(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 330 573 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
24.05.2006 Bulletin 2006/21

(21) Application number: **01969838.0**

(22) Date of filing: **21.09.2001**

(51) Int Cl.:
D21G 1/00 *(2006.01)*

(86) International application number:
PCT/FI2001/000827

(87) International publication number:
WO 2002/029159 (11.04.2002 Gazette 2002/15)

(54) **METHOD AND ARRANGEMENT FOR CALENDERING A WEB COMPRISING A LONG-NIP CALENDER**

VERFAHREN UND ANORDNUNG ZUM KALANDRIEREN EINER BAHN MIT LANGSPALTKALANDER

PROCEDE DE CALANDRAGE D'UNE FEUILLE CONTINUE ET SYSTEME ASSOCIE COMPORTANT UNE CALANDRE A GRANDE LONGUEUR DE CONTACT

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR

(30) Priority: **02.10.2000 FI 20002170**

(43) Date of publication of application:
30.07.2003 Bulletin 2003/31

(73) Proprietor: **Metso Paper, Inc.**
00130 Helsinki (FI)

(72) Inventors:
- **LARES, Matti**
  FIN-00240 Helsinki (FI)
- **TANI, Mikko**
  Appleton, WI 54913 (US)
- **SAHARINEN, Kimmo**
  FIN-04400 Järvenpää (FI)
- **VAITTINEN, Henri**
  FIN-04400 Järvenpää (FI)
- **KOIVUKUNNAS, Pekka**
  FIN-04430 Järvenpää (FI)
- **PIETIKÄINEN, Reijo**
  FIN-04420 Järvenpää (FI)

(74) Representative: **TBK-Patent**
Bavariaring 4-6
80336 München (DE)

(56) References cited:
WO-A1-98/44196 **US-A- 5 329 847**

EP 1 330 573 B1

Description

[0001] The present invention relates to a method for calendering a material web and a calender arrangement for implementing the method.

[0002] The object of the invention is a method for calendering a material web, especially a paper or board web, in a long-nip calender, in which the backing roll of the long-nip roll is a heated, metal-surfaced roll, in which case the length of the nip in the direction of travel of the material web is within the range from approximately 10 mm to 500 mm. The invention also relates to a calender arrangement for calendering a material web, especially a paper or board web, the said arrangement comprising a long-nip calender, in which the backing roll of the long-nip roll is a heated, metal-surfaced roll, the rolls of which form a long nip between them, the length of which in the direction of travel of the web is within the range from approximately 10 mm to 500 mm.

[0003] In improving the quality of calendering, in practice the only possibility has previously been to increase the number of calendering nips, which has resulted in a more complex calender structure and more difficult paper web control and threading. Attempts have been made to solve these problems by using various belt and shoe calenders, by means of which the calendering nip is lengthened, and thus the operation of the nip is enhanced. For example, paper calendered with belt calenders is brought by means of an endless belt into initial contact with a hot calender roll, whereby a steep temperature gradient advantageous to calendering can be achieved. By means of the belt, the effective length of the nip increases due to the initial contact and because it is possible to use much softer polymers as belt material than in roll coatings without problems arising from deformation due to heat. By means of a nip longer than that in a super- or softcalender, the pressure impulse directed at the paper can be increased without the pressure peak becoming too great and the bulkiness beginning to diminish.

[0004] A belt calendering solution has been previously described, for example, in Finnish patent publication no. 95061 and in WO- 98 00270, in which the calendering nip is formed between a heated, hard-surfaced roll and a metal belt supported by means of a calender roll having a resilient coating. One disadvantage of this solution is that the maximum nip pressure is insufficient for several paper grades requiring a high degree of calendering.

[0005] One aim of the present invention is to achieve a solution by means of which calendering can be carried out between two hard surfaces without the disadvantages relating to conventional machine calendering, such as relatively great variations in gloss and a decrease in bulk. These disadvantages are caused by the relatively high nip pressure used in machine calendering, which is typically of the order of approximately 100 MPa.

[0006] To achieve the aims of the present invention, the method relating to the invention is characterised in that as a long-nip roll is used a roll, the mantle of which is made of metal, at least as concerns its calendering, longitudinal, central area; that in the method, a nip pressure within the range from about 0.1 MPa to about 50 MPa is directed at the material web W, and that the surface temperature of the rolls before the nip N is adjusted to a value from about 60°C to about 350°C. The nip pressure is preferably within the range from about 0.2 MPa to about 15 MPa, and the surface temperature is preferably within the range from about 120°C to about 300°C. Compared with machine calendering, by means of the solution relating to the invention is achieved, among other things, more uniform gloss, preservation of bulk and good smoothness.

[0007] The calender arrangement relating to the invention is in turn characterised in that the mantle of the long-nip roll is made of metal, at least as concerns its calendering, longitudinal, central area.

[0008] The invention is described in greater detail in the following, with reference to the accompanying drawings, in which

Figure 1 shows a diagrammatic view of the long-nip calender arrangement relating to the invention, as seen from the end, and

Figure 2 shows a diagrammatic perspective view of an embodiment of a belt mantle of a long-nip roll applicable to the calender arrangement relating to the invention.

Figure 3 shows a diagrammatic view of another embodiment of a belt mantle of a long-nip roll applicable to the calender arrangement relating to the invention, as seen from the end.

[0009] According to Figure1, the calender arrangement relating to the invention comprises a shoe roll 15, in which on a stationary axle 16, at the nip N, is arranged a loading member 17, which comprises a shoe part 19 extending over the width of the nip (in the longitudinal direction of the roll), and the pistons 20 loading it. Around the shoe 19 runs a belt mantle 30, which is made of metal, at least in its calendering central area, as shown in Figure 2.

[0010] In the embodiment shown in Figure 2, the central area of the belt mantle 30 is comprised of a steel belt 31, which extends over the length of the shoe 19, and to it are connected end sections 32 made of resilient material, which may be, for example, polymer, rubber, silicone, etc. The end sections 32 are connected to the steel belt 31 in a flexible manner, for example, by glueing or curing. The connection is made at a point outside the shoe part 19 to avoid directing a fatiguing load on the steel belt.

[0011] The steel belt 30 can also be made completely of metal, for example, by providing the end sections of the belt mantle with elastic sealing rings, which are fitted to rotate with the said mantle, as described in Finnish patent no. 66932.

[0012] Figure 3 shows a solution in which a thin-walled metal cylinder 41 is fitted over the polymer belt 40 of a shoe roll 15, the cylinder being tightened in place by means of the internal air pressure of the roll. The length of the cylinder 41 is the same as the width of the material web and it is not fixed to the end structures of the shoe roll, whereby loading causing fatigue in metal materials is avoided in the edge area of the shoe.

[0013] Between the long-nip roll 15 and its heated, metal-surfaced backing roll 11 is formed a long nip N, through which the material web W is guided, in order to calender it. At the web is directed a nip pressure which is within the range from about 0.1 to about 50 MPa, preferably within the range from about 0.2 to about 15 MPa, which is considerably less than the pressure used in normal machine calendering, which is of the order of 100 MPa. The surface temperature of the rolls before the nip N is adjusted to a value from about 60°C to about 350°C, and preferably to a value from about 120°C to about 300°C, when the surface temperature used in conventional machine calendering is typically within the range from about 60°C to about 120°C.

[0014] The length of the nip N in the direction of travel of the material web is preferably within the range from about 10 mm to about 500 mm. The surface roughness R_a of both the steel belt 30 of the long-nip roll 15 and of the outer surface of the backing roll 11 is preferably less than 0.3 μm, whereby the material web W can be subjected to gloss treatment. The calender arrangement relating to the invention can also be used for one-sided or both-sided mat drive by using a sufficiently high R_a value for the steel belt and/or the surface of the backing roll, for example, within the range R_a = about 0.4 to about 2.0 μm.

[0015] The solution relating to the invention is applicable to both on-line use and off-line use. It is conceivable to use the calender arrangement relating to the invention, for example, on the press section for drying the material web, for pre-calendering before the coating machine and for final calendering after the coating machine.

[0016] When using the apparatus relating to the invention in the dryer section of a paper machine, the paper machine can be shortened by leaving a part of the drying cylinder out.

Claims

1. A method for calendering a material web (W), especially a paper or board web, in a long-nip calender, in which the backing roll (11) of the long-nip roll (15) is a heated roll, in which case the length of the nip (N) in the direction of travel of the material web (W) is within the range from approximately 70 mm to 270 mm, **characterised in that** as a long-nip roll (15) is used a roll, the mantle (30) of which is made of metal at least as concerns its calendering, longitudinal, central area (31); that in the method, a nip pressure within the range from about 0.1 MPa to about 50 MPa is directed at the material web (W), and that the temperature of the rolls (11, 15) before the nip (N) is adjusted to a value from about 60°C to about 350°C.

2. A method as claimed in claim 1, **characterised in that** the nip pressure is within the range from about 0.2 MPa to about 15 MPa, and that the surface temperature of the rolls before the nip (N) is within the range from about 120°C to about 300°C.

3. A method as claimed in claim 1 or 2, **characterised in that** in the method are used rolls (11, 15), the surface roughness R_a of the outer surface of the mantle of which is less than 0.3 μm.

4. A method as claimed in any of the above claims, **characterised in that** in the method is used a long-nip roll (15), the belt mantle (30) of which is made completely of metal.

5. A calender arrangement for calendering a material web (W), preferably a paper or board web, the arrangement comprising a long-nip calender, in which the backing roll of the long-nip roll (15) is a heated, metal-surfaced roll (11), the rolls (11, 15) of which form a long nip (N) between them, the length of the nip in the direction of travel of the material web (W) being within the range from approximately 70 mm to 270 mm, **characterised in that** the mantle (30) of the long-nip roll (15) is made of metal at least as concerns its calendering, longitudinal, central area (31).

6. A calender arrangement as claimed in claim 5, **characterised in that** the central area of the belt mantle (30) is comprised of a steel belt (31), on the edges of which are flexibly connected end sections (32) made of a resilient non-metallic material.

7. A calender arrangement as claimed in claim 6, **characterised in that** the end sections (32) are connected to the steel belt (31) by glueing or curing.

8. A calender arrangement as claimed in claim 5, **characterised in that** the belt mantle (30) is made completely of metal.

9. A calender arrangement for calendering a material web (W), preferably a paper or board web, the said arrangement comprising a long-nip calender, in which the backing roll of the long-nip roll (15) is a heated, metal-surfaced roll (11), the rolls (11, 15) of which form a long nip (N) between them, the length of which in the direction of travel of the web (W) is within the range from approximately 10 mm to 500 mm, **characterised in that** the mantle of the long-

nip roll (15) is comprised of a belt (40) made of a polymer, over which is fitted a thin-walled metal cylinder (41).

10. A calender arrangement as claimed in claim 9, **characterised in that** the metal cylinder (41) is tightened in place by means of the internal air pressure of the roll or connected by glueing or curing to the polymer belt (40) so as to rotate with it.

Patentansprüche

1. Verfahren zum Kalandrieren einer Materialbahn (W), insbesondere einer Papierbahn oder Kartonbahn in einem Langspaltkalander, bei dem die Gegenwalze (11) von der Langspaltwalze (15) eine erwärmte Walze ist, wobei in diesem Fall die Länge von dem Spalt (N) in der Laufrichtung der Materialbahn (W) innerhalb des Bereiches von ungefähr 70 mm bis 270 mm ist,
dadurch gekennzeichnet, dass
als eine Langspaltwalze (15) eine Walze verwendet wird, deren Mantel (30) aus einem Metall hergestellt ist, zumindest was seinen kalandrierenden Längsmittelbereich (31) anbelangt;
dass bei dem Verfahren ein Spaltdruck innerhalb des Bereiches von ungefähr 0,1 MPa bis ungefähr 50 MPa auf die Materialbahn (W) gerichtet wird, und
dass die Temperatur der Walzen (11, 15) vor dem Spalt (N) auf einen Wert von ungefähr 60°C bis ungefähr 350°C eingestellt wird.

2. Verfahren gemäß Anspruch 1,
dadurch gekennzeichnet, dass
der Spaltdruck innerhalb des Bereiches von ungefähr 0,2 MPa bis ungefähr 15 MPa ist und,
dass die Oberflächentemperatur der Walzen vor dem Spalt (N) innerhalb des Bereiches von ungefähr 120°C bis ungefähr 300°C ist.

3. Verfahren gemäß Anspruch 1 oder 2,
dadurch gekennzeichnet, dass
bei dem Verfahren Walzen (11, 15) verwendet werden, bei denen die Oberflächenrauhigkeit (R_a) von der Außenfläche ihres Mantels geringer als 0,3 μm ist.

4. Verfahren gemäß einem der vorherigen Ansprüche,
dadurch gekennzeichnet, dass
bei dem Verfahren eine Langspaltwalze (15) angewendet wird, deren Riemenmantel (30) vollständig aus Metall hergestellt ist.

5. Kalanderaufbau zum Kalandrieren einer Materialbahn (W), vorzugsweise einer Papierbahn oder Kartonbahn, wobei der Aufbau einen Langspaltkalander aufweist, bei dem die Gegenwalze von der Langspaltwalze (15) eine erwärmte Walze (11) mit einer Oberfläche aus Metall ist, wobei seine Walzen (11, 15) einen Langspalt (N) zwischen ihnen ausbilden, wobei die Länge von dem Spalt in der Laufrichtung der Materialbahn (W) innerhalb des Bereiches von ungefähr 70 mm bis 270 mm ist,
dadurch gekennzeichnet, dass
der Mantel (30) von der Langspaltwalze (15) aus Metall hergestellt ist, zumindest was seinen kalandrierenden Längsmittelbereich (31) anbelangt.

6. Kalanderaufbau gemäß Anspruch 5,
dadurch gekennzeichnet, dass
der mittlere Bereich von dem Riemenmantel (30) aus einem Stahlriemen (31) besteht, wobei an seinen Rändern flexibel verbundene Endabschnitte (32) sind, die aus einem elastischen nichtmetallischen Material hergestellt sind.

7. Kalanderaufbau gemäß Anspruch 6,
dadurch gekennzeichnet, dass
die Endabschnitte (32) mit dem Stahlriemen (31) durch Kleben oder Aushärten verbunden sind.

8. Kalanderaufbau gemäß Anspruch 5,
dadurch gekennzeichnet, dass
der Riemenmantel (30) vollständig aus Metall hergestellt ist.

9. Kalanderaufbau für ein Kalandrieren einer Materialbahn (W), vorzugsweise einer Papierbahn oder Kartonbahn, wobei der Aufbau einen Langspaltkalander aufweist, bei dem die Gegenwalze von der Langspaltwalze (15) eine erwärmte Walze (11) mit einer Oberfläche aus Metall ist, wobei die Walzen (11, 15) von ihm einen Langspalt (N) zwischen ihnen ausbilden, wobei die Länge von diesem in der Laufrichtung der Bahn (W) innerhalb des Bereiches von ungefähr 10 mm bis 500 mm ist,
dadurch gekennzeichnet, dass
der Mantel von der Langspaltwalze (15) aus einem Riemen (14) besteht, der aus einem Polymer hergestellt ist, über den ein dünnwandiger Metallzylinder (41) gesetzt ist.

10. Kalanderaufbau gemäß Anspruch 9,
dadurch gekennzeichnet, dass
der Metallzylinder (41) an Ort und Stelle mittels des Innenluftdrucks von der Walze festgezogen ist oder verbunden ist, indem er an den Polymerriemen (40) in einer derartigen Weise geklebt oder ausgehärtet ist, dass er sich mit diesem dreht.

Revendications

1. Procédé pour calandrer une bande de matériau (W), spécialement une bande de papier ou une bande de

carton, dans une calandre à longue ligne de contact , dans lequel le rouleau d'appui (11) du rouleau à longue ligne de contact (15) est un rouleau chauffé, dans lequel cas la longueur de la ligne de contact (N) dans la direction du déplacement de la bande de matériau (W) est à l'intérieur de la plage d'approximativement de 70 mm à 270 mm, **caractérisé en ce que** comme rouleau à longue ligne de contact (15) est utilisé un rouleau, dont le revêtement (30) est constitué de métal au moins en ce qui concerne le calandrage, de la zone centrale longitudinale (31) ; **en ce que** dans le procédé, une pression de ligne de contact à l'intérieur de la plage d'environ 0,1 MPa à environ 50 MPa est dirigée vers la bande de matériau (W), et **en ce que** la température des rouleaux (11,15) avant la ligne de contact (N) est ajustée à une valeur d'environ 60 °C à environ 350 °C.

2. Procédé selon la revendication 1, **caractérisé en ce que** la pression de la ligne de contact est à l'intérieur de la plage d'environ 0,2 Mpa à environ 15 MPa, et **en ce que** la température de surface des rouleaux avant la ligne de contact (N) est à l'intérieur de la plage d'environ 120 °C à environ 300 °C.

3. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** dans le procédé sont utilisés des rouleaux (11,15), dont la rugosité en surface Ra de la surface extérieure du revêtement est inférieure à 0,3 micromètres.

4. Procédé selon l'une quelconque des revendications ci-dessus, **caractérisé en ce que** dans le procédé est utilisé un rouleau à longue ligne de contact (15), dont le revêtement de la courroie (30) est totalement constitué de métal.

5. Agencement de calandre pour calandrer une bande de matériau (W), de préférence une bande de papier ou une bande de carton, l'agencement comprenant une calandre à longue de ligne de contact, dans lequel le rouleau d'appui du rouleau à longue ligne de contact (15) et un rouleau à surface métallique chauffée (11), dont les rouleaux (11,15) forment une longue de ligne de contact (N) entre eux, la longueur de la ligne de contact dans la direction du déplacement de la bande de matériau (W) étant à l'intérieur de la plage d'approximativement de 70 mm à 270 m, **caractérisé en ce que** le revêtement (30) du rouleau à longue ligne de contact (15) est constitué de métal au moins en ce qui concerne le calandrage de la zone centrale longitudinale (31).

6. Agencement de calandre selon la revendication 5, **caractérisé en ce que** la zone centrale du revêtement de courroie (30) est constituée d'une courroie d'acier (31), sur les bords de laquelle seront connectés de manière flexible des sections d'extrémité (32) constituées d'un matériau non-métallique résilient.

7. Agencement de calandre selon la revendication 6, **caractérisé en ce que** les sections d'extrémité (32) sont connectées à la courroie d'acier par collage ou durcissement.

8. Agencement de calandre selon la revendication 5, **caractérisé en ce que** le revêtement de la courroie (30) est totalement constitué de métal.

9. Agencement de calandre pour calandrer une bande de matériau (W), de préférence une bande de papier ou une bande de carton, ledit agencement comprenant une calandre à longue de ligne de contact, dans lequel le rouleau d'appui du rouleau à longue ligne de contact (15) est un rouleau à surface métallique chauffée (11), dont les rouleaux (11,15) forment une longue de ligne de contact (N) entre eux, la longueur de la ligne de contact dans la direction du déplacement de la bande de matériau (W) étant à l'intérieur de la plage d'approximativement 10 mm à 500 mm, **caractérisé en ce que** le revêtement (30) du rouleau à longue ligne de contact (15) est constitué d'une courroie (40) constitué de polymère, sur laquelle est ajusté un cylindre métallique à paroi mince (41) .

10. Agencement de calandre selon la revendication 9, **caractérisé en ce que** le cylindre métallique (41) est serré de manière étanche en place au moyen de la pression de l'air interne du rouleau ou connecté par collage ou durcissement à la courroie de polymère (40) de façon à tourner avec celle-ci.

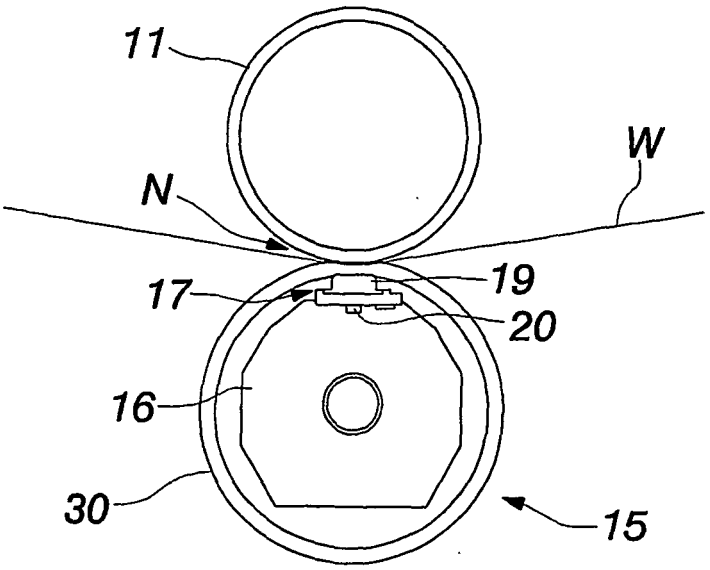

Fig.1

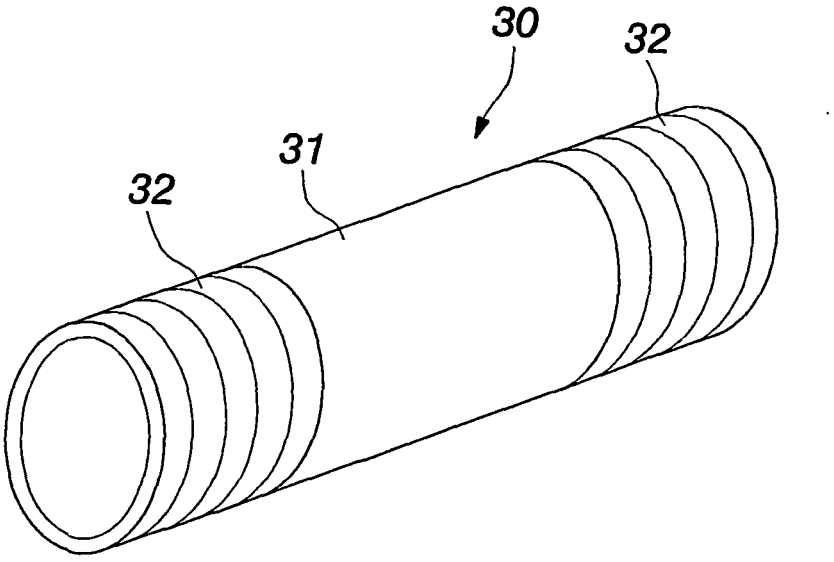

Fig.2

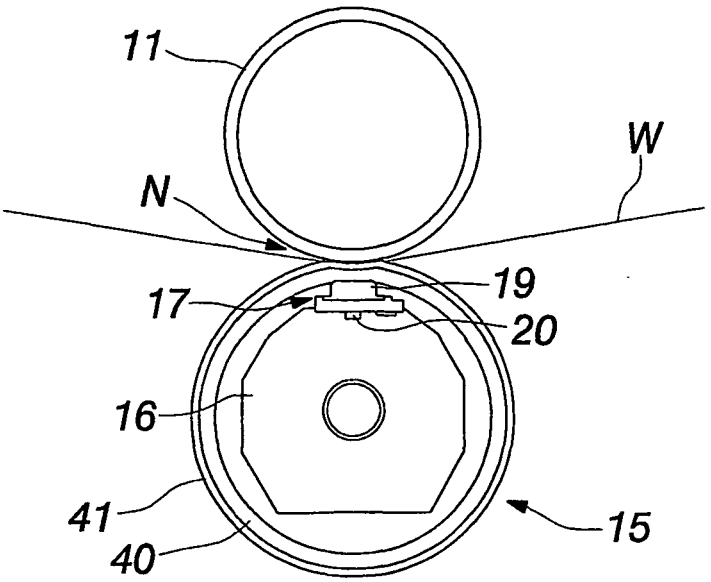

Fig.3