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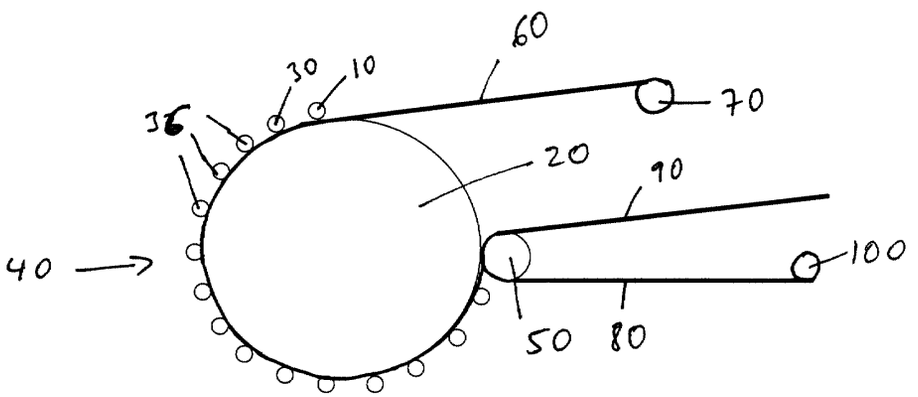
(54) Method and apparatus for longitudinally corrugating a web material

(57) The present invention relates to a method and an apparatus for longitudinally corrugating web materials. The web materials are corrugated with a reduced increase in transverse surface path length by forming single corrugations in consecutive steps.

FIG. 4



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Description

Field of the invention

[0001] The present invention relates to a method and an apparatus for longitudinally corrugating web materials.

Background

[0002] There has been a need in the industry to use corrugated web materials in the online manufacturer of articles. During such manufacturing processes, raw materials are supplied to the process in the form of a web material for example as roll stock. The piece of material which is to be incorporated into the article of manufacturer is obtained by transversely severing the piece from the web material.

[0003] Corrugated web material yield a wide variety of benefits including low-density, softness, and the like. Typical corrugation that materials include woven materials, nonwoven materials, sheets, films, foams, and the like.

[0004] Due to their voluminous configuration, corrugated web materials are expensive to transport and yield only short roll stock lifetimes compared to their known corrugated counterparts. Accordingly, it is desirable to transport in supplying the materials to the process of manufacture in a non-corrugated configuration and to online corrugate the materials prior to incorporation into the article.

[0005] There exist in the art processes for online corrugation of the materials such as for example US-A-4 806 300 (Walton et al.). During such processes, the materials are corrugated by being fed through between two interpenetrating corrugated rolls. This procedure, however, leads to stretching of the material and potentially to plastic deformation in the transverse direction. In turn, such stretching and plastic deformation may change the physical structure of the material and hence its properties.

[0006] It is therefore object of the present invention to provide a process for forming longitudinal corrugations in a web material which overcomes the problems of the prior art processes.

[0007] It is a further object of the present invention to provide a process for forming longitudinal corrugations in a web material during which the transverse surface path length of the web material remains substantially unchanged.

Summary of the invention

[0008] The present invention provides a method for corrugating a web material. The web material has a first longitudinal edge and a second longitudinal edge and the corrugations are oriented along the longitudinal dimension of said web material. The process of the present invention is characterized in that it comprises the following steps

- -- forming a first corrugation in said web material followed by at least one repetition of the following step
- -- forming a series of additional corrugations in said web material while maintaining all previously formed corrugations, each of said additional corrugations being positioned intermediate a previously formed corrugation and one of said longitudinal edges of said web material

[0009] The present invention further provides an apparatus for forming longitudinal corrugations in a web material. The apparatus comprises a drum having a diameter and an outer drum surface, said outer drum surface having a longitudinal direction substantially parallel to the perimeter of said drum and a transverse direction perpendicular to said longitudinal direction, said outer drum surface comprising a plurality of longitudinal grooves, said longitudinal grooves corresponding in position and geometry to the longitudinal corrugations to be formed in said web material. The apparatus further comprises a series of rolls having a diameter smaller than the diameter of said drum, said series of rolls being arranged in proximity to at least a portion of said outer drum surface, each of said rolls having an outer roll surface having a longitudinal direction substantially parallel to the perimeter of said roll and a transverse direction substantially perpendicular to longitudinal direction, the first of said rolls comprising one or two longitudinal protuberances on its outer surface, said one or two longitudinal protuberances corresponding in position and geometry to one or two of said longitudinal grooves on said outer drum surface, each consecutive roll comprising one or two longitudinal protuberances on its outer surface, said one or two longitudinal protuberances being positioned between the longitudinal edge of the outer roll surface and the position of the respective outer most longitudinal protuberance on the preceding roll. The apparatus further comprises a web material supply means capable of feeding said web material between the outer drum surface and the outer roll surfaces

Brief description of the figures

[0010] Fig. 1 is a schematic side view of a first roll of the apparatus of the present invention.

[0011] Fig. 2 is a schematic side view of the drum of the apparatus of the present invention

[0012] Fig. 3 is a schematic side view of the second roll of the apparatus of the present invention.

[0013] Fig. 4 is a schematic side view of the apparatus of the present invention.

Detailed description of the invention

[0014] The present invention provides a method for forming longitudinal corrugations in a web material.

[0015] The term "web material" as used herein refers to a sheet-like material, or to a composite or laminate comprising two or more sheet-like materials. For example, a web material can be a fibrous web, a non-fibrous web, a foam, a film, or the like. The web material has a longitudinal dimension, a transverse dimension, and a thickness dimension. The longitudinal dimension of the material is substantially larger than the transverse dimension and than the thickness dimension. Typically, the material is supplied to the manufacturing process along the longitudinal dimension. Accordingly, the material is ideally rendered virtually infinite in the longitudinal dimension by splicing together a plurality of stretches of web material. By cutting the web material perpendicular to the longitudinal dimension, pieces of the material suitable for incorporation into the article manufacture are obtained. Typically, the pieces of material which are incorporated into the article manufacture have the same transverse dimension and thickness dimension as the web material. Due to the sheet like nature of the web material, the thickness dimension is typically smaller than the thickness dimension. Such web materials are typically useful for the production of articles, in particular disposable articles including disposable absorbent articles such as diapers, sanitary napkins, adult incontinence products, and the like.

[0016] The term "corrugation" as used herein refers to a local configuration of a portion of the web material where the corrugation has a thickness dimension substantially larger than the thickness dimension of the non-corrugated web material or of a non-corrugated portion of the material. The corrugation may have a wide variety of cross-sectional shapes including but not being limited to spherical, semi spherical, hyperbolic, parabolic, triangular square, and the like. The corrugation may comprise a sharp edge such as a full line or the corrugation may comprise a rounded edge. The corrugation of the present invention preferably has a thickness dimension of at least 150 percent of the thickness dimension of the web material, more preferably has a thickness dimension of at least 200 percent of the thickness dimension of the material, even more preferably has a thickness dimension of at least 300 percent of the thickness dimension of the material, most preferably has a thickness dimension of at least 500 percent of the thickness dimension of the material.

[0017] The process of the present invention comprises a steps of forming a corrugations in the web material. There exist in the art a wide variety of suitable techniques for forming a corrugation in the material. Generally, there are two principal classes of such techniques. The first class of techniques pushes the web material into the corrugated configuration by applying a force to the major surface of the material which becomes the inner surface of the corrugated portion. An example of this technique is a roll which comprises on its outer surface at least one protuberance which is formed in correspondence to the geometry of the corrugation to be formed. Optionally, the forming of the corrugations by this technique may be supported by a second roll which comprise on it's outer surface grooves which correspond to the protuberances and where the second roll is arranged such that the protuberances of the first roll penetrate into the respective grooves on the second roll. The second class of techniques pulls the material into the corrugated configuration by applying a force to that major surface of the material which becomes the outer surface of the corrugated portion. An example of this technique is a roll which comprises on its outer surface at least one groove corresponding to the geometry of the corrugation to be formed and which is capable of pulling the material into the crew for example by applying a vacuum. Of course, there also exist processes for forming corrugation to the material which combine elements of the first class of techniques which elements from the second class of techniques. The preferred choice of the process for forming corrugation is an aperture of the present invention depends on the particular properties of the web material to be corrugated. Accordingly, it will be readily apparent to the skilled person which specific process for forming the corrugations for a particular material is the most suitable process.

[0018] The process of the present invention reduces the impact of the formation of corrugations onto the material properties of the web material. This objective is achieved by aiming at reducing the increase in transverse surface path length by the corrugation and preferably at eliminating the increase in transverse surface path length by the corrugation . The term "transverse surface path length" as used herein refers to the distance between the two longitudinal edges of the web material as measured alone the local configuration of the surface, i.e. for a corrugated web material the distance is measured along the local configuration of the corrugations. It is to be understood in this context, however, that the transverse surface have length as defined herein does not include the microscopic structure of the web material such as for example of the microscopic structure of a fibrous web material.

[0019] The reduction of increase in transverse surface path length is achieved by corrugating the web material in a serious of subsequent corrugation steps rather than in a single step. All of additional corrugations in subsequent steps are positioned intermediate the outer most previously formed corrugation and the respective longitudinal side edge of the web material. By this principle, the web material to form the corrugation is obtained by pulling in web material from the non-corrugated outer portion of the web material rather than by locally stretching the web material. Accordingly, the formation of two neighboring corrugations is excluded for the second corrugation step and any subsequent corrugation

step and the simultaneous formation of more than two corrugations is further excluded.

[0020] The first corrugation step of the process of the present invention may comprise the formation of a single corrugation, preferably positioned close to the longitudinal centerline of the web material. Alternatively, the first corrugation step may comprise the formation of two corrugations which are preferably positioned in symmetric fashion with respect to the longitudinal centerline of the web material.

[0021] The second and any subsequent corrugation step of the process of the present invention may comprise the formation of the single corrugation positioned outward of the outer most previously formed corrugation on one side of the previously formed corrugations or outward of the outer most previously formed corrugation on the opposite side of the previously formed corrugations. In case only a single previously formed corrugation exists, the newly formed corrugation may be positioned on either side of that previously formed corrugation.

[0022] During formation of additional corrugations, care has to be taken to maintain all previously configured corrugations. Such maintenance may be achieved either by applying a pull force to the outer surface of the web material at the corrugation or by applying a push force to the inner surface of the web material at the corrugation. Suitable techniques for applying such forces to the web material surfaces at the corrugation have been described herein for forming the corrugations. It is to be noted, however, that the technique for maintaining the corrugation does not have to be the same technique that was applied when forming the corrugation. In analogy to the forming step, it will be readily apparent to the skilled person which technique for maintenance of previously formed corrugations to choose in light of the specific material properties of the web material to be corrugated.

[0023] The process for forming corrugation in the material corn the present invention is suitable for forming corrugations over the entire transverse dimension of the material and is further suitable to form corrugation is only longitudinally extending portion of the web material whereby it this portion is preferably centered with respect to the longitudinal centerline of the web material.

[0024] Optionally, the process of the present invention further comprises an additional step of stabilizing the corrugations formed in the web material by joining the web material to a stabilization member such as for example a second web material, a plurality of strands, or other suitable stabilization means as known in the art. Preferably, the stabilization member is joined to the backside of the corrugated web material. In order to stabilize all of the corrugations formed in the web material, the stabilization member preferably has a transverse dimension equal to or larger than the transverse dimension of the corrugated portion of the web material. A wide variety of suitable techniques for joining the second material to the corrugated material including but not been limited to thermobonding, pressure bonding, ultrasonic bonding, adhesive bonding, and the like. It will be readily apparent to the skilled person to choose the most suitable joining technique in light of the specific material properties of the corrugated web material and of the second material.

[0025] It is a further aspect of the present invention to provide an apparatus to carry out the method of the present invention, i.e. to form longitudinal corrugations in a web material.

[0026] One embodiment of the apparatus of the present invention is shown schematically the in Fig. 1 through Fig. 4. The apparatus comprises a drum 20 of generally cylindrical form being rotatable around its symmetry axis. The drum has an outer surface 22 and has a diameter which is twice the distance from the symmetry axis to the outer surface 22. The outer surface 22 has a longitudinal direction which is substantially parallel to the perimeter of the cylindrical drum and the outer surface 22 has a transverse direction which is substantially perpendicular to the longitudinal direction. The drum 20 further comprises on its outer surface 22 a plurality of longitudinal grooves 24. The depth of the longitudinal grooves 24 is directed radially inward from the outer surface 22. The apparatus 40 further comprises a first roll 10 of generally cylindrical form. First roll 10 is rotatable around its symmetry axis and comprises an outer surface 12 and a diameter defined in analogy to the drum 20. First roll 10 further comprises on it's outer surface a longitudinal protuberance 14 extending radially outward from the outer surface 12. The apparatus 40 further comprises a second roll 30 of generally cylindrical form. The longitudinal protuberance 14 corresponds in geometry to at least one groove 24. Second roll 30 is rotatable around its symmetry axis and comprises an outer surface 32 and a diameter defined in analogy to the drum 20. Second roll 30 further comprises on its outer surface three longitudinal protuberances 34 extending radially outward from the outer surface 32. The longitudinal protuberances 34 correspond in geometry to three grooves 24. The apparatus 14 further comprises additional roles designed in analogy to first roll 10 and second roll 30. First roll 10, second roll 30, and additional rolls 36 are positioned in proximity to at least a portion of the outer surface 22 of the drum 20 and such that the longitudinal protuberances 14, 34 penetrate the grooves 24. The web material 60 is supplied to the apparatus from web material supply means 70. The web material 60 is then fed through the nip between the first roll can and the outer surface 22 of the drum 20. Subsequently, the web material is fed through the nip between second roll 30 and the outer surface 22 and through the nips between the additional roles 36 and the outer surface 22. Optionally, the apparatus 40 comprises a second web material supply means 100, supplying a second web material 80 onto the outer surface of the corrugated web material 60. The second web material 80 is then joined to the outer surface of the corrugated

web material 60 by joining means 50. The corrugated web material 90 is then released from the apparatus 40 to be supplied to additional process steps or to be stored for later use.

[0027] The longitudinal grooves comprised in the outer surface of the term are intended to form the corrugations in the web material. Accordingly, a cross-sectional shape of the corrugations will determine a cross-sectional shape of the corrugations. Suitable cross-sectional shapes of the corrugations include but are not limited to spherical, semi spherical, hyperbolic, parabolic, triangular, square, and the like. The depth of the corrugations will likewise determine the thickness dimension of the corrugations.

[0028] The first roll of the apparatus of the present invention may comprise one longitudinal protuberance on its outer surface, preferably being located close to the longitudinal centerline of the outer surface. Alternatively, the first roll may comprise two longitudinal protuberances, preferably being positioned in symmetric fashion with respect to the longitudinal centerline of the outer surface of the first roll.

[0029] The second roll of the apparatus the present invention and any consecutive roll comprises its outer surface at least one longitudinal protuberance which is positioned either between the outer most longitudinal protuberance on one side of the longitudinal centerline on the preceding roll and the respective longitudinal edge of the outer surface or between the outer most longitudinal protuberance on the preceding roll and respective longitudinal edge of the outer surface on the other side of longitudinal centerline. Alternatively the second roll and any consecutive roll may comprise two longitudinal protuberances positioned between the outer most longitudinal protuberances on both sides of the longitudinal centerline on the preceding roll and the respective longitudinal edges of the outer surface.

[0030] The diameter of the first roll, the second roll, and all consecutive rolls needs to be substantially smaller than the diameter of the drum. The diameter of the individual rolls, however, do not have to be identical whilst identical diameters are preferred. It will be readily apparent to the skilled person to choose appropriate parameters for the rolls in light of the total number of rolls, the diameter of the drum, other geometrical considerations, and the specific material properties of the web material to be corrugated.

[0031] A wide variety of suitable joining means is well known in the art including but not be limited to thermobonding means, pressure bonding means, ultrasonic bonding means, adhesive bonding means, and the like.

[0032] The material obtainable by the process of the present invention is particularly useful for disposable absorbent article such as diapers, sanitary napkins and adult incontinence articles. In such articles, it may be used as a liquid handling member for handling body exudates such as urine, menses, and fecal material.

Claims

1. A method for forming corrugations in a web material, said web material having a first longitudinal edge and a second longitudinal edge, said corrugations being oriented along the longitudinal dimension of said web material, characterized in that said method comprises the following step

   -- forming a first corrugation in said web material followed by at least one repetition of the following step
   -- forming an additional corrugation in said web material while maintaining all previously formed corrugations, each of said additional corrugations being positioned intermediate one of the outermost previously formed corrugations and the respective longitudinal edge of said web material

2. A method for corrugating a web material according to claim wherein the transverse surface path length of said first web material remains substantially unchanged during corrugation.

3. A method for corrugating a web material according to claim wherein said method further comprises a step of stabilizing said corrugations in said web material by joining said corrugated web material to a stabilization member.

4. A method for corrugating a web material according to claim wherein said stabilization member has a transverse dimension equal to or larger than the transverse dimension of the corrugated portion of said web material after corrugation.

5. An apparatus for forming longitudinal corrugations in a web material comprising

   -- a drum having a diameter and an outer drum surface, said outer drum surface having a longitudinal direction substantially parallel to the perimeter of said drum and a transverse direction perpendicular to said longitudinal direction, said outer drum surface comprising a plurality of longitudinal grooves, said longitudinal grooves corresponding in position and geometry to the longitudinal corrugations to be formed in said web material and
   -- a series of rolls having a diameter smaller than the diameter of said drum, said series of rolls being arranged in proximity to at least a portion of said outer drum surface, each of said rolls having an outer roll surface having a longitudinal direction substantially parallel to the perimeter of said roll and a transverse direction substantially perpendicular to longitudinal direc-

tion, the first of said rolls comprising one or two longitudinal protuberances on its outer surface, said one or two longitudinal protuberances corresponding in position and geometry to one or two of said longitudinal grooves on said outer drum surface, each consecutive roll comprising one or two longitudinal protuberances on its outer surface, said one or two longitudinal protuberances being positioned between the longitudinal edge of the outer roll surface and the position of the respective outer most longitudinal protuberance on the preceding roll

-- a web material supply means capable of feeding said web material between the outer drum surface and the outer roll surfaces

6. An apparatus for forming longitudinal corrugations in the web material according to claim wherein said apparatus further comprises

-- a second web material supply means for feeding a second web material onto the backside of said web material subsequent to corrugation of said first web material and

-- a joining means for joining said second web material to the outer side of said first web material subsequent to corrugation of said first web material.

FIG 1

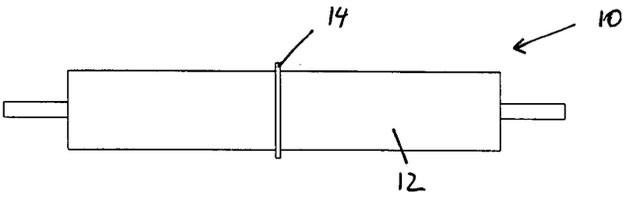


FIG. 2

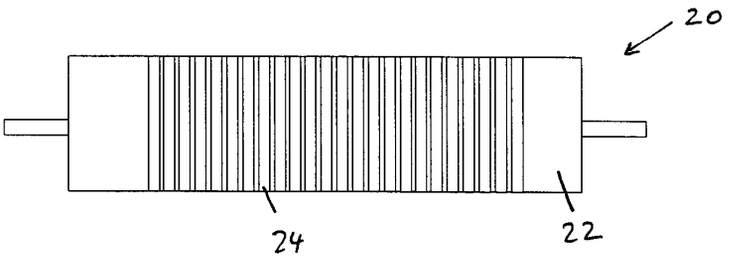


FIG. 3

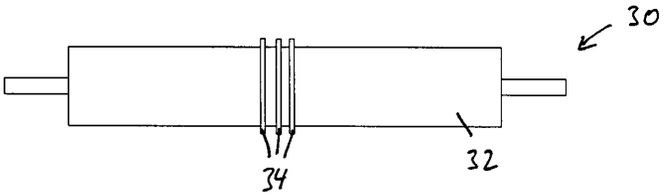
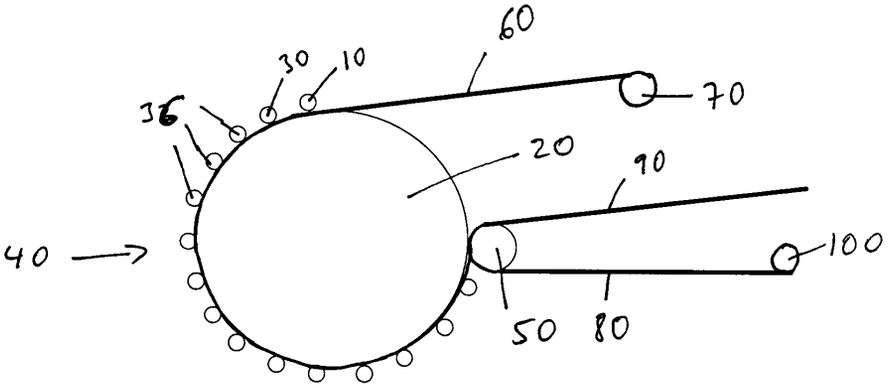


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 99 12 4637

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 364 084 A (TORRES MARTINEZ M) 18 April 1990 (1990-04-18) * abstract * * page 2, column 1, line 1 - page 3, column 3, line 4; claims; figures *	1-6	B31F1/22
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B31F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 May 2000	Soederberg, J

CATEGORY OF CITED DOCUMENTS

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