214 has series of grooves cut in form of series of spaced apart bands 108, however, in another implementation, the series of grooves cut may be in form of dots, trapezoids, triangles, hexagons, circles or any other
15 conventionally known shapes. In the said implementation, the bands 108 may exhibit a two-dimensional pattern or an array. The two-dimensional pattern or the array extends in a longitudinal or a transverse direction of the non-absorbent film 204.

[0047] The formulation application device 214 is partially submerged in the surface treatment formulation 210 in the liquid tank 208. Accordingly, when the non-
20 absorbent film 204 passes through between the impression roller 212 and the formulation application device 214, because of the presence of grooves on surface of the formulation application device 214, the surface treatment formulation 210 is deposited as bands onto the non-absorbent film 204. A doctor blade (not shown in Fig 2(a)) is located near the formulation application device 214. Since the non-absorbent film 204 is of low porosity,
25 the surface treatment formulation 210 is not absorbed by the non-absorbent film 204. The surface treatment formulation 210 remains unabsorbed on the surface of the non-absorbent film 204, thereby forming a treated substrate 218, also referred to as substrate 218.

[0048] In other implementations, as will be understood by a person skilled in the art, the apparatus 206 may include an application coating rod or any other suitable device
30 for transferring the surface treatment formulation 210 in a predefined pattern onto the non-absorbent film 204 to form the substrate 218.

[0049] A continuous web of base paper 220 is reeled out at the same time from the paper unwinder 222. The base paper 220 may be made of an absorbent material. The paper unwinder 222 is shown rotating in a clockwise direction, causing the continuous web of base paper 220 to travel in the direction of the arrow as shown in Fig 2(a). The base paper 220 may be a conventional cigarette paper or paper web made from a fibrous material. The substrate 218 and the base paper 220 travels between the nip rolls 224, such that the surface treatment formulation 210 is transferred from the surface of the substrate 218 to the base paper 220. The surface treatment formulation 210 is transferred in forms of bands 108 onto the surface of the base paper 220. Since surface energies of the substrate 218 and the surface treatment formulation 210 are optimally chosen and lower than that of the base paper 220, the surface treatment formulation 210 gets completely transferred from the substrate 218 to the base paper 220, thereby forming a treated base paper 226 which is still in contact with the substrate 218. The absorbent nature of the base paper 220 also facilitates the transfer of the surface treatment formulation 210. In an example, coating of the surface treatment formulation 210 on the treated base paper 226 may have a dry weight in a range of 4 grams per square metre (gsm) to 15 grams per square metre (gsm).

[0050] The treated base paper 226 then passes through a dryer 228. When the treated base paper 226 passes through the dryer 228, the dryer 228 dries the treated base paper 226 at a predefined temperature. For example, temperature range of about 90° C may be used. This depends on the solid content of the surface treatment formulation and also the application process adopted. The dryer 228 dries the surface treatment formulation 210 on the treated base paper 226, to thereby form the bands 108. Upon drying, the treated base paper 226 is taken up by rewinder 230. Subsequently, before being slit into bobbins, the substrate 218 is separated from the treated base paper 226, thereby forming LIP paper 106. Thus, the LIP paper 106 has reduced porosity in the area where bands 108 are formed. These bands 108 tend to cause a lit cigarette 100 to extinguish due to decrease in access to oxygen for combustion upon non-smoking. Moreover, since the base paper 220 is supported by the non-absorbent film 204 while formation of the bands 108, the base paper 220 does not shrink.

[0051] Fig. 2b illustrates a schematic of the process 200 of transferring the surface treatment formulation 210 onto the base paper 220, in accordance with another embodiment of the present subject matter.

[0052] According to another embodiment of the present subject matter, the substrate 218 is separated from the treated base paper 226 before the treated base paper 226 is taken up by the rewinder 230, immediately after drying. The separated substrate 218 is taken up by film rewinder 232. Therefore, curing time between the treated base paper 226 and the substrate 218 is reduced. Also, the quality of the peel off of the substrate 218 is enhanced.

[0053] Fig. 2c illustrates a schematic of the process 200 of transferring the surface treatment formulation 210 onto the base paper 220, in accordance with yet another embodiment of the present subject matter.

10 [0054] According to yet another embodiment of the present subject matter, the substrate 218 is separated from the treated base paper 226 before the treated base paper 226 is dried. The separated substrate 218 is taken up by the film rewinder 232 as shown in Fig 2c. The treated base paper 226 is then dried and re-wound.

15 [0055] Fig. 2d illustrates a schematic of the process 200 of transferring the surface treatment formulation 210 onto the base paper 220, in accordance with yet another embodiment of the present subject matter.

[0056] According to yet another embodiment of the present subject matter, the surface treatment formulation 210 gets completely transferred from the substrate 218 to the base paper 220, thereby forming a treated base paper 226 which is still in contact with the substrate 218. The absorbent nature of the base paper 220 also facilitates the transfer of the surface treatment formulation 210. Thereafter, the treated base paper 226 along with the substrate 218 is taken up by rewinder 230 without use of intermediate dryers.

[0057] It will be appreciated that various process parameters, such as speed and tension of winding and unwinding, time of contact between the non-absorbent film and apparatus for coating, time of contact between the treated substrate and the base paper, time of drying, drying temperature, nip pressure, weight (gsm) of surface treatment formulation to be transferred, etc. can be suitably determined by a person skilled in the art depending on the type of film used, surface treatment formulation used, and desired properties of the base paper. Further, in one implementation, the process 200 can be carried out as a part of a papermaking process, a printing process, and the like. Moreover, while process of making LIP paper has been discussed as an example, it will be

understood that the transfer process for surface treatment of paper and paperboards can be used to treat a variety of paper types for various purposes.

[0058] Although embodiments for process for surface treatment of paper and paperboards have been described in language specific to structural features and/or processes, it is to be understood that the invention is not necessarily limited to the specific features or processes described. Rather, the specific features and processes are disclosed as exemplary implementations for process for surface treatment of paper and paperboards

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I/We claim:

1. A process for transferring a surface treatment formulation (210) onto a base paper (220), the process comprising:
applying at least one layer of the surface treatment formulation (210) on a
5 non-absorbent film (204) to form a treated substrate (218); and
transferring the surface treatment formulation (210) from the treated
substrate (218) to the base paper (220), to make a treated base paper (226), wherein
surface energy of the surface treatment formulation (210) is less than surface
energy of the non-absorbent film (204) and surface energy of the base paper (220).
- 10 2. The process as claimed in claim 1, wherein the base paper (220) is made of an
absorbent material.
3. The process as claimed in claim 1, wherein the non-absorbent film (204) is a
polymeric film having an adsorbent surface.
4. The process as claimed in claim 1, wherein the non-absorbent film (204) is one of
15 a Poly Ethylene Terephthalate (PET) film, a Low Density Poly Ethylene (LDPE)
film, and a treated LDPE film.
5. The process as claimed in claim 1, wherein the surface treatment formulation (210)
comprises one of a film forming substance, a non-film forming substance, and a
combination of the film forming substance and the non-film forming substance.
- 20 6. The process as claimed in claim 1, wherein the the surface treatment formulation
(210) is one of an aqueous based formulation and a non-aqueous based
formulation.
7. The process as claimed in claim 5, wherein the film forming substance is at least
one of polysaccharides, poly vinyl acetates, Polyvinyl Alcohol (PVA), Propylene
25 Glycol (PG), humectants, alginates, starch, and gums.
8. The process as claimed in claim 5, wherein the non-film forming substance is at
least one of synthetic substance and natural nanoparticle substance.
9. The process as claimed in claim 8, wherein the natural nanoparticle substance
includes organic compounds comprising latexes, Styrene Maleic Anhydrides
30 (SMA), Styrene Maleic Imides (SMI), inorganic sols (silicates, Aluminates), and
laminar (clay) compounds.

10. The process as claimed in any one of claims 1-9, wherein the surface energy of the non-absorbent film (204) is less than the surface energy of the base paper (220).
11. A process for making a low ignition propensity (LIP) cigarette paper (106), the process comprising:
- 5 applying at least one layer of a surface treatment formulation (210) on a non-absorbent film (204), at discrete locations, to form a treated substrate (218); and
- transferring the surface treatment formulation (210) from the treated substrate (218) to a base paper (220) by passing the treated substrate (218) and the
- 10 base paper (220) between nip rolls (224) in contact with each other, to make the LIP cigarette paper (106).
12. The process as claimed in claim 11, wherein the at least one layer of the surface treatment formulation (210) is applied in a predefined pattern including one or more bands (108).
- 15 13. The process as claimed in claim 11, wherein the at least one layer of the surface treatment formulation (210) has a dry weight in a range of 4 grams per square metre (gsm) to 15 grams per square metre (gsm).
14. The process as claimed in claim 11, wherein the surface treatment formulation (210) is prepared with an aqueous solution of 30 percent of precipitated calcium carbonate and 10 percent of Poly Vinyl Alcohol.
- 20 15. The process as claimed in claim 14, wherein the precipitated calcium carbonate has median particle size in a range of 0 micrometre (μm) to 5 micrometre (μm).
16. The process as claimed in claim 11, wherein the LIP cigarette paper (106) has porosity in a range of 3 Coresta units to 20 Coresta units in the discrete locations.
- 25 17. The process as claimed in claim 11, wherein the LIP cigarette paper (106) has diffusivity in a range of 0 centimeter per second (cm/s) to 0.5 centimeter per second (cm/s).
18. The process as claimed in claim 11, wherein the LIP cigarette paper (106) has diffusivity in a range of 0 centimeter per second (cm/s) to 0.25 centimeter per second
- 30 (cm/s).

19. The process as claimed in claim 11, wherein the LIP cigarette paper (106) has diffusivity in a range of 0 centimeter per second (cm/s) to 0.1 centimeter per second (cm/s).
20. The process as claimed in claim 11, wherein surface energy of the non-absorbent film (204) is at least 38 dynes per centimeter.
21. The process as claimed in claim 11, wherein the base paper (220) has porosity in a range of 50 Coresta units to 100 Coresta units.
22. The process as claimed in claim 11, wherein the base paper (220) has diffusivity in a range of 0.6 centimeter per second (cm/s) to 1.5 centimeter per second (cm/s).

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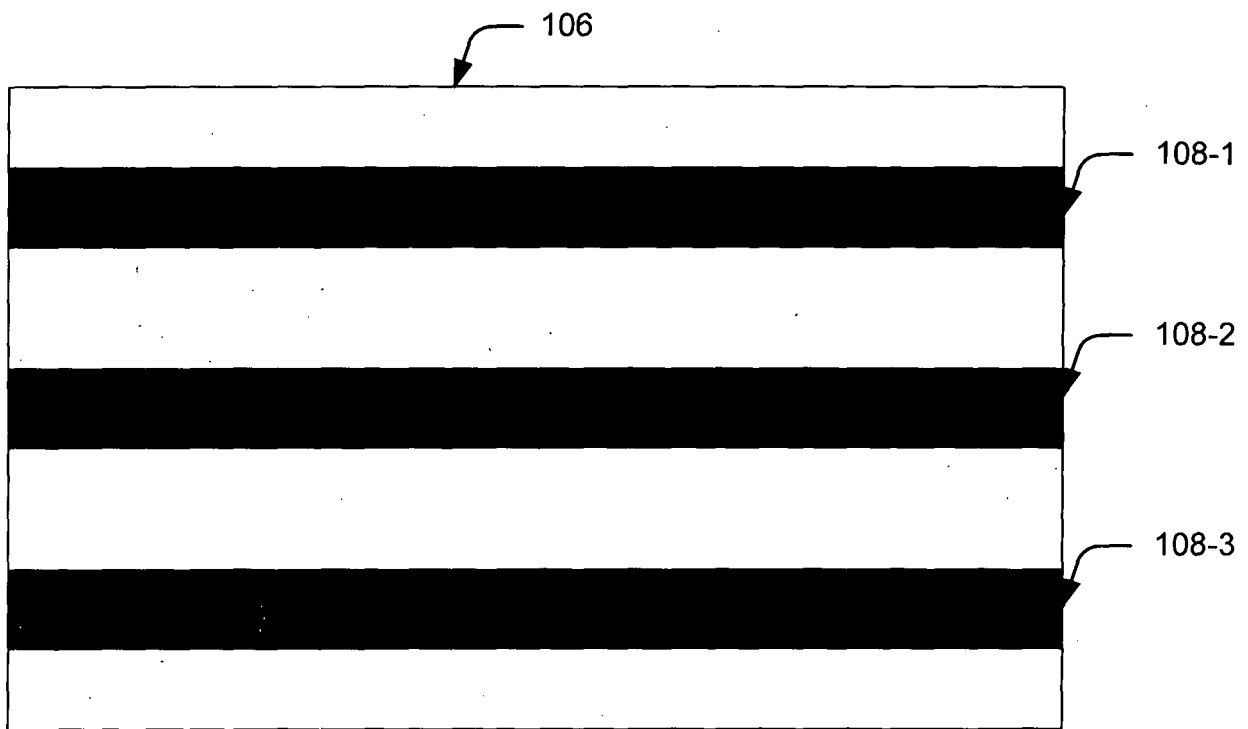


Fig. 1a

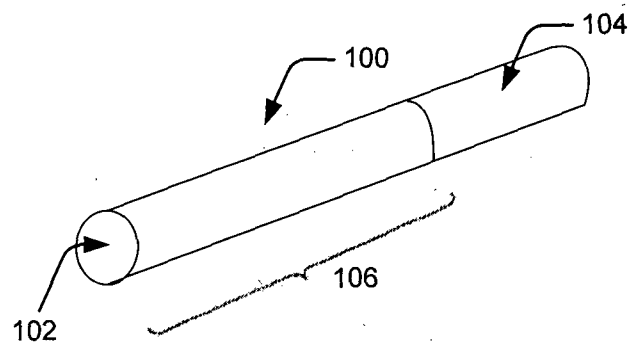


Fig. 1b

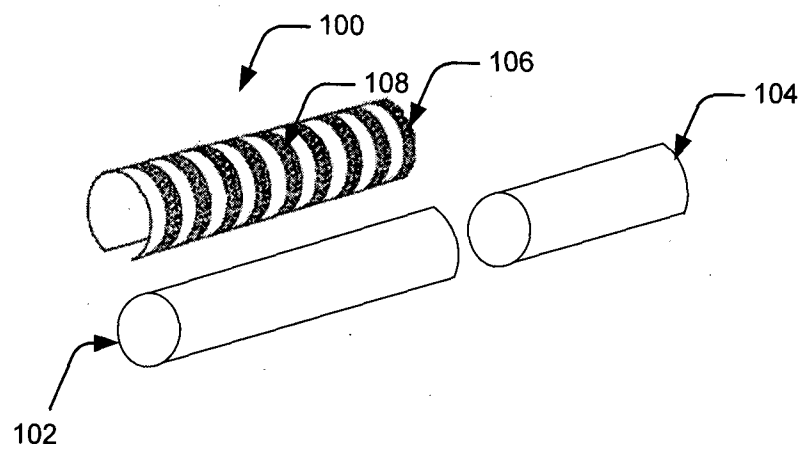


Fig. 1c

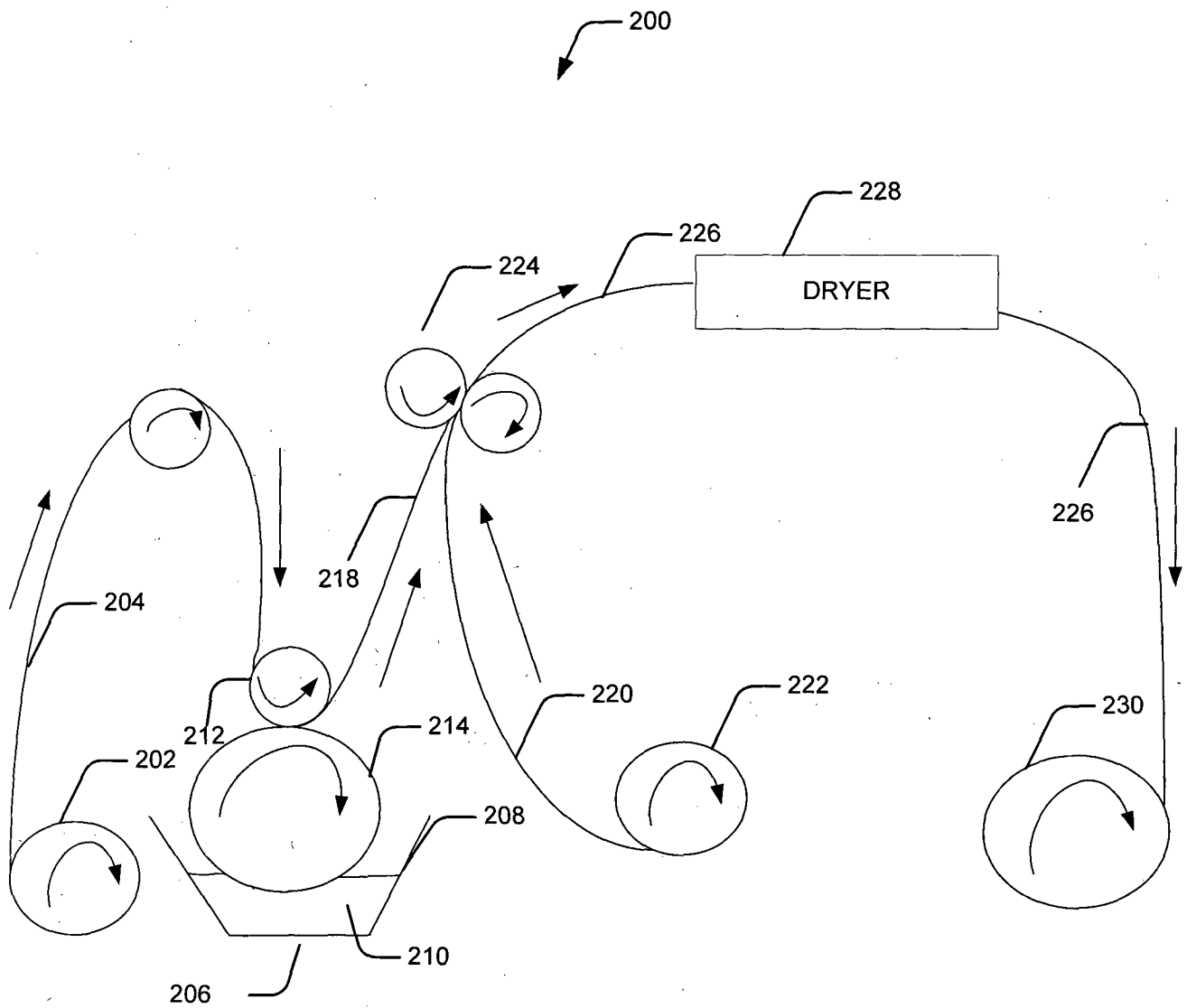


Fig. 2a

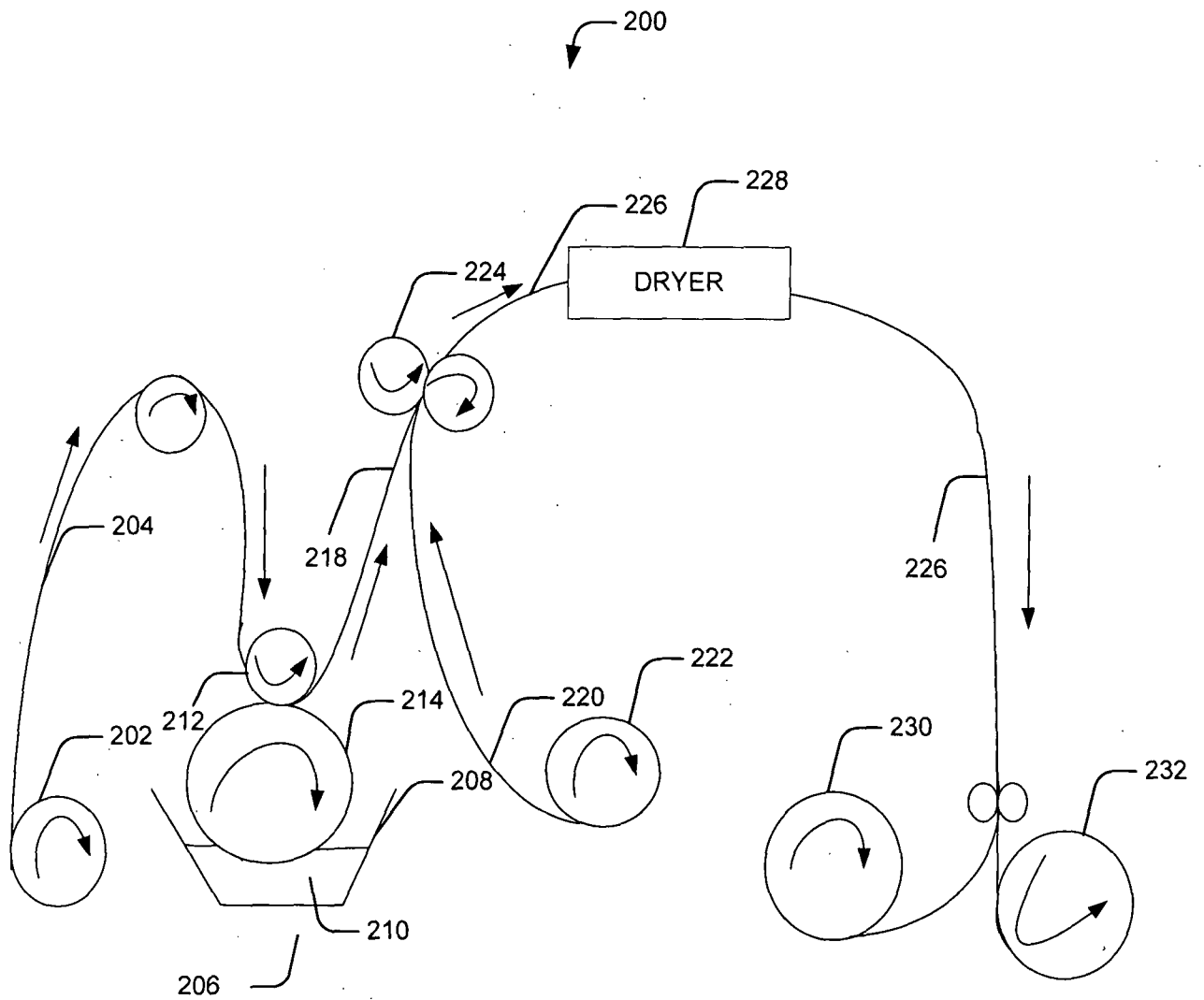


Fig. 2b

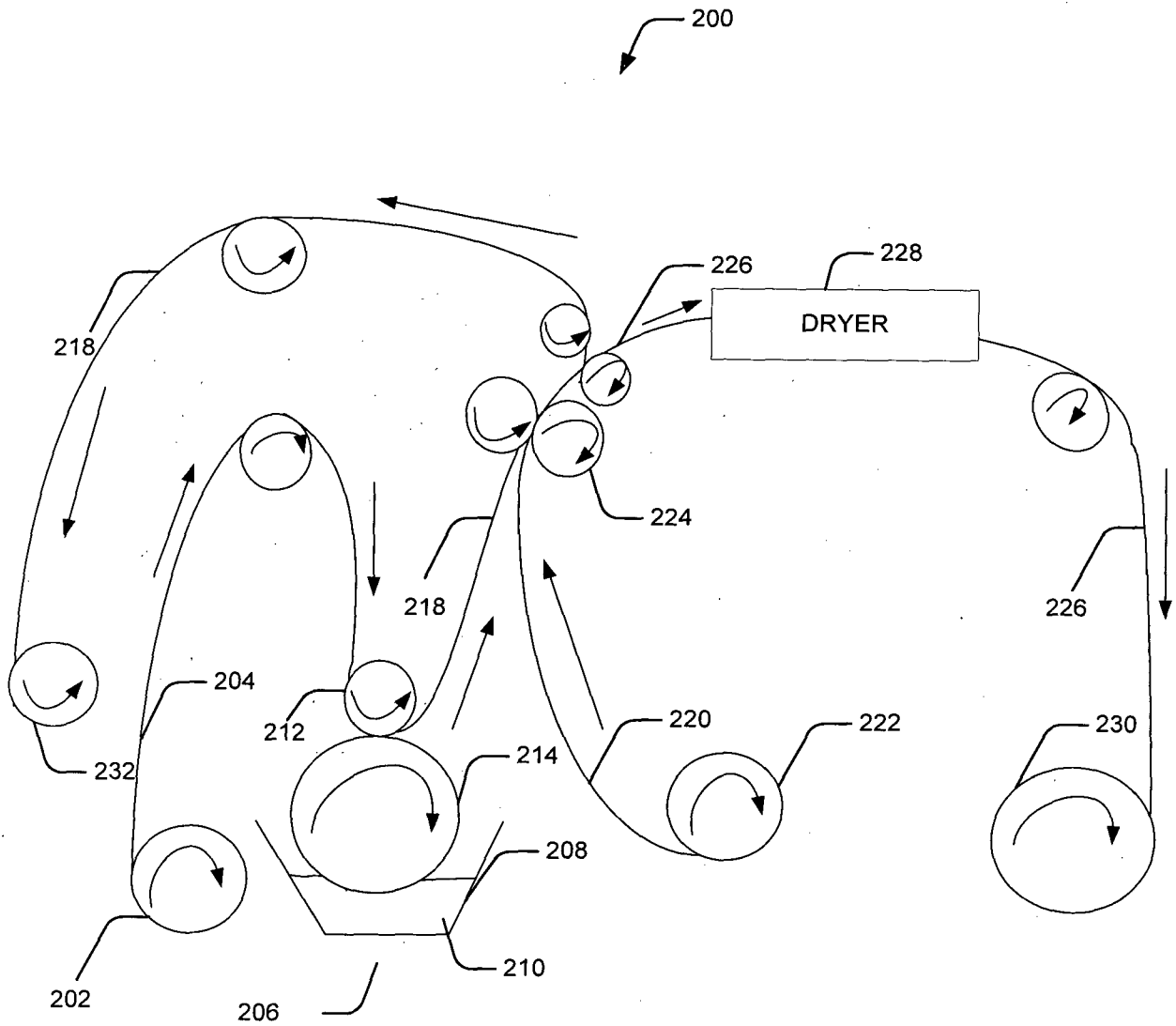


Fig. 2c

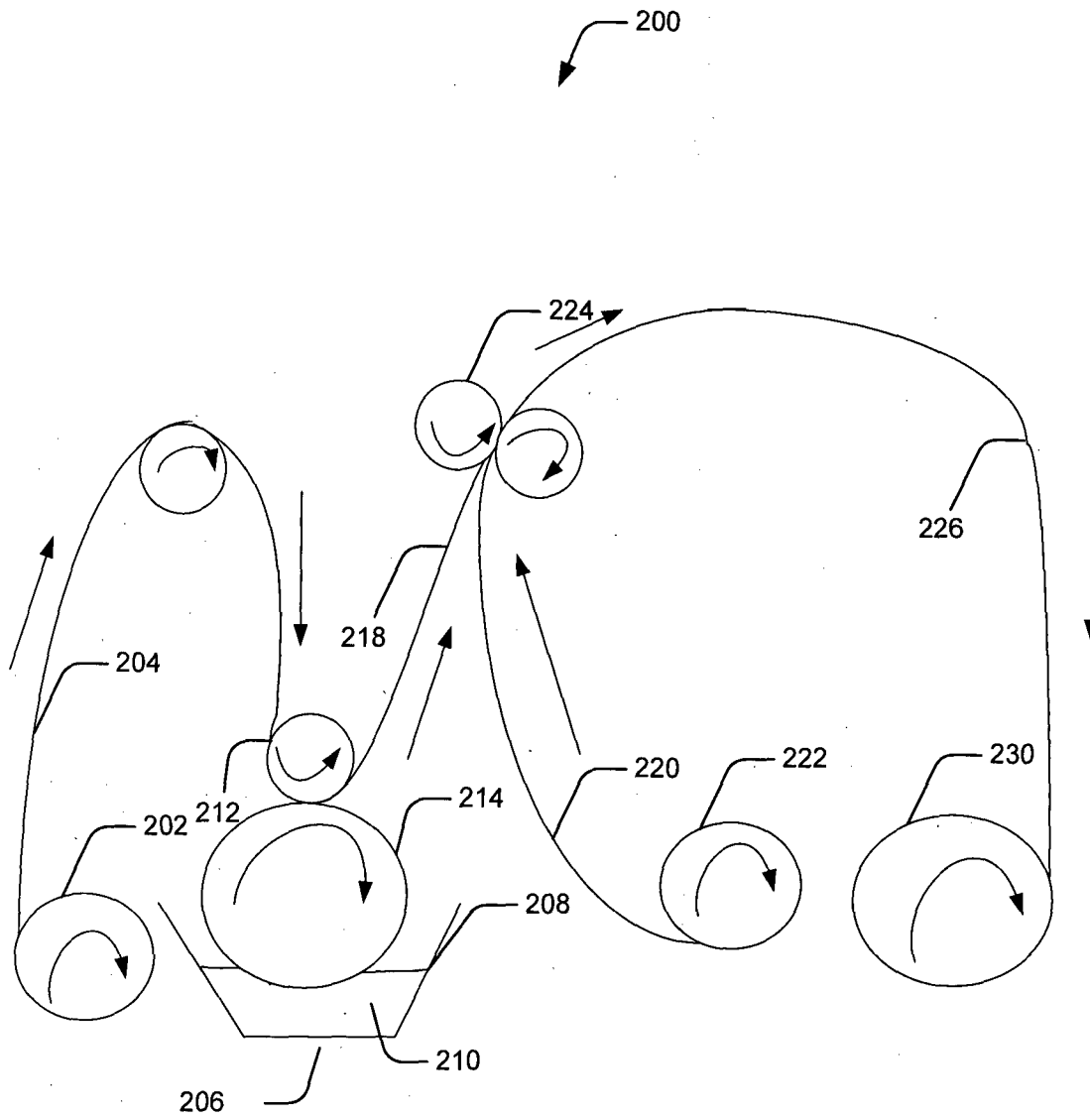


Fig. 2d