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(54) **METHOD OF FORMING A SIEVE FOR THE WET END SECTION OF A PAPER MACHINE**

VERFAHREN ZUR HERSTELLUNG EINES FORMIERSIEBES FÜR DIE NASSPARTIE EINER PAPIERMASCHINE

PROCEDE PERMETTANT DE FORMER UNE TOILE POUR LA PARTIE HUMIDE D'UNE MACHINE A PAPIER

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Description

[0001] The present invention relates to a method of forming a sieve for the wet end section of a paper machine.

Background to the Invention

[0002] In the conventional Fourdrinier paper-manufacturing method, an aqueous pulp or suspension of cellulose fibres (known as "paper stock") is placed onto the upper surface of a so-called endless web made of wire and/or a synthetic material. This wire web acts as a filter, which causes the cellulose fibres to be separated from the aqueous medium and form a so-called wet-paper sheet. During formation of this wet-paper sheet, the forming sieve acts as a filter which separates the aqueous medium from the cellulose fibres, as the aqueous medium passes through the openings in the sieve.

[0003] To accelerate the removal of the water, the filtering process is very often carried out with the additional action of a vacuum applied to the underside of the sieve, i.e. on the machine side. Once the paper sheet has left the forming end section it is transferred to a press section of the paper machine, at this point it is guided through the gap between a pair, or several pairs, of pressure rollers, over which is stretched another fabric: a so-called "press felt". The pressure of the rollers acting on the paper sheet removes additional moisture, and is frequently enhanced by the presence of a "mat" layer within the press felt. After passing through the pressing section, the paper is sent to a drying section of the machine for further removal of moisture. After drying, the paper is ready for any secondary processing which may be undertaken and finally packing.

[0004] The sieves used in paper-machines are made available as endless webs, and are manufactured by one of two methods. According to the first method, the free ends of individual flat woven webs are connected together by a procedure known as "splicing", and in so doing the endless web is formed. In flat-woven paper-machine sieves formed in this way, the warp threads run in the machine direction, and the filling or weft threads run in the cross direction. According to the second production technique, the paper-machine sieves are directly fashioned in the form of a continuous strip, by the so-called endless-web method. In this method, the warp threads run in the cross direction of the machine, with the weft threads in the machine direction. Within the relevant literature, abbreviations for these terms are commonly used, with MD standing for "machine direction" and CMD for "cross machine direction".

[0005] Within the wet end section of a paper machine, it is extremely important to maintain the cellulose fibres in the suspension on the paper side of the sieve, and to avoid markings within the forming sheet. These markings can occur when individual cellulose fibres are oriented within the paper sheet, such that their ends coincide with interstices between the individual threads of the sieve. In general, an attempt is made to solve this problem by providing a permeable sieve structure which is possessed of a coplanar surface, and which further allows the paper fibres to form a bridge over adjacent threads in the fabric and not penetrate into the interstices between them. As used herein, "coplanar" means that the uppermost parts of the threads, those which define the paper-forming surface of the sieve and are termed floats or knuckles respectively, lie at substantially the same height, so as to present a surface which is substantially "planar". Fine paper, such as that used for high-quality printing, carbonization, cigarettes, electrical capacitors, and other papers of similar quality, has previously been produced on very finely woven sieves, as these present the flattest surfaces.

[0006] In order to make the surface of the cloth as close to planar as possible, particularly in the case of forming sieves, the surfaces are very often ground down with fine-grain emery paper. Such grinding is intended to improve the topography of the paper, and lead to a better final surface. Unfortunately, by grinding the surface in this way, the thread floats and knuckles of a sieve become damaged; this can be seen in Figs. 3 and 4 when compared with Figs. 1 and 2. Fig. 1 shows a section of a forming sieve which has not been processed, that is the floats or knuckles have not been ground with emery paper. Fig. 2 shows a section of the sieve according to Fig. 1, but under greater magnification.

[0007] Figs. 3 and 4 correspond to the photographs shown in Figs. 1 and 2, with the exception that in the sieve according to Figs. 3 and 4, the topography of the paper has been evened out by grinding down the floats or knuckles. Whilst this particular levelling procedure does not reduce the interior volume of the sieve, the thickness is slightly reduced. This has further disadvantageous side effects, in that the stability of the sieve is adversely affected as a result: primarily, the loss of material entails a lower sieve stiffness. Furthermore, it has been found that as a result of this mechanical intervention, the sieve suffers from increased abrasion and hence a shorter operating life. In the case of threads with small diameters, e.g. 0.11 mm to 0.13 mm, the grinding process reduces the cross section of the threads by 30-40%. Such severe mechanical alteration of the threads, and hence of the sieve, can be seen as the root cause of the reduction in sieve stiffness. This is a further problem, as current trends in the paper industry are moving increasingly towards even thinner sieves with correspondingly thinner thread diameters. With this progression, limits are being placed on the mechanical alterations possible in order to produce coplanar sieve surfaces.

[0008] To further elucidate the state of the art as shown in Figs. 1 to 4, reference is also made to Figs. 5 and 6 as well as 7 and 8. Fig. 5 shows the contact surface of a sieve according to Figs. 1 and 2, the untreated sieve, wherein about 30% of the total surface comprises the contact surface of the sieve. Fig. 6 shows the "standard"

shape of floats and knuckles present in an untreated sieve, according to Figs. 1 and 2. Figs. 7 and 8 detail the structure of a ground-down sieve, wherein removal of 0.02 mm from the protruding floats and knuckles, increases the contact surface of the sieve to about 34%. The float or knuckle shape after grinding is shown in Fig. 8.

[0009] WO-A-97/01431 discloses a process for producing a woven papermakers' forming or dryer fabric, wherein the paper contacting surface of the fabric is molded by passing the fabric between two rolls adapted to apply contact pressure to the fabric to optimally smoothen the paper contacting surface of the fabric and egalize caliper variations in the fabric. At least one of the roll is heated to a temperature between about 130°C and about 240°C, and the specific loading used for the molding process varies between about 20 kp/cm^2 and 150 kp/cm^2 (between about 1962 kPa and 14715 kPa).

[0010] An objective of the current invention; is the preparation of sieves that present a highly coplanar surface, at least on the paper side, but preferably on both the paper and machine sides. This is to be achieved, even for sieves that are considerably thinner than those disclosed in the art, and have correspondingly reduced thread diameters. In light of the various problems presented above, this objective is to be achieved in particular for so-called forming sieves, i.e. sieves intended for use in the wet end section of a paper machine.

Summary of the Invention

[0011] The above objective is achieved by the process given in Claim 1, with advantageous further developments and embodiments being described in the subordinate claims.

Detailed Description of One Way of Implementing the Invention.

[0012] The production of sieves for paper machines in the current invention, is based around a system of compacting or "hot calendering" the fabric making up the sieve, in a press arrangement. This action is undertaken at least at one of, or a combination of: an elevated pressure, an elevated temperature and/or at an elevated moisture level, for a specific time; this time being a result of the chosen threads, and the desired properties of the finished product.

[0013] When fabrics which are possessed of an endless structure are employed, that is there are no ends making up a joining seam, they are usually configured with two warp thread systems. The calendering, or compacting, of this fabric is accomplished between at least two rollers, as can be seen in the examples shown in Fig. 9. Whilst three possible structures are shown in this figure detailing apparatus for compacting the fabric, these are not to be considered as limiting the invention in any way, and are shown as examples only.

[0014] Fig. 9b shows the simplest structure, in that only two rollers are provided, between which the fabric is compacted. In order to increase the usable area of the heated roller, which in turn means that the fabric will be in contact with the heat for a greater length of time, a third roller c can be provided as shown in figs. 9 a and Fig. 9 c. Furthermore, these additional rollers can be heatable if further heat application to the fabric is required in the process. The specific number and relative positions of the fabric, can be chosen depending upon the precise requirements of the fabric and the final desired structure at the surface thereof.

[0015] To compact or calender the fabric of the sieve, requires the provision of two rollers which can be brought together and a desired pressure applied between them. These are shown by reference numerals A and B in Fig. 9. Here, the sieve fabric passes between the gap provided between the two rollers, and the required pressure is applied; this pressure, commonly lies between 10 and 40 kPa. The roller A, called a press roller, is formed of a plurality of segments which run along the width of the sieve fabric and can be tuned to provide different pressures across the sieve. This plurality of press rollers, allows the final sieve to be formed with a specific and selectable cross sectional profile.

[0016] As shown in the examples of Fig. 9, at least one of the rollers can be heated, with the temperature lying somewhere between 100-190°C, although it has been found that most processes are undertaken in the range 140-170°C. The specific temperature chosen will depend upon the thread within the fabric, and the final desired structure to the surface of the sieve. It is possible to heat one or both sides of the fabric as it is being compacted, and it is further possible to adjust the temperature profile along the width and length of the fabric during such processing. This will result in a fabric for which, at each point along its length and width, the specific temperature and pressure can be individually tailored to suit the desired final requirements of the sieve in a targeted manner.

[0017] For fabrics that are possessed of two ends, which are joined together via a seam to form the endless structure, the compacting process is a little different. Initially, it is necessary to specifically control the pressures which are applied to the starting and end points of the fabric. This is achieved by providing a ramp control to the applied pressure, wherein the machine is aware of the start and end points to the fabric, and thus a process is achieved which suffers from no transitions. All other processing of the fabric follows the method detailed above for the preformed endless fabric.

[0018] The specific tension applied to the fabric during the calendering process, whether preformed or one with a seam, is dependent upon the individual fabric design. During the compacting process the fabric will change its length by up to $\pm$ 1.5%, a fact which requires taking into account at the fabric forming stage and prior to the calendering process. Furthermore, changes to the width of the fabric, which lie in the range 0-3% are generally monitored, and compensated for with simultaneous thermal

treatment of the fabric.

[0019] As shown in Fig. 9c, an additional drying unit can be provided which applies heat to the fabric after the compacting process. This is shown in the figure as being provided by a heat box with a tenter for drying the fabric over. Clearly, other options exist for this drying stage, and are not limited to that disclosed in the drawings.

[0020] The threads which form the fabric of the sieves can comprise or contain a polymer such as one, or a combination of: a polyester, a polyamide and/or a polyolefin. Furthermore, the calendering process as disclosed can readily be implemented on sieves which have warp threads present on the paper side with a diameter of between 0.09 and 0.20 mm, and machine-side warp threads having a diameter of between 0.15 and 0.30 mm. In particular the paper side threads are chosen with a diameter of 0.13mm and the machine-side threads with a diameter of about 0.18 mm. Additionally, the compressive process can be used on fabrics which are possessed of one or multiple layers.

[0021] As is shown in Figs. 10 and 11, the fabrics processed according to the current invention, have a substantially different structure to those processed with the conventional grinding techniques. The knuckles or floats of the interwoven threads, can be seen to have a compacted or flattened shape on the side facing the paper and/or the papermaking machine. The key difference here, however, is that the floats or knuckles are not mechanically damaged as they are when ground down; compare Fig. 11 with Fig. 4. In addition to this, there is the further advantage that the calendered fabric has no loss of material, as Fig. 12 shows when compared with Fig. 8, which removes the problems associated with the sieves having a reduced stiffness.

[0022] The protruding knuckles or floats, can be seen in Figs. 10 and 11 to be somewhat flattened as a result of the compacting. This produces a relatively broad "thread ellipse", which will run quietly within the paper machine as the fabric moves. As a result of this "thread ellipse", the width of the permanently flattened floats and knuckles is greater than the diameter of the remainder of the thread, which is best observed in Fig. 11. Indeed, it is preferable that the width of the flattened floats and knuckles be about 5-15% greater than the diameter of the remainder of the thread. Furthermore, the height of the flattened floats and knuckles is reduced by about 10-30%, and preferably is approximately 20% less than the diameter of the remainder of the thread. That is, compacting has reduced the diameter by about 30-50%.

[0023] By compacting the threads in the fabric of the sieve at the float or knuckle points, the contact area of the sieve with the paper is increased by around 25-30%, when compared with an untreated sieve. This increase, leads to a sieve which is possessed of a contact area that is around 40-45% of the total area of the sieve. Such a measurement can be seen in Fig. 4, wherein a treated fabric is shown to have a contact area of 41 % of its total surface area. Comparing Fig. 13 with both of Figs. 5 and 7, it is clear that the current invention shows greatly improved surface characteristics to the fabric over the prior art techniques.

[0024] In addition to the increase in contact area for the calendered fabrics, these sieves have much smoother surfaces, when compared with untreated or ground fabrics, which leads to a much improved final paper topography. Moreover, a sieve which has appropriately compacted floats on the paper-machine side in addition to the paper side, shows no different weft knuckle heights when the fabric is loaded, as would be caused by different materials: this again improves the final paper surface as the knuckle heights are reduced on the paper machine side, other problems associated with new sieves running on the machine are dramatically reduced. Of such problems, the most significant are those associated with the load which needs to be supported by the paper machine, and the starting up of the machine with a new sieve that has not been properly run-in. In particular, as a result of the broad, already formed, "thread ellipse", a sieve which is adapted to the machine is more rapidly obtained. In a papermaking machine a sieve which is constructed in accordance with the present invention, can start up more rapidly, it requires less subsequent adjustment and begins quiet running sooner, this is when compared with currently employed sieves.

[0025] Sieves with the float or knuckle shape in accordance with the invention, exhibit no, or at least greatly reduced, differences at the transition point between the seam region and the solid fabric. This leads to the sieves producing no marking on topographically sensitive kinds of paper. As a result of the slightly broader and flatter float shapes, the sieve exhibits higher stability and stiffness, because the interwoven threads are displaced less with respect to one another.

[0026] Clearly, the process of calendering a fabric leads to a permanent reduction in the fabric thickness as a result of the applied pressure. Depending upon the specific treatment applied, the thickness of the fabric can be reduced by between 1 and 20% of the original. In order to achieve this, the inflection heights and shapes of the individual threads running through the fabric are permanently altered. As there is no loss of material in this technique, merely a compressing, the weight per unit area of the fabric remains constant.

[0027] In addition to the geometry of the threads within the sieve being altered after calendering, the internal volumes within the body of the fabric are permanently reduced. Obviously, when the fabrics are compressed and the thread geometry adjusted, it is necessary for the threads to move somewhere, and in this case there is a reduction in the void size lying between them as they are brought closer together. This reduction in cavity size between the fibres has advantageous effects for the sieves as they run on the paper making machines. When the sieve is being used to hold the paper stock as the aqueous medium is being removed, it is possible for the cavities within the fabric to induce turbulence as they move.

Such turbulence often produces the unwanted side effect of dragging water along with the cavities, as the sieve moves through the machine. Clearly, if the water remains within the sieve, the drying of the paper stock is adversely affected. With the reduction in cavity size associated with fabrics treated by the current process, however, the problems associated with turbulence and water logging are lessened. Once again, depending upon the specific fabric and treatment thereto, the cavities can be reduced in size by between 1 and 15%.

[0028] Further advantages result from the change in inflection points between the threads in the fabric, and from their altered geometry. With the increase in contact surface area to the fabric, there is a related increase to the level of friction between the sieves and the paper forming machine. This leads to a reduced delay in the movement of the fabric when the machinery is initially started, and further reductions in the transverse motion whilst the machine is running. Such improvements increases the efficiency of the paper drying process, whilst additionally requiring less adjustment to the belts with prolonged usage. Moreover, in the seam regions where present, the thread-thread friction is increased with this change in the inflection between the warp and weft threads, the result being an increase in the seam stability and strength.

[0029] Standard, that is un-calendered, sieves which are formed with a seam, will tend to suffer from inconsistencies in the thickness of the fabric between the regions of the seam and the main body of the fabric. This difference in surface properties can have adverse effects on the paper production, leading to marking of the page, and will also lead to an increased level of wear in this region. The compressing techniques of the current invention, however, alleviate these problems by giving a fabric which has a uniform thickness along its entire length. Furthermore, internal stresses and tensions on the fabric threads which result from these inconsistencies in the un-treated sieves, are substantially equalised in the fabric calendered in accordance with the present invention.

[0030] A final property of the fabric that is altered with the compressive treatment, is that of the permeability. It is assumed that it is the compaction of the fabric, giving the reduction in fabric thickness with corresponding changes to the void size and density, which leads to this difference. Dependent upon the initial fabric, and the treatment done thereto, the permeability can be reduced from between 0 and 30%, and this is usually taken into consideration when the specific processing and fabric are being chosen.

Claims

1. A method of forming a sieve for the wet end-section of a paper machine, comprising the step of:

   calendering a woven sieve fabric with a plurality of rollers at one, or a combination of more than one, of:

   temperature, pressure and/or moisture, so as to permanently reshape the thread inflection regions at least on the paper-side of the sieve, so that

   as a result of the thread inflection regions being reshaped, the void size laying between the threads is reduced by between 1% and 15% from the original void size prior to inflection region reshaping.

2. The method according to claim 1, wherein at least one of the plurality of rollers is formed from a plurality of segments which can be individually adjusted to change the pressure exerted on the fabric, so that the resulting sieve has a tailored cross sectional profile across its width.

3. The method according to any of claims 1 and 2, wherein at least one of the plurality of rollers can be heated to apply a specific heat to the sieve during processing, and the temperature can be changed along the length of the roller to apply a specific profile to the sieve.

4. The method according to any of claims 1 to 3, wherein the pressure lies between 10 kPa and 40 kPa.

5. The method according to any of claims 1 to 4, wherein the temperature lies between 100°C and 190°C.

6. The method according to any of claims 1 to 5, wherein the temperature lies between 150°C and 170°C.

7. The method according to any of the claims 1 to 6, n wherein the sieve comprises upper machine-direction (MD) and cross-machine-direction (CMD) threads facing the paper side and lower MD and CMD threads facing the machine, and the threads on the paper side have a diameter of between 0.09mm and 0.20mm, and the machine-side threads have a diameter of between 0.15mm and 0.30mm.

8. The method according to claim 7, wherein the threads on the paper side have a diameter of 0.13mm, and the machine-side threads have a diameter of 0.18mm.

9. The method according to any of the claims 1 to 8, wherein the width of the paper side thread floats or knuckles is greater than the diameter of the remainder of the thread, by between 5% and 15%.

10. The method according to any of the claims 1 to 8, wherein the height of paper side the thread floats or

knuckles is between 10% and 30% less than the diameter of the remainder of the thread.

11. The method according to claim 10, wherein the height of the paper side thread floats or knuckles is 20% less than the diameter of the remainder of the thread.

12. The method according to any of the claims 1 to 11, wherein the paper side thread floats or knuckles comprise flat "thread ellipses" extending approximately parallel with the plane of the sieve.

13. The method according to any of the claims 1 to 12, wherein the total contact area of the sieve with the paper is about 40 to 45% of the total surface area of the sieve.

14. The method according to any of the claims 1 to 13, wherein one, or a combination of more than one, of:

the thread inflection shape, the width of the paper side thread floats or knuckles, the height of the paper side thread floats or knuckles, the degree of ellipticity of the threads, the total contact area of the sieve with the paper and the void size lying between the threads varies across each point of the sieve's width.

Patentansprüche

1. Verfahren zum Ausbilden eines Siebes für eine Nassendsektion einer Papiermaschine, welches die Schritte umfasst:

Kalandrieren einer gewebten Siebstruktur mit einer Mehrzahl von Rollen bei oder bei einer Kombination von:

einer Temperatur, einem Druck und/oder einer Feuchtigkeit, so dass Fadenkröpfungsbereiche zumindest auf der Papierseite des Siebes permanent neu geformt werden, so dass
resultierend aus den neu geformten Fadenkröpfungsbereichen, die Lochgrösse, welche zwischen den Fäden liegt, um etwa zwischen 1% und 15% zu der ursprünglichen Lochgrösse vor der Neuformung der Kröpfungsbereiche reduziert wird.

2. Verfahren nach Anspruch 1, bei welchem zumindest eine der Mehrzahl von Rollen aus einer Mehrzahl von Segmenten ausgebildet wird, welche individuell derart eingestellt werden können, um den an die Struktur angelegten Druck zu ändern, so dass das resultierende Sieb über seine Breite ein zugeschnittenes Querschnittsprofil hat.

3. Verfahren nach Anspruch 1 oder 2, bei welchem zumindest eine der Mehrzahl von Rollen erwärmt werden kann, um während der Verarbeitung eine spezifische Wärme an das Sieb anzulegen, und wobei die Temperatur entlang der Länge der Rolle geändert werden kann, um dem Sieb ein spezifisches Profil zu vermitteln.

4. Verfahren nach einem der Ansprüche 1 bis 3, bei welchem der Druck zwischen 10 kPa und 40 kPa beträgt.

5. Verfahren nach einem der Ansprüche 1 bis 4, bei welchem die Temperatur zwischen 100°C und 190°C beträgt.

6. Verfahren nach einem der Ansprüche 1 bis 5, bei welchem die Temperatur zwischen 150°C und 170°C beträgt.

7. Verfahren nach einem der Ansprüche 1 bis 6, bei welchem das Sieb obere Maschinenrichtungs-(MD) und Maschinenquerrichtungs-(CMD)-Fäden, welche der Papierseite zugewandt sind, und untere MD- und CMD-Fäden, welche der Maschine zugewandt sind, enthält, und wobei die papierseitigen Fäden einen Durchmesser zwischen 0,09 mm und 0,20 mm haben und die maschinenseitigen Fäden einen Durchmesser zwischen 0,15 mm und 0,30 mm haben.

8. Verfahren nach Anspruch 7, bei welchem die Fäden auf der Papierseite einen Durchmesser von 0,13 mm haben und die Fäden auf der Maschinenseite einen Durchmesser von 0,18 mm haben.

9. Verfahren nach einem der Ansprüche 1 bis 8, bei welchem die Breite der Flottierfäden oder Schlaufen auf der Papierseite zwischen 5% und 15% grösser ist als der Durchmesser der restlichen Fäden.

10. Verfahren nach einem der Ansprüche 1 bis 8, bei welchem die Höhe der Flottierfäden oder Schlaufen auf der Papierseite zwischen 10% und 30% kleiner ist als der Durchmesser der restlichen Fäden.

11. Verfahren nach Anspruch 10, bei welchem die Höhe der Flottierfäden oder Schlaufen auf der Papierseite 20% kleiner ist als der Durchmesser der restlichen Fäden.

12. Verfahren nach einem der Ansprüche 1 bis 11, bei welchem die Flottierfäden oder Schlaufen auf der Papierseite flache "Fadenellipsen" enthalten, welche sich etwa parallel zur Siebebene erstrecken.

13. Verfahren nach einem der Ansprüche 1 bis 12, bei welchem der gesamte Kontaktbereich des Siebes mit dem Papier etwa 40 bis 45% des gesamten Flächenbereichs des Siebes beträgt.

14. Verfahren nach einem der Ansprüche 1 bis 13, bei welchem eines oder eine Kombination von mehr als einem gilt aus:

die Fadenkröpfungsform, die Breite der Flottierfäden oder Schlaufen auf der Papierseite, die Höhe der Flottierfäden oder Schlaufen auf der Papierseite, der Elliptizitätsgrad der Fäden, der gesamte Kontaktbereich des Siebes mit dem Papier, und die Lochgrösse, welche zwischen den Fäden liegt variiert über jeden Punkt der Breite des Siebes.

Revendications

1. Procédé pour former un tamis pour la section d'extrémité humide d'une machine à papier, comprenant l'étape de :

calandrage d'un étoffe de tamis tissée avec une pluralité de rouleaux à un, ou une combinaison de plus d'un, de :

la température, la pression et/ou l'humidité, de manière à reformer de façon permanente les régions d'inflexion de fil au moins sur le côté papier du tamis, de sorte que en conséquence du fait que les régions d'inflexion filetées sont reformées, la taille du vide s'étendant entre les fils est réduite d'entre 1 % et 15 % par rapport à la taille de vide originelle avant le reformage de la région d'inflexion.

2. Procédé selon la revendication 1, dans lequel au moins l'un de la pluralité de rouleaux est formé à partir d'une pluralité de segments qui peut être ajustée individuellement pour modifier la pression exercée sur l'étoffe, de sorte que le tamis résultant ait un profil de section transversale adapté sur toute sa largeur.

3. Procédé selon l'une quelconque des revendications 1 et 2, dans lequel au moins l'un de la pluralité de rouleaux peut être chauffé pour appliquer une chaleur spécifique au tamis pendant le traitement, et la température peut être modifiée le long de la longueur du rouleau pour appliquer un profil spécifique au tamis.

4. Procédé selon l'une quelconque des revendications 1 à 3, dans lequel la pression est comprise entre 10 kPa et 40 kPa.

5. Procédé selon l'une quelconque des revendications 1 à 4, dans lequel la température est comprise entre 100 °C et 190 °C.

6. Procédé selon l'une quelconque des revendications 1 à 5, dans lequel la température est comprise entre 150 °C et 170 °C.

7. Procédé selon l'une quelconque des revendications 1 à 6, dans lequel le tamis comprend des fils de direction machine (MD) et de direction transversale (CMD) supérieurs sur le côté papier et des fils MD et CMD inférieurs sur le côté machine, et les fils côté papier ont un diamètre compris entre 0,09 mm et 0,20 mm, et les fils côté machine ont un diamètre compris entre 0,15 mm et 0,30 mm.

8. Procédé selon la revendication 7, dans lequel les fils côté papier ont un diamètre de 0,13 mm, et les fils côté machine ont un diamètre de 0,18 mm.

9. Procédé selon l'une quelconque des revendications 1 à 8, dans lequel la largeur du fil côté papier qui flotte ou se croise est supérieure au diamètre du reste du fil, d'entre 5 % et 15 %.

10. Procédé selon l'une quelconque des revendications 1 à 8, dans lequel la hauteur du fil côté papier qui flotte ou se croise est inférieure de 10 % à 30 % au diamètre du reste du fil.

11. Procédé selon la revendication 10, dans lequel la hauteur du fil côté papier qui flotte ou se croise est de 20 % inférieure au diamètre du reste du fil.

12. Procédé selon l'une quelconque des revendications 1 à 11, dans lequel le fil côté papier qui flotte ou se croise comprend des « ellipses de fil » plates s'étendant approximativement en parallèle au plan du tamis.

13. Procédé selon l'une quelconque des revendications 1 à 12, dans lequel la surface de contact totale du tamis avec le papier est d'environ 40 à 45 % de la surface totale du tamis.

14. Procédé selon l'une quelconque des revendications 1 à 13, dans lequel un, ou une combinaison de plus d'un, de :

la forme d'inflexion de fil, la largeur du fil côté papier qui flotte ou se croise, la hauteur du fil côté papier qui flotte ou se croise, le degré d'ellipticité des fils, la surface de contact totale du tamis avec le papier et la taille de vide s'étendant entre les fils varie le long de chaque point de la largeur du tamis.

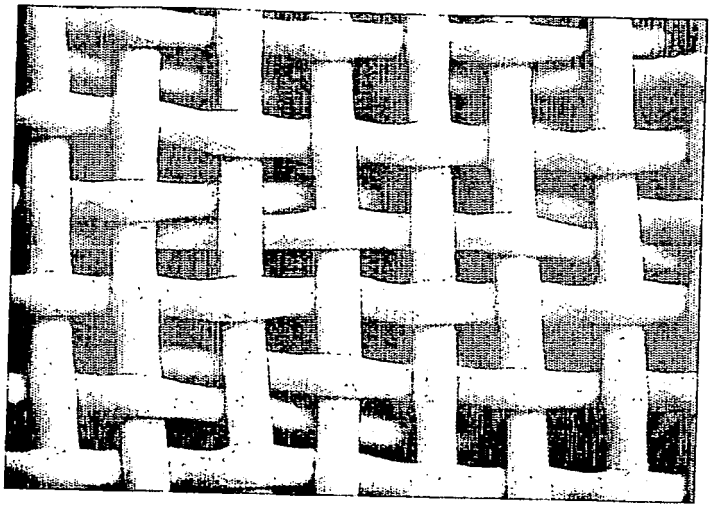


Fig. 1

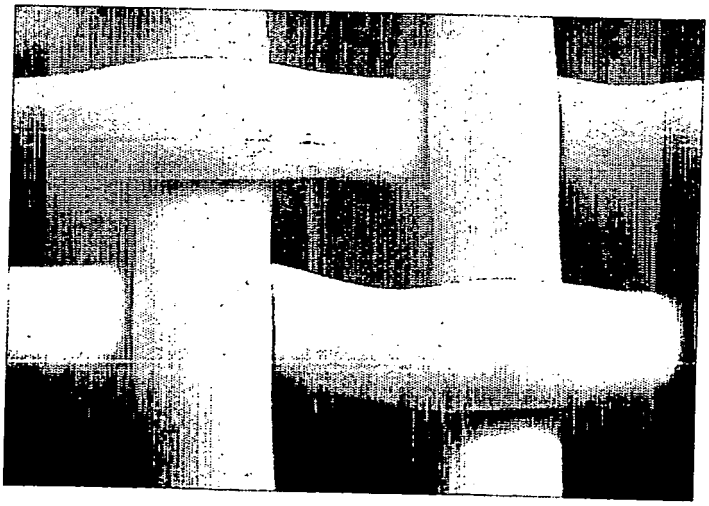


Fig. 2

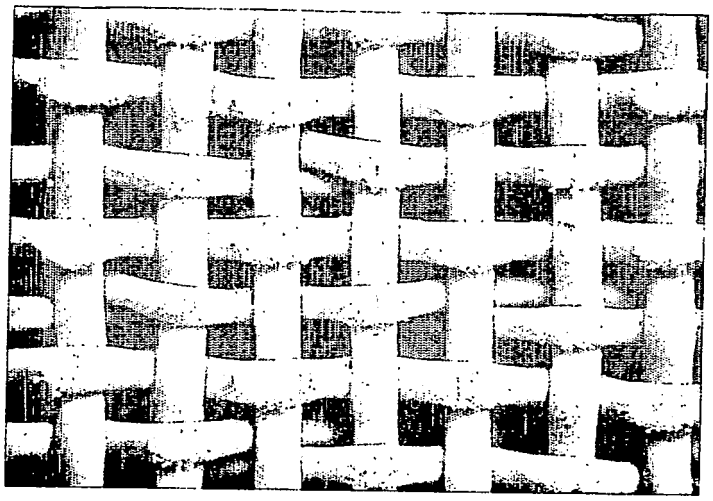


Fig. 3

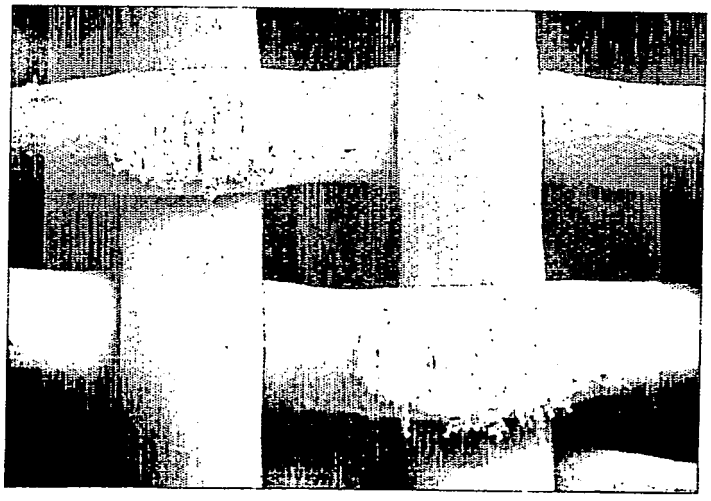


Fig. 4

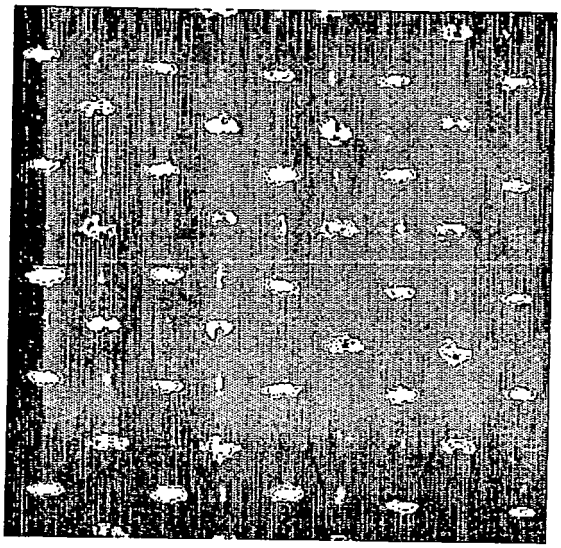


Fig. 5

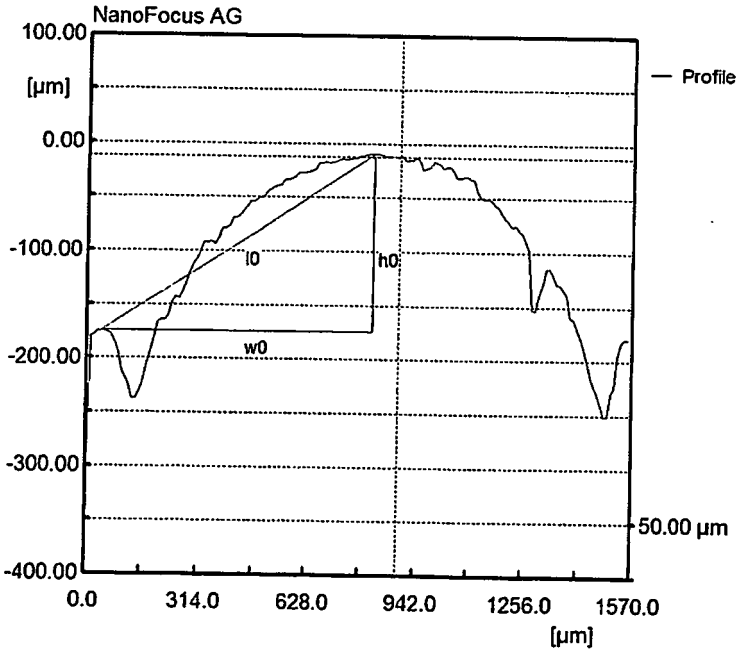

NanoFocus AG
100.00
[µm]
0.00
-100.00
-200.00
-300.00
-400.00
0.0
314.0
628.0
942.0
1256.0
1570.0
[µm]
Profile
50.00 µm
l0
h0
w0

Fig. 6

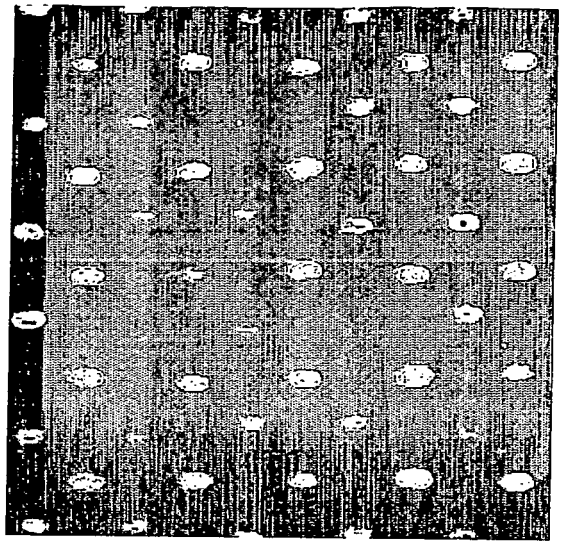


Fig. 7

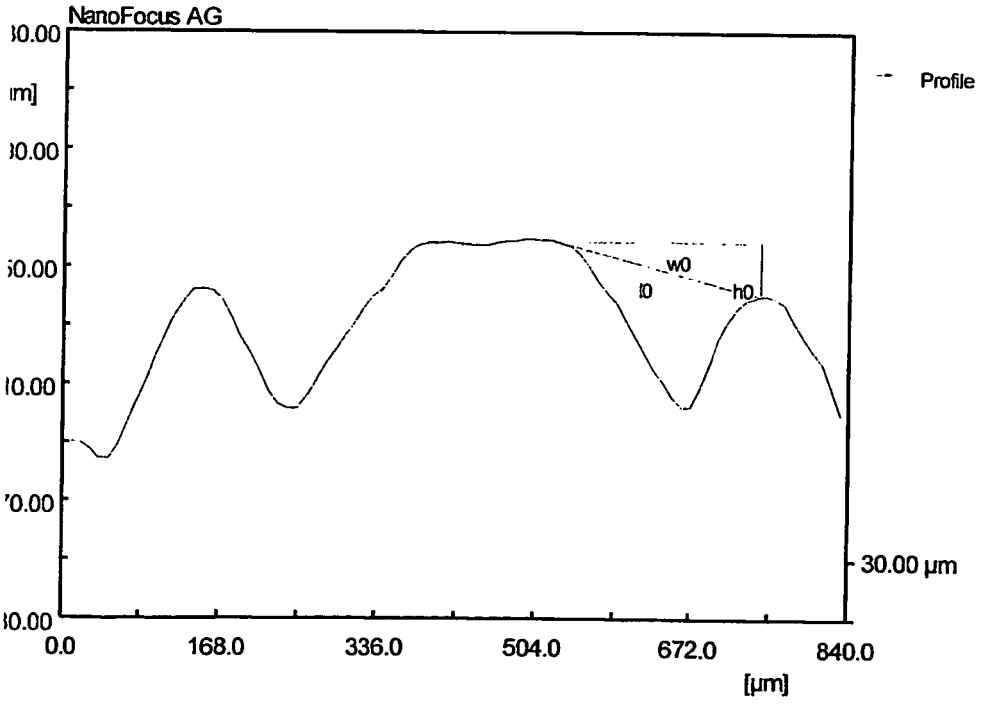
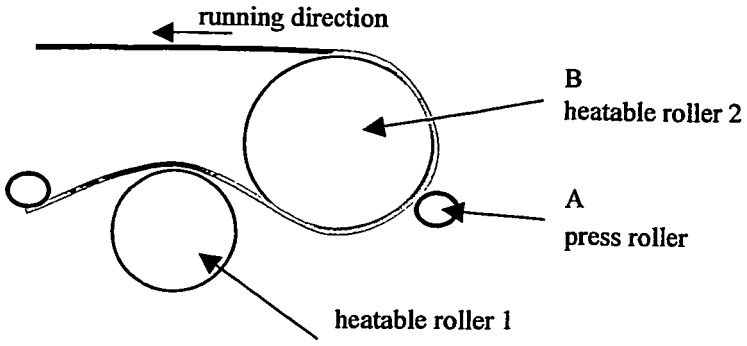
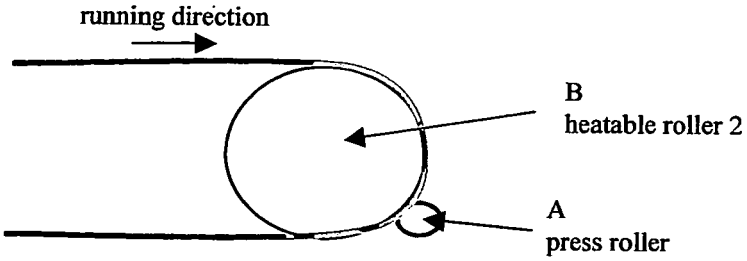

NanoFocus AG
Profile
w0
h0
30.00 µm
0.0
168.0
336.0
504.0
672.0
840.0
[µm]

Fig. 8

a


running direction
B
heatable roller 2
A
press roller
heatable roller 1

b


running direction
B
heatable roller 2
A
press roller

c

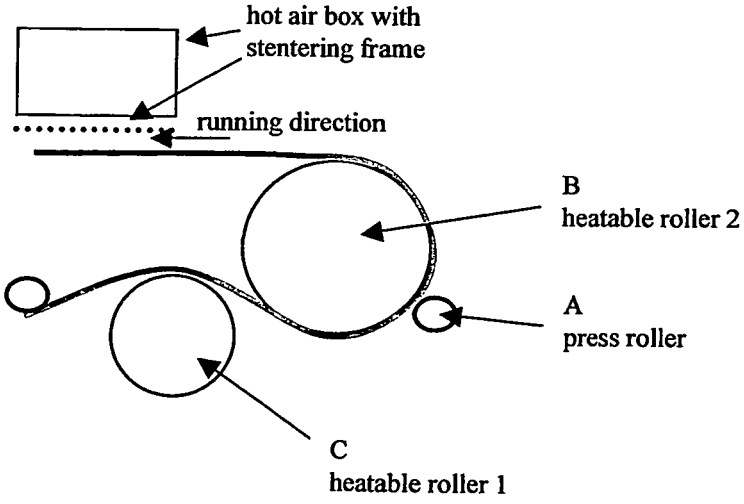

hot air box with
stentering frame
running direction
B
heatable roller 2
A
press roller
C
heatable roller 1

Fig. 9

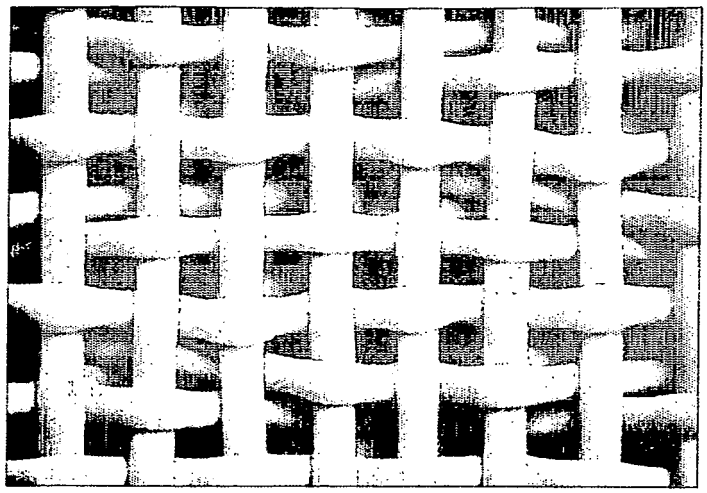


Fig. 10

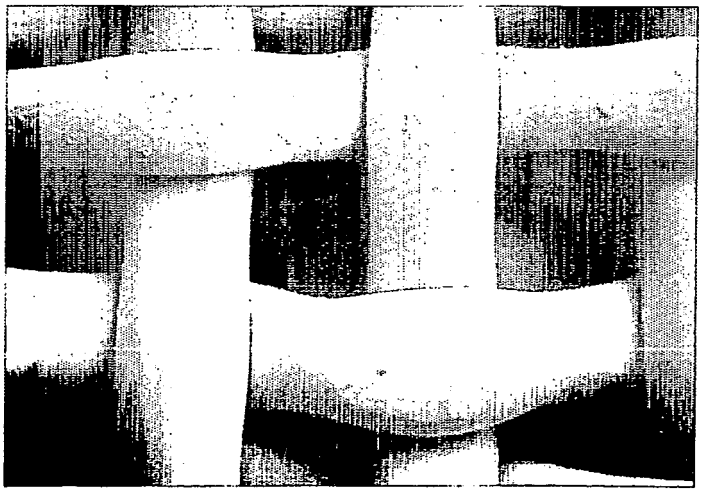


Fig. 11

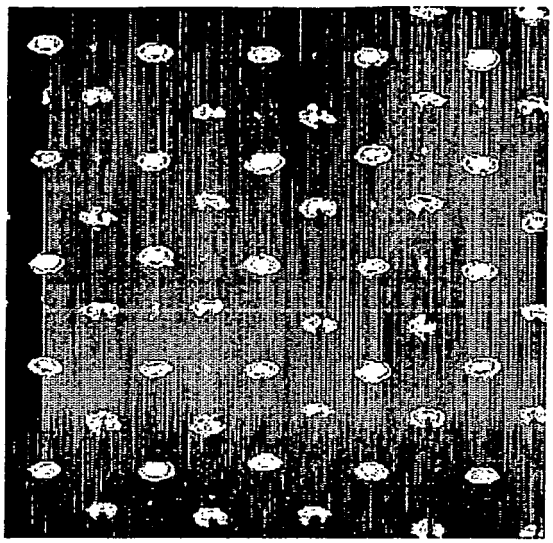


Fig. 12

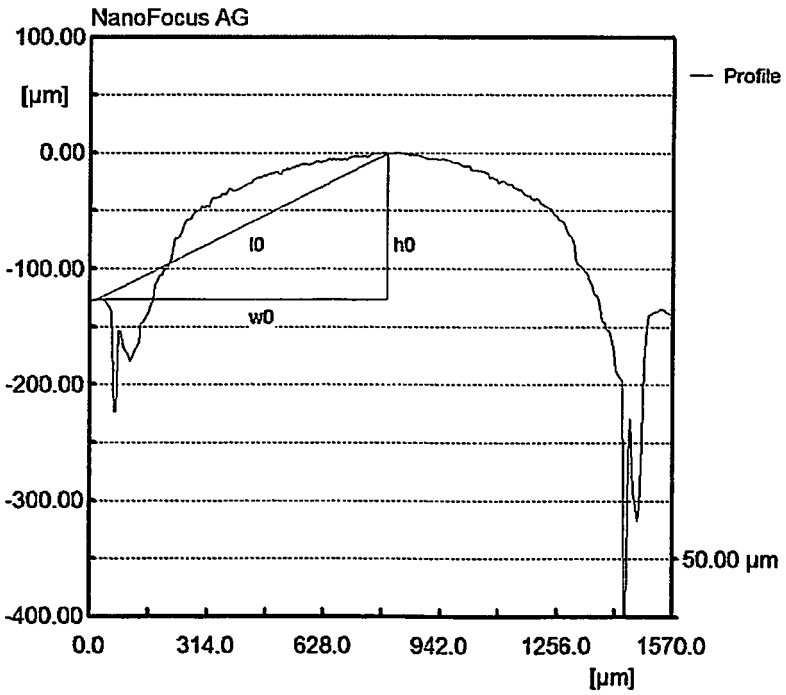

NanoFocus AG
100.00
[µm]
0.00
-100.00
-200.00
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-400.00
0.0
314.0
628.0
942.0
1256.0
1570.0
[µm]
Profile
l0
h0
w0
50.00 µm

Fig. 13

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 9701431 A **[0009]**