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(71) Applicant: **The Procter & Gamble Company**
Cincinnati, Ohio 45202 (US)

(72) Inventor: **Hilbig, Klaus**
60318 Frankfurt (DE)

(74) Representative: **Borbach, Markus et al**
Procter & Gamble Service GmbH,
Sulzbacher Strasse 40
65823 Schwalbach (DE)

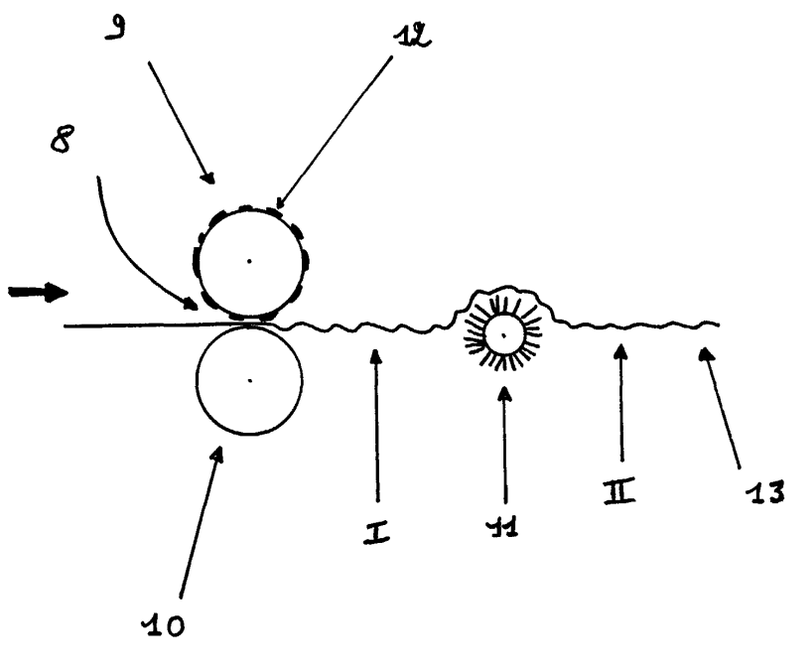
(54) Embossed tissue having loosened surface fibers and method for its production

(57) The present invention relates to paper tissues and paper tissue products, and in particular to disposable handkerchiefs, kitchen paper towels, toilet paper and facial tissues.

More particularly, the invention relates to paper tissue product exhibiting a soft and smooth surface, and a high bulkiness together with a high strength, in order to provide to the user an enhanced functionality and a high degree of comfort during usage.

The present invention also relates to the process of making paper tissue and paper tissue products, and in particular to disposable handkerchiefs, kitchen paper towels, toilet paper and facial tissues, presenting the characteristics mentioned above and including the process steps of embossing and brushing of the surface of the tissue.

Figure 3



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Description

Field of Invention

[0001] The present invention relates to paper tissues and paper tissue products, and in particular to disposable handkerchiefs, kitchen paper towels, toilet paper and facial tissues.

[0002] More particularly, the invention relates to paper tissue product exhibiting a soft and smooth surface, and a high bulkiness together with a high strength, in order to provide to the user an enhanced functionality and a high degree of comfort during usage.

[0003] The present invention also relates to the process of making paper tissue and paper tissue products, and in particular to disposable handkerchiefs, kitchen paper towels, toilet paper and facial tissues, presenting the characteristics mentioned above and including the process steps of embossing and brushing of the surface of the tissue.

Background of the Invention

[0004] Paper tissues sometimes called paper webs or sheets, tissues, tissue layers, paper plies or paper tissue webs, and products made there from, such as paper handkerchiefs, paper kitchen towel or toilet paper, find extensive use in modern society and are well known in the art.

[0005] Paper tissues are generally made by the layering of cellulose fibers, in a wet form, onto a screen, with the addition of various additives or other ingredients, followed by a drying step. Other process steps, before, during or after the above-mentioned paper making steps are targeted at giving the desired properties to the tissue. Converting steps are aimed at creating a finished product from the paper tissue(s).

[0006] Products made from paper tissues can be made by the association of multiple layers of tissues, also called plies, or can comprise a single tissue layer (single ply products). Those plies can be combined and held together in multiple ways to form the finished product, for example by embossing of the multi-ply structure or/and by gluing. The finished products are herein referred to as paper tissue products.

[0007] It has long been recognised that important physical attributes of these paper tissues are their strength and thickness/bulkiness, their softness and smoothness, and their absorbency. Research and development efforts have been directed to the improvement of each of these attributes without seriously affecting the others as well as to the improvement of two or three attributes simultaneously.

[0008] Softness and smoothness relate to the tactile sensation perceived by the consumer when holding a particular product, rubbing it across the skin, or crumpling it within the hands. The tactile sensation is a combination of several physical properties. The tactile sensation can be well captured by the objective parameter of the physiological surface smoothness (PSS) parameter as known e.g. from US 5,855,738. As important for the tactile sensation of consumers is the thickness/caliper of a tissue product also called bulkiness.

[0009] Strength is the ability of the product to maintain physical integrity and to resist tearing, bursting, and shredding under conventional use conditions.

[0010] Absorbency is the measure of the ability of a tissue or product to absorb quantities of liquid, particularly aqueous solutions or dispersions. Overall absorbency as perceived by the consumer is generally considered to be a combination of the total quantity of a liquid a given mass of paper tissue or product will absorb at saturation as well as the rate at which the mass absorbs the liquid.

[0011] Relatively thick and yet soft disposable paper products, namely in the form of paper handkerchiefs, are known. For example, Tempo™, sold by The Procter & Gamble Company, is a multi-ply paper product experienced as thick and soft and having a caliper of about 0.3 mm. A high calliper conveys the idea of high dry and wet strength to the consumer. A high wet strength, also referred to as wet burst strength, in particular prevents tearing or bursting which for a paper handkerchief in turn results in contamination of the user's hand with mucus or other body fluids.

[0012] A common way to enhance the smoothness of the tissue surface is to calender the material. For example US-5'855'738 by Weisman et al. describes a calendering step that helps in the manufacture of a smooth high-density tissue. This manufacturing step flattens the surface of the tissue, thus re-orienting and re-bonding the paper fibers at the surface of the paper web. However calendering reduces considerably the caliper of the paper web, impairing the desired bulkiness of the final product.

[0013] Methods for creating tissues with high bulkiness have been described: For example in US-5'702'571 and EP-0 696 334 B1, both by Kamps et al. In these, the tissue's bulkiness is enhanced by embossing the tissue between a nip formed by one male engraved roll and one female engraved roll. Another example is given in the patent application EP01103798.3 by K. Hilbig, M. Liplijn and H. Reinheimer, filed on Feb 16 2001, it consists in the creation of a tri-dimensional structure at the paper surface (via micro-embossing, also called stretch deformation before a calendering step). This is a way to create a relatively smooth and bulky final product. However the above-mentioned paper tissue is still submitted to a calendering step, and exhibits a notably reduced thickness versus the micro-embossed paper tissue.

[0014] Another way, known in the art, for obtaining a smooth paper tissue surface is to submit the paper tissue to a step of brushing. Brushing of tissue is known in the art and has been in particular described in US-3'592'732 by Wand et al. in which the tissue is brushed

by a rotating brush using an engraved or dented roll as a counter surface. In US-5'180'471, Sauer et al. describes a multi-ply tissue (and related method) which the inward surface(s) has (have) been brushed. It is believed that the brushing of the paper surface acts on the paper fibers (cellulose fibers) by unbonding one end of the paper fibers close to the surface of the tissue, herein referred to as extending fibers, thus allowing the extending fibers to raise above the paper web surface, thus creating a surface which is smooth to the touch. As a drawback, it would appear however that brushing could be damaging for the strength of the paper web as it modifies the structure of the fibre network forming the paper web (as mentioned in the above reference US-3'592'732) and reduces the bonding between the fibers making up the surface of the tissue.

[0015] The prior art teach that each of the above methods present disadvantages affecting one or more of the key characteristics of the paper tissue when trying to improve another one.

[0016] In the view of the prior art and the consideration set out above, there remains a need for paper tissues which combine apparently incompatible features:

- a high surface smoothness,
- a high strength,
- a high thickness / bulkiness,

[0017] The same requirements are valid for the finished products, which are usually, but not always, made of a combination of multiple plies of paper tissues.

[0018] The present invention responds to that need.

Summary of the Invention

[0019] The present invention relates to paper tissues comprising cellulose fibers. The tissues have a first and a second surface, and an embossing pattern, which form raised regions surrounded by depressed regions on the first surface. The regions coincide with the respective opposite regions on the second surface of the tissue. The first surface has extending fibers, which have a first and a second end, with the first end being un-bonded to the tissue and the second end being bonded to the tissue. The unbounded ends of the extending fibers are obtainable by brushing of the first surface, such that there are more extending fibers in the raised regions than in the depressed regions.

[0020] The present invention also relates to paper products such as handkerchiefs, paper towels, facials and toilet papers, made of one or more of the tissues of the above.

[0021] The present invention also relates to the process for making a paper tissue according to the above. The process comprises the steps of

- embossing the tissue by passing it between two rolls forming an embossing nip,
- brushing at least one of the surfaces of the tissue.

Preferably the process is characterized in that the brushing process step is carried out subsequent to the embossing step.

[0022] All documents cited herein are, in their relevant part, incorporated herein by reference; the citation of any document is not to be construed as an admission that it takes away patentability of the present invention.

Brief Description of the Drawings

[0023]

Figure 1 represents a paper handkerchief composed of 3 paper tissues (also called plies or layers), and exhibiting a substantially non-flat / non-uniform surface.

Figure 2 is a magnified portion of figure 1, on which the 3 paper tissues are seen.

Figure 3 shows the process for making a tissue as shown in Fig 1.

Figure 4 shows an enlarged portion of the paper tissue at location I of Fig. 3.

Figure 5 shows an enlarge portion of the paper tissue at location II of Fig. 3.

Detailed Description of the Invention

[0024] The present invention provides a paper tissue exhibiting a high level of surface smoothness and softness, a high strength and a high bulkiness. These apparently competing characteristics have been combined by following the concept of the present invention.

[0025] Without wishing to be bound by the theory, the concept behind the present invention can in particular be described as to create a paper tissue surface, which is not uniform and presents the desired characteristics in separate regions:

- Smoothness/softness in the most prominent regions (raised regions) by the presence of loose paper fibre ends, which supports the tactile benefits of the tissue,
- Strength in the inward regions (depressed regions), by providing a substantially non-altered network of fibers,
- Bulkiness being created by the very presence of raised and depressed regions and conserved through the downstream process of converting the paper tissue, by both the nature of these process steps and preferably by their determined sequence.

[0026] This can be achieved by applying selected

process steps to the paper tissue. These process steps are optimized to deliver the desired end result and to deliver a synergistic effect. They are preferably applied in a particular order.

[0027] The present invention is specifically concerned with the steps known in the art as "converting steps", in which a paper tissue, made by any suitable "paper making process", is provided.

[0028] The present invention can be practiced by the following process steps:

- a paper tissue is provided.
- The tissue is submitted to process/es intended preferably to modify the surface(s) and/or the of the inner structure of the paper tissue, in order to provide the desired characteristics to the tissue,

  and/or

- It is combined with one or more paper tissues to form a product or a entity convertible into a product

  and/or

- The entity or the product is submitted to further process/es intended to modify the surface and/or the inner structure of the product or of the said entity.

[0029] The paper tissue according to the present invention will now be explained in reference to the drawing and the steps to make such tissues.

Embossing (stretch embossing or micro-embossing or stretch deformation)

[0030] Although any known-in-the-art type of embossing can be practised within the present invention, one preferred embossing step is a so-called micro-embossing or stretch embossing step, also called stretch deformation, as described in the European patent application EP01103798.3 by K. Hilbig, M. Liplijn and H. Reinheimer, filed on Feb 16 2001, in which a very fine pattern is embossed using a low pressure.

[0031] Embossing can be carried out on one tissue, such as reference numeral (13) of figures 3,4,or 5 or reference numeral (2), (3), (4) of figures 1 and 2. Alternatively embossing can be carried out on a multi-ply entity, such as reference numeral (1) of figure 1. For simplicity, reference numeral (13) of figures 3 is described below as a tissue (i.e. a single-ply entity), but the skilled person understands that it can be replaced by a multi-ply entity such as reference numeral (1) of figure 1, without deviating from the present invention.

[0032] As shown in figure 3, embossing of a paper tissue, such as those of figures 1 and 2, under reference numerals (2) (3), (4), or embossing of a multi-ply entity, such as the one of figure 1 under reference numeral (1), is generally achieved by passing the tissue or the multiply entity (reference numeral (13) of figure 3) through the nip (8) formed between two embossing rolls (9) (10), at least one embossing roll (9) comprising embossing elements (12).

An embossing roll typically comprises a smooth surface. Embossing elements (12) are protrusions raising above this surface and having a certain height as measured in a radial direction of the axis of the embossing roll above the smooth roll surface to the utmost point of the protrusion.

Embossing elements also have width in a direction parallel to the roll axis and a length in a radial direction. The term width and length as used herein can be the diameter of a round embossing element. Such a diameter needs not be constant from the bottom of the embossing element to its top. Preferably, the largest width of an embossing element is on said smooth surface.

[0033] The embossing elements (12) can have any shape, such as pyramidal or half spherical, and the cross section of the embossing elements can be circular, oval or square. The embossing elements may form a continuous pattern, but preferably are distinct from each other, such as the smooth surface of the roll forms a continuous plane.

[0034] In one embodiment of the present invention, the embossing elements (12) are disposed over at least one embossing roll in a very fine pattern, comprising at least 30 embossing elements, preferably at least 50, more preferably at least 60, yet more preferably at least 70, most preferably at least 80 embossing elements per square centimetre surface area of the embossing roll.

[0035] The embossing elements are not high, preferably they have a height of less than 1 mm, more preferably less than 0.8 mm, yet more preferably less than 0.6 mm, yet even more preferably less than 0.5 mm or less than 0.4 mm, and most preferably less than 0.3 mm.

[0036] Preferably the stretch embossing has a ratio of embossed areas to un-embossed areas from 5% - 95%, more preferably 20% to 80% and most preferably 40% - 60%, i.e. for the most preferred case 40% - 60% of the total surface area of the tissue paper are embossed.

[0037] Any known type of embossing roll and mode of operation of such roll is within the scope of the present invention. In particular, two hard metal, e.g. steel, embossing rolls can be used, wherein a first roll comprises protruding embossing elements, referred to as the male roll, and a second roll comprises matching recesses, referred to a the female roll. The recesses may be mirror images of the protruding embossing elements or may be adapted to be slightly smaller than exact mirror images, eg. due to a slight difference in size or shape (eg. slope) of those recesses in the female roll. It is also possible to use so called pin-to-pin embossing where two rolls are used with matching protrusions.

[0038] Alternatively the use can be made of a first embossing roll comprising a web contacting surface provided from a hard metal comprising protruding emboss-

ing elements and a second roll comprising a web contacting surface comprising a softer material, eg. rubber, preferably a material of Shore A hardness 40-70, in which recesses are formed upon sufficiently close contact with the protruding embossing elements. Providing an embossing nip from a hard metal roll in combination with a rubber roll has numerous advantages, such as cheaper and easier production and operation, since the adjustment of the rolls in much less critical than for a male and a female hard metal roll.

[0039] The size of the nip formed between the two embossing rolls is to be adapted depending eg. on the tissue paper to be processed and depending on the embossing pattern used. Also depending on those considerations no pressure or some pressure may be applied to urge the first embossing roll and the second embossing roll together.

[0040] When two hard metal rolls are employed in the process, a male and a female role, the rolls should be operated so as to leave a space corresponding to 60% to 140%, preferably 80% - 120% of the calliper of the un-embossed tissue paper between the protruding embossing elements of the male role and the bottom of the recesses of the female role.

[0041] When a hard metal roll is used in combination with a rubber roll, the rolls should be pressed against each other with a pressure of 10 N/square centimetre to 1000 N/square centimetre, preferably 20 N/square centimetre to 200 N/square centimetre and most preferably 50 N/square centimetre to 100 N/square centimetre.

[0042] Known modes of operation are suitable for the present invention, preferably the embossing rolls are not heated and run at the same speed, but in alternative modes of operation at least one roll may be heated and the rolls may run at unequal speed.

[0043] The above described embossing with a fine pattern, in one important aspect serves to increase the caliper, or in other words the bulk of the paper tissue. Therefore, in a preferred mode of the present invention a single tissue is passed through the embossing nip (figure 3, (8)). In alternative modes of operation a multitude of plies of paper tissues may be passed through the nip (figure 3, (8)) at the same time. This will results in embossments which initially match or nest between the tissues.

Brushing step:

[0044] According to one aspect of the present invention, the brushing of the paper tissue(s) (figure 3, reference (13)), is preferably performed after the embossing step, but can also be considered as an independent step provided it delivers the intended result described.

[0045] The terms brush and brushing are being used in the present document as an example, but without limiting the scope of this invention. In accordance with the present invention are any tool, equipment or means able to provide the desired modification on the surface and structure of the paper tissue (i.e. to lift fiber ends up without complete detachment). Conventionally such means include any type of abrasive surface such as those provided by the bristles of a brush or by sand paper. Useful structures providing abrasive functionability can be made from natural or artificial materials such as foam, metal or polymers. To create the desired abrasion a relative movement between the surface of the paper tissue and mean of abrasion is preferably needed. As alternatives, chemical, optical, or physical processes resulting in the described modification of the surface and/or structure of the tissue, are optionally considered within the present invention.

[0046] Preferably, the modification on the surface and structure of the paper tissue is achieved with a rotating tool which is in abrasive contact with the surface of the tissue(s), most preferably a brush cylinder comprising brushing bristles along its full circumference is used. The bristles can be polymeric but are preferably from natural origins such as animal hair or fur, for better electrostatic performance.

[0047] The brushing step can be performed on one side of the paper tissue or on both, depending on the intended benefits desired, by a combination of one, two or more brushes. Preferably, one brush cylinder is applied to each tissue side. For simplicity however, the embodiment of the invention is described in the following with one brush cylinder (identified in the figure 3 by the reference numeral 11) acting on one tissue side. Alternative sets-up can be practiced also. For example, 2 or more brushes acting on the same tissue side, brushing of the first and second surfaces simultaneously or consecutively are envisioned.

[0048] Key results of the brushing step is a modification of the most outwardly lying fibers on the surface of the tissue. The tissue fibers are generally bonded by hydrogen bridges to each other during the tissue making, drying or subsequent calendering at a multitude of points where the fibers intersect. It is the inventor's believe that, during the brushing step, the paper fibers are provided with sufficient energy to break some of the hydrogen bonds linking the fibers together and insuring the cohesion of the paper structure. This energy is provided by the tear force or shear force of the individual bristles when colliding with the fibers. Without being bound by the theory, the inventors believe that the energy must be sufficient to break some of the bond between the fibers but low enough not to break all of the bonds which would provoke a complete dislocation of the fibers from tissue surface (also known as linting), and to not break the fiber structure itself.

[0049] By the brushing step of the present invention, extending fibers (7) as shown in figures 2 and 5, are created, i.e. fibers having one fiber end still bonded to other. fibers while the other fiber end is freed, and able to raise above the surface of the tissue. These extending fibers (7) are key to provide tactile smoothness and softness to the tissue.

[0050] The process according to the present invention is targeted to preferably loosen or free only one end of the fibers by breaking their bonds to the other fibers at one end. It is however observed that the brushing step also induces inevitably a complete release of some complete fibers or fiber breakage. These fibers or pieces of fibers should be removed from the tissue thereby helping to reduce linting. They can be recycled. Schematically the process according to the present invention can be seen in Figure 3: first a tissue web (13) is provided, usually unwound from a roll of tissue web. The tissue web (13) is guided to an embossing station where the tissue web is guided through a nip (8) between two embossing rolls (9), (10). The tissue (13), after embossing is then guided toward a brushing station where at least one side is exposed to a brushing cylinder (11). The brushing cylinder can be operated to rotate so that its surface moves with or against the tissue movement or simply stands still. The setting of the equipment, particularly the brushing cylinder, such as rotation speed, distance of the brush to the tissue web, extend of wrapping of the tissue web around the brush, and the design of the brush, such as the nature of the bristles, their length, the bending moment of the bristles, the density and the diameter of the bristles, the treatment or coating of the bristles, are optimized to deliver the best results for the quality of the paper tissue after brushing (analyzed by strength, smoothness, softness and bulk of the tissue), the stability of the process, and the life of the equipment.

[0051] The brushing step is preferably performed with only the inherent force of the moving paper tissue web acting on the brush, i.e. without the use of a counter-roll or counter-surface to apply pressure and/or guide the paper tissue onto the brush. Only the tension of the paper tissue web and to a much lesser extend the own weigh of the paper tissue applies a pressure on the rotating brush (11), as shown in figure 3.

[0052] When more than one brush cylinder are used in the process, some of the brushes may, or may not, be positioned in such a way that they brush the 2 sides of the paper web simultaneously.

[0053] In a preferred way to practice the invention, the brush rotate in the direction of the web movement on the converting line. Opposite direction is however also contemplated.

[0054] Together with the design of the brush, its speed of rotation is a crucial parameter in the effectiveness of the brushing step, affecting the wearing of the equipment as well end results of the process step. Preferably, the speed of the brushing cylinder relatively to the tissue web surface is higher than 1'000m/min (linear velocity of point of contact to the paper web), more preferably more than 1'500 m/min, most preferably more than 2'000 m/min and further most preferably more than 3'000m/min.

[0055] The brush (figure 3, reference (11)) as used in the present invention can be of very wide nature and design, including synthetic, metallic or natural hair, over a wide range of dimension and density. In a preferred way to conduct the invention, brushes made of horsehair have been used, as sold by Mink GmbH (Goeppingen, Germany) under the reference ZZB12528-K2509. Such brushes are used conventionally in the treatment of textiles. Preferably, the brush is substantially circular and operates by rotation around one axis. The inventors however contemplate as being part of the present invention; the use of other types of brushes (for example, fixed brushes or brushes operating by translation of the brush surface or abrasive surface over the surface of the paper tissue), provided the action of the brush induces the described modification on the surface and structure of the paper tissue.

[0056] In one preferred way to practice the invention, the embossed paper tissue web is wrapped around two brush rolls without being fixed on a guide roll. Each brushing roll brushes one surface of the tissue. The travel distance of the paper tissue on the surface of the brush (i.e. the wrapping of the paper tissue around the brush or in other words, length of contact between the brush and the paper tissue) can vary over a wide range. It has been found useful to set this length to less than 20cm, preferably less than 5cm, most preferably less than 1cm, although a wider range of length is contemplated.

[0057] For paper tissue, which has been made in the paper making operation as a non homogeneous mixtures of long and short fibers, with one side of the tissue presenting more short fibers than the other side, the present invention contemplates a preferred orientation of the paper web on the brush. Preferably the paper tissue or the brush are orientated as such as the short fibers of the paper tissue are brought to contact wit the brush. Without whishing to be bound by the theory, it is easily conceivable that the short fibers present less bonding to each other. It is thus easier to loosen more fiber ends out of short fiber side than out of long fiber side of a tissue.

[0058] It has been observed that the brushing step of a paper tissue tends to increase its caliper and increases in the range of 1 to 25% have been measured, averaging to about 5%. Importantly, this increase in caliper, leading to a high bulk, is additive to the caliper increase created by the embossment step, preferably the stretch deformation process step. The stretch deformation itself generally adds about 50% to 200% of caliper to the paper tissue, according to the European patent application EP01103798.3 supra.

[0059] One advantage of the present invention in comparison to the process described in European patent application EP01103798.3 supra, is the possibility to eliminate the conventional calendering step after the stretch deformation step. This conventional calendaring generally results in a decrease of the stretch deformed paper tissue caliper, which led to a total caliper increase (after both steps: stretch deformation and smooth cal-

endering) of 10% to 100%. The elimination of the calendering after the embossing but the use of brushing allows achieving an exceptionally high-end caliper of the treated tissue web, in the range of 51% to 225% in the examples given above.

[0060] In one preferred way to perform the invention, shown on Figure 3, the tissue (13) of figures 3, 4, 5 has been previously submitted to an embossing step, most preferably the micro-embossing (or stretch embossing or stretch deformation step) described under the "Embossing" headline in this document. In that case, the paper tissue (13) enters the brushing step being an essentially non-flat surface, i.e. presenting raised regions (6) and depressed regions (5), relatively to each other, created by the embossing step.

[0061] The effect of brushing on this pre-deformed paper tissue has been unexpected and constitute one the key findings of the present invention: It has been identified that the brushing step acts preferentially on the raised regions (6) while leaving the depressed regions (5) substantially unaltered. Thus, more extending fibers (7) are created on the raised regions (6) relative to those created in the depressed regions (5). A network of substantially unaltered depressed regions is thereby created. This network substantially conserves the strength and tensile characteristics of the un-treated tissue.

[0062] This delivers the intended results of creating a paper tissue with a high degree of softness and smoothness (provided in particular by the extending fibers of the raised regions), a high strength (in particular provided by the network of unaltered depressed regions) and bulkiness (provided by the presence of raised and depressed regions).

Further process steps

[0063] The method for making a paper product according to the present invention may comprise a number of further optional steps. Some examples, not limiting in their scope, function or nature are given below:

[0064] A lotion may be applied to the tissue by any suitable means, such as, but not limited to printing or spraying, onto one or more surfaces of the paper tissue or paper product, or a portion of these surfaces

[0065] Juxtaposed plies of the paper tissue may be joined so as to provide a multi-ply paper product, preferably by attachment embossing. "Attachment embossing", as used herein, refers to an embossing by which all plies of a multi-ply product according to the present invention are embossed in one process step. "Attachment embossing" has been described by H. Reinheimer, K. Hilbig and W. Schmitt in WO-95/27429. Preferably the attachment embossing does not or at least not to a large extent affects the smoothness of any calendered tissue. Therefore, preferably the paper product has an un-embossed surface over a major part of the surface area of the tissue, preferably on the first and the second surface. As used herein, this means that the tissue has one or more regions not comprising an attachment embossing and, optionally, one or more regions comprising an attachment embossing, and that the region not comprising an attachment embossing is at least 50%, preferably at least 80% and in some preferred embodiments as much as 99%, of the surface area of the tissue. Most commonly the regions comprising an attachment embossing lie close to the edge of the tissue (for example along two or four edges). Attachment embossing may also be used for decorative purposes (for example to create a pattern or to spell out a logo or brand name). Attachment embossing is preferably done by steel-to-steel pin-to-pin embossing and with 10 to 40 embossing elements per square-centimetre having a height from 0.01 mm to 1 mm, preferably 0.05 mm to 0.2 mm. The percentage of attachment embossed areas to un-embossed or fine embossed areas of the total surface area of a paper tissue product is preferably 0.01% to 5%. Attachment embossing involves as substantive densification of the paper tissue products as to achieve the attachment. Therefore the nip or space between one embossing element and its counterpart, eg. two pins where pin-to-pin embossing is employed, is less that the calliper of the paper tissue to be embossed, typically 5% to 50%, preferably 10% to 20% of the calliper of the paper tissue to be embossed, which leads to embossing pressures of 10 000 to 50 000 N/square-centimetre.

[0066] The method of the present invention may further comprise a step of sizing the paper tissue web or paper product to the desired dimensions.

[0067] If desired, the paper products according to the present invention may be provided with functional or aesthetic indicia. The indicia may be applied to either or both of the surfaces of the paper products. The indicia may cover all or part of the paper products and be applied in a continuous or discontinuous pattern.

[0068] The indicia may be applied to the paper tissue products by any means well known in the art, such as spraying, extruding, and preferably printing.

Examples:

Paper tissue:

[0069] A piece of paper tissue according to the present invention is cut from a paper tissue web and presents a non-uniform surface, obtainable for example by a process step of micro-embossing. It has typically 30 to 100 depressed regions per cm^2 and the depressed regions have typically a depth of less than 260µ and typically a diameter of more than 20µ.

[0070] The thickness of the tissue depends highly on the manufacturing process and is typically 100µ. per native paper tissue ply, 150µ to 200µ when embossed or stretch deformed. This results in about 400µ to 500µ when 3 plies are combined (after embossing) to form a finished product.

[0071] The dimensions of the paper tissue are not rel-

evant as it depends almost only on the setting of the cutting equipment on a manufacturing machine.

[0072] As it can be seen in figure 5, the raised regions (6) of the paper tissue (13) show extending fibers (7), visible under a microscope or magnifier lens. The ends of the fibers are non-bonded to the other fibers and thus have the ability to stick out of the surface of the paper tissue.

[0073] These extending fibers are believed to provide the particular characteristics, according to the present invention, which are responsible for the benefits described above, in particular softness, smoothness and bulkiness of a tissue. The strength characteristics of the tissue, on the other hand is substantially not altered because the number of extending fibers in the depressed regions is smaller than in the raised regions.

[0074] The present invention in general encompasses any tissue (13) having raised (6) and depressed regions (5), which present generally more extending fibers (7) in the raised regions (6) than in the depressed regions (5). However the invention is preferably practiced with at least 20 % more extending fibers in the raised region than in the depressed regions, more preferably at least 50% and most preferably at least 80%.

[0075] Counting of the extending fibers can be made under light magnification (for example 10 times magnifier lens) by estimating the density or the number of extending fibers or by numerical counting of those, both in the raised regions and in the depressed regions.

Paper handkerchiefs:

[0076] In the particular example of Tempo™ paper handkerchiefs, the handkerchiefs are constituted typically of 3 to 4 plies of paper tissues. The handkerchief has a basis weigh of about 50 to 80 g/sqm (i.e. about 18 g/sqm per ply) and a caliper of 400µ. to 600µ (about 140µ per ply). The plies are linked together by a particular embossing, according to WO95/27429, and possibly gluing, which keeps the plies together and enable the design of a particular pattern at the surface of the paper handkerchief. In a particular example, only the 2 outside surfaces of the handkerchiefs (after combining the plies) have unbounded fiber ends in the raised regions of the tissues in accordance with the present invention. The other surfaces of the tissues (inwardly oriented surfaces of the outside tissue and internal tissue's surfaces) present raised regions and depressed regions providing bulkiness and caliper, but an about equal quantity of unbounded fibers on the raised and depressed regions.

[0077] While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

Claims

1. A paper tissue comprising cellulose fibers
said tissue having a first and a second surface,
said tissue having a embossing pattern,
said embossing pattern having raised regions surrounded by depressed regions on said first surface which regions coincide with the respective opposite regions on the second surface of the said tissue,
said first surface having extending fibers
said extending fibers having a first and a second end,
said first end being unbonded to said tissue and said second end being bonded to said tissue, said unbounded ends of said extending fibers being obtainable by brushing of said first surface,
characterized in that
there are more of said extending fibers in said raised regions than in said depressed regions.

2. A tissue of claim 1 **characterized in that**
said second surface has also extending fibers.

3. A tissue of claim 1 or 2 **characterized in that**
said first surface exhibits at least 25 % more of said extending fibers in said raised regions than in said depressed regions.

4. A tissue of claim 3 **characterized in that**
said first surface exhibits at least 50 % more of said extending fibers in said raised regions than in said depressed regions.

5. A tissue of claim 4 **characterized in that**
said first surface exhibits at least 80 % more of said extending fibers in said raised regions than in said depressed regions.

6. A tissue of any of the preceding claims, **characterized in that**
said embossing pattern is a micro-embossing pattern obtainable by stretch deformation of said tissue.

7. A tissue of any of preceding claims, **characterized in that**
said depressed regions form an interconnected network.

8. A paper-product such as a handkerchief or a kitchen towel or toilet paper, **characterized in that** said

product comprises at least one of the tissues of claims 1-7, and said first surface of at least one said tissue forms an outer surface of said paper product.

9. A paper-product of claims 8 or 9 **characterized in that**
it comprises at least 2 of said tissues and said embossing patterns are registered, preferably by having embossed said at least 2 tissues together.

10. A process for making a paper tissue according to claim 1,
Said tissue comprising cellulose fibers,
Said tissue having a first and a second surface,
Said process comprising the steps of:

- embossing said tissue by passing said tissue between two rolls forming an embossing nip,
- brushing at least one of the said surfaces of said tissue

characterized in that
said brushing process step is applied subsequently to said embossing step.

11. The process of claim 1 **characterized in that**
said embossing step is a micro-embossing step created by stretch deformation of said tissue without creating local tissue breakage.

12. The process of claim 1 **characterized in that**
said brushing process step uses a brushing tool on said first surface without a counter-surface being applied to said second surface of said tissue.

Figure 1

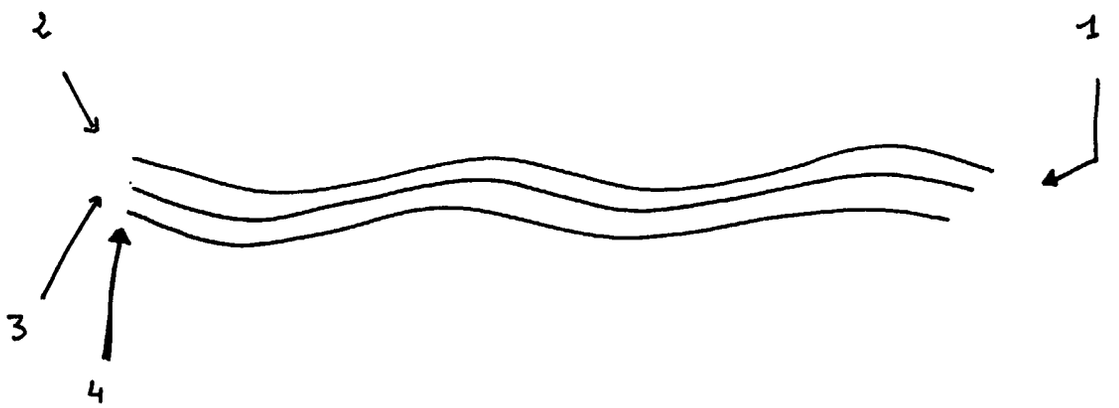


Figure 2

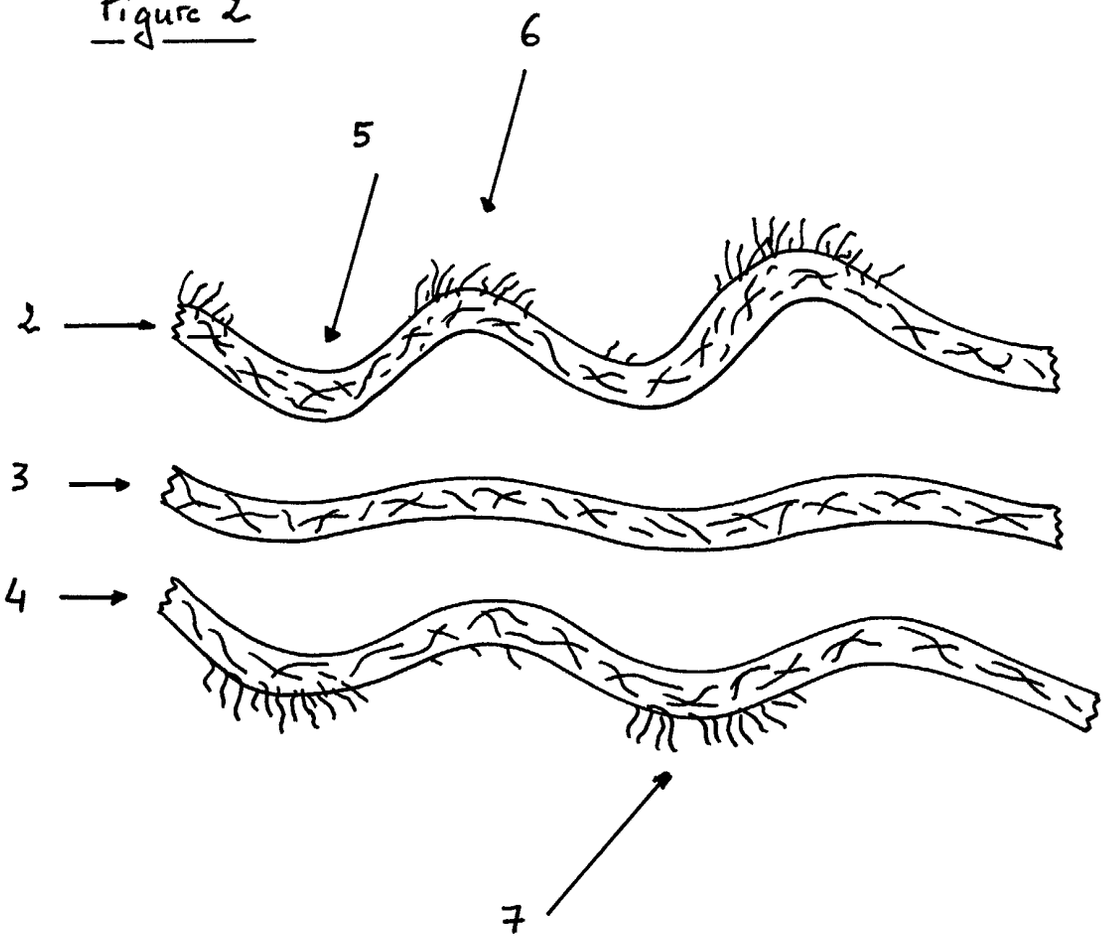


Figure 3

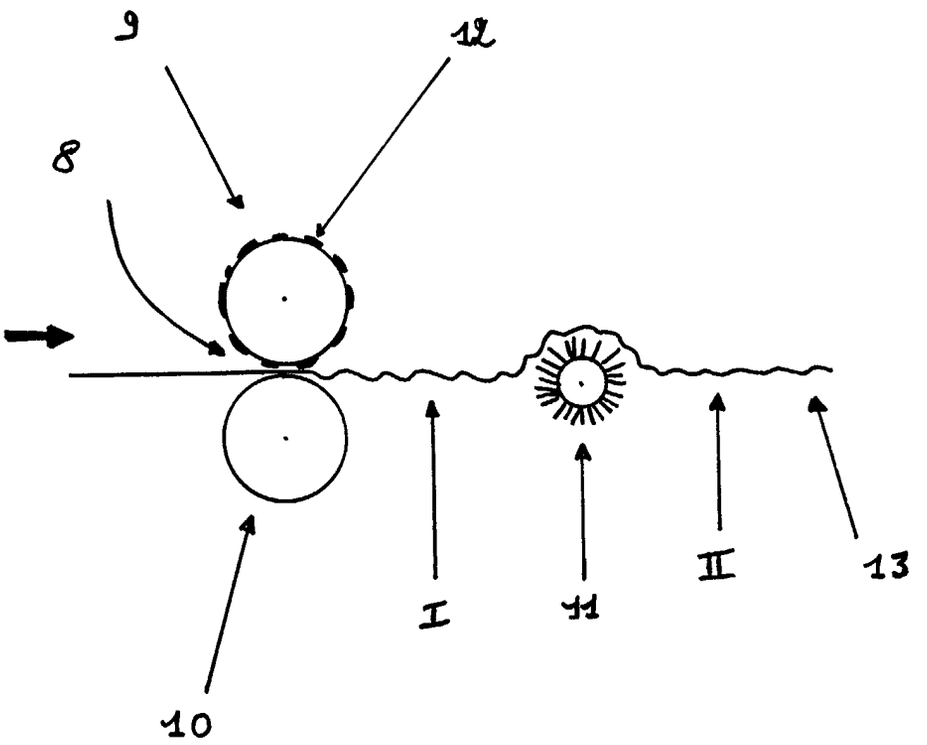


Figure 4

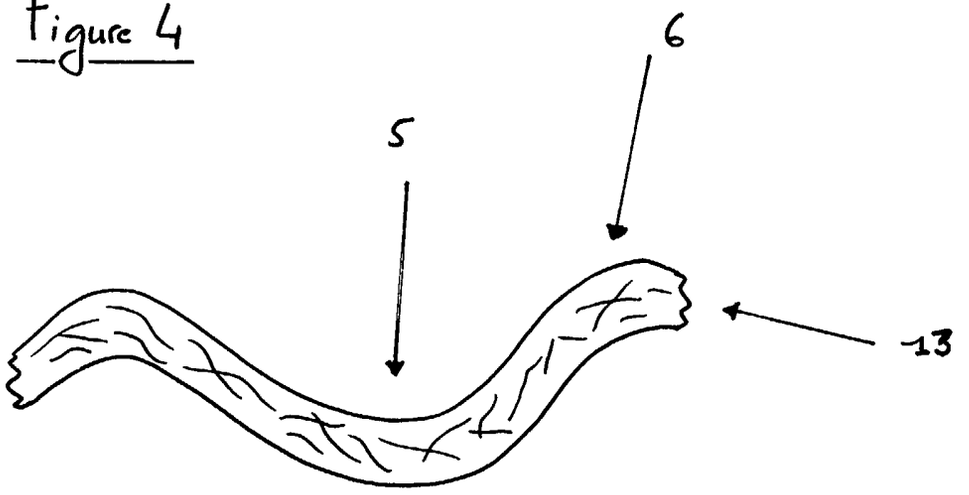
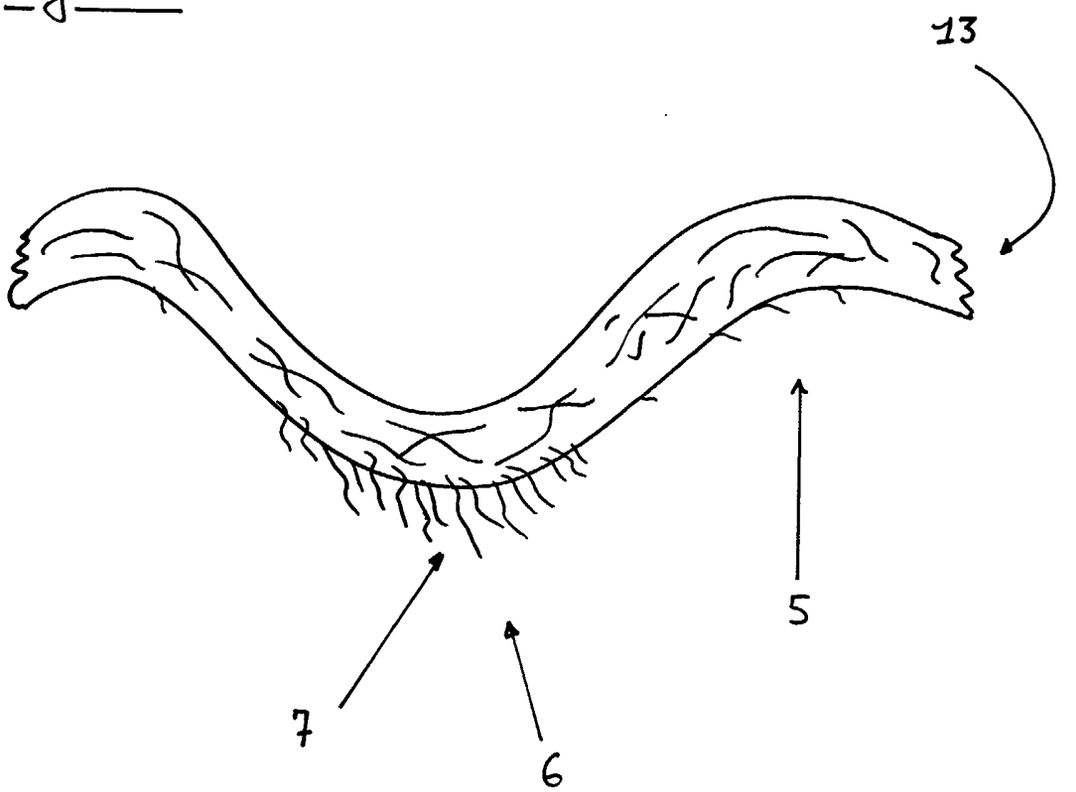


Figure 5



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 01 0577

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 5 990 377 A (LAKE ANDREW MICHAEL ET AL) 23 November 1999 (1999-11-23) * column 27, line 1-37 * * column 36, line 30 - line 40; figure 13 * ---	1-9	D21F11/00 D21F11/14
X	EP 0 668 152 A (KIMBERLY CLARK CO) 23 August 1995 (1995-08-23) * page 4, line 16 - line 21 * * page 6, line 38 - page 7, line 3; figures 3,10 * ---	1-11	
A,D	US 5 180 471 A (JAMAL MUSTAFA M ET AL) 19 January 1993 (1993-01-19) * column 2, line 35 - line 46; figures 1,2 * ---	1,10	
A,D	US 5 702 571 A (BEHNKE JANICA SUE ET AL) 30 December 1997 (1997-12-30) * abstract; figure 6 * -----	1,10	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

D21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	24 September 2002	Pregetter, M

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 01 0577

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The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

24-09-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5990377 A	23-11-1999	AU 6464698 A	20-10-1998
		AU 738012 B2	06-09-2001
		AU 6575798 A	20-10-1998
		BR 9808031 A	08-03-2000
		EP 1236827 A1	04-09-2002
		EP 0969787 A1	12-01-2000
		JP 2001521590 T	06-11-2001
		US 2002103469 A1	01-08-2002
		US 2002107495 A1	08-08-2002
		US 2002099347 A1	25-07-2002
		WO 9842289 A1	01-10-1998
		WO 9842290 A1	01-10-1998
		US 6395957 B1	28-05-2002
		TW 410154 B	01-11-2000
		ZA 9802342 A	22-09-1998
EP 0668152 A	23-08-1995	US 5562805 A	08-10-1996
		AU 690614 B2	30-04-1998
		AU 1231895 A	31-08-1995
		AU 703904 B2	01-04-1999
		AU 5465898 A	11-06-1998
		CA 2116602 A1	19-08-1995
		DE 69506748 D1	04-02-1999
		DE 69506748 T2	22-07-1999
		EP 0668152 A1	23-08-1995
		ES 2127482 T3	16-04-1999
		JP 7258999 A	09-10-1995
		US 5702571 A	30-12-1997
US 5180471 A	19-01-1993	AU 643859 B2	25-11-1993
		AU 9013591 A	16-07-1992
		CA 2052743 A1	10-07-1992
		FR 2672311 A1	07-08-1992
		GB 2251578 A ,B	15-07-1992
		JP 5003835 A	14-01-1993
		MX 9200090 A1	01-01-1993
US 5702571 A	30-12-1997	US 5562805 A	08-10-1996
		AU 690614 B2	30-04-1998
		AU 1231895 A	31-08-1995
		AU 703904 B2	01-04-1999
		AU 5465898 A	11-06-1998
		CA 2116602 A1	19-08-1995
		DE 69506748 D1	04-02-1999
		DE 69506748 T2	22-07-1999
		EP 0668152 A1	23-08-1995

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 01 0577

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

24-09-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5702571 A		ES 2127482 T3	16-04-1999
		JP 7258999 A	09-10-1995

EPO FORM P0459

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