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

(11) EP 0 944 761 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
29.12.2004 Bulletin 2004/53

(21) Application number: **98947590.0**

(22) Date of filing: **14.10.1998**

(51) Int Cl.[7]: **D21G 1/00**, D21G 1/02

(86) International application number:
PCT/FI1998/000801

(87) International publication number:
WO 1999/028551 (10.06.1999 Gazette 1999/23)

(54) **CALENDER PROVIDED WITH AN EXTENDED NIP**

KALENDER MIT VERLÄNGERTER PRESSZONE

CALANDRE MUNIE D'UNE PINCE ALLONGEE

(84) Designated Contracting States:
AT DE FI FR GB IT SE

(30) Priority: **14.10.1997 FI 973954**

(43) Date of publication of application:
29.09.1999 Bulletin 1999/39

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

(72) Inventors:
- **KOIVUKUNNAS, Pekka**
  FIN-04430 Järvenpää (FI)
- **TANI, Mikko**
  FIN-04400 Järvenpää (FI)
- **HASANEN, Kari**
  FIN-04400 Järvenpää (FI)

(74) Representative: **Salonen, Esko Tapani et al**
Forssén & Salomaa Oy,
Eerikinkatu 2
00100 Helsinki (FI)

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EP 0 944 761 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The invention concerns a calender provided with an extended nip for calendering of a paper or board web, which calender comprises at least one calendering nip, which is formed between a heatable hard roll, on one hand, and a calendering belt which has been formed as an endless loop and which is loaded against the heatable hard roll by means of a backup roll or a press shoe, on the other hand, the paper or board web to be calendered being arranged to run through said calendering nip, whereby through the nip, at the side of the backup roll or of the press shoe, respectively, in relation to the web, a belt has been passed which is, in respect of at least a part of its thickness, made of a material of compressible volume.

[0002] When it has been desirable to raise the level of calendering, with the present-day solutions, practically the only possibility has been to increase the number of calendering nips. This results in a more complex construction of the calender and in more difficult control and threading of the paper web. In particular in the case of on-line machines, it must be possible to solve the contradictions arising from high running speed and full-speed web threading. Attempts have been made to solve these problems by means of various belt and shoe calenders, by whose means the calendering nip is extended and, thereby, the operation of the nip is enhanced. In shoe calenders, as a rule, the technique very well known from extended-nip presses is employed, according to which the extended nip is produced so that the paper web is pressed against the backup roll by means of a shaped glide shoe and an endless belt running over the shoe. In a belt calender, by means of the belt, attempts are made to provide the necessary resilience in the calendering nip when the paper web is pressed between the rolls that form the calendering nip. Belt calenders in themselves are relatively new constructions, and they can also be formed so that the paper to be calendered is passed, by means of the endless belt, into a preliminary contact with a hot calender roll, in which case it is possible to provide a steep temperature gradient, which is favourable from the point of view of calendering. In such a case, by means of the belt, the effective length of the nip is increased because of the preliminary contact and because, as the belt material, it is possible to employ. considerably softer polymers than in roll coatings without problems arising from deformations related to heat. With a nip more extended than in a supercalender or soft calender, the press impulse applied to the paper can be increased so that the pressure peak does not become excessively high and that the bulk is not reduced. With respect to the prior art related to belt calenders, reference is made, for example, to the *Finnish Patent No. 95,061* and to the equivalent *US Patent No. 5,483,873.*

[0003] The belt and shoe calenders that have been used so far have involved quite a significant problem, which has arisen from the structure of the belt that has been used. The belts that have been used have been almost completely non-compressible, and, as a rule, their structure has been such that there is a support fabric in the middle of the belts, and a polyurethane layer at both sides of the support fabric. Even though the belt in itself may have been elastic, its volume has not been compressible. Such a belt of substantially non-compressible volume behaves in a calendering nip, in which it is pressed with a high pressure to make it thinner, so that the material of the belt has to flow parallel to the face of the belt away from the nip. This has, among other things, the effect that a wave is formed ahead of the nip out of the belt material. Owing to the non-compressibility, in the belt material, forces parallel to the belt face are formed, which promote a collapse of the fibrous structure in the paper, i.e. a reduction in the thickness of the paper. In a nip, reversible and non-reversible compression of paper always take place. Shear forces in the nip increase the amount of non-reversible compression, which has a detrimental effect on the bulk of the paper. Further, a shear force that changes its direction abruptly in the nip tends to vibrate the paper, which mechanism can have quite a considerable effect on the calendered density of the paper. Thus, employment of a non-compressible belt makes the fibrous structure of the paper collapse and increases the strains applied to the belt face, the wear and the fatigue.

[0004] In document WO 95 34715 A is disclosed a calender belt having in its thickness direction a first layer on the side of the belt closest to the web and a sedond layer on the opposite side of the belt. The hardness of the second layer on the opposite side of the belt is higher than the hardness of the first layer on the side of the belt closest to the web. The structure of the calendering belt according to WO 95 34715 A, i.e. the soft layer on the side of the belt closest to the web, is directed to remove or at least to reduce the problems in the smoothness, gloss and density of the web, said problems being caused by an uneven base material. So the structure of the belt and the purpose of the same are different from those of the present invention.

[0005] The object of the present invention is to provide an essential improvement over the existing calenders provided with extended nips. In view of achieving this objective, the invention is mainly characterized in that the belt of a material of compressible volume is either a calendering belt provided with a multi-layer structure, which comprises a support layer of compressible volume and, at least on its face to be placed against the material web to be calendered, a tight polymer layer, or a support belt formed as an endless loop and running at the side facing the backup roll in relation to the tight calendering belt.

[0006] By means of the invention, a significant advantage is obtained over the prior art, and of the advantages obtainable by means of the invention, in this connection, among other things, the following can be stated. Thus,

the essential features of the invention are that the belt that is used in the calender, i.e. the belt of a material of compressible volume is either a calendering belt provided with a multi-layer structure, which comprises a support layer of compressible volume and, at least on its face to be placed against the material web to be calendered, a tight polymer layer, or in belt calendering, through the calendering nip, a calendering belt, favourably a conventional polyurethane belt, is passed, and additionally a separate, substantially fully compressible support belt is passed, which performs the major part of the compression work in the nip.

[0007] In studies that have been carried out and in test runs, it has been noticed that, by means of such a belt of compressible volume, and, similarly, by means of a solution in which, in addition to a polyurethane belt, a support belt of compressible volume is used, the forces parallel to the face of the paper and/or belt can be eliminated from the nip almost completely. Owing to the compressibility of the calendering belt or of the support belt placed underneath the calendering belt, the extent of non-reversible compression of the paper in the nip is reduced essentially, in which case the thickness and the bulk of the paper can be maintained as well as possible. Further, it is to be considered a significant additional advantage that the so-called "toleration of fibre string" is substantially better than in earlier solutions, because, owing to the compressibility of the calendering belt or of the support belt placed underneath the calendering belt, respectively, fibre strings can pass through the nip readily without causing a shear load. From the point of view of manufacturing technology, a multi-layer belt of the novel type is considerably easier to manufacture than the earlier belt provided with a support fabric, and, for example, the belt can be provided with uniform thickness more easily than in the prior art.

[0008] Similarly, a solution with two belts can be accomplished very easily, because, in the manufacture, it is possible to employ conventional prior-art techniques, in particular in the case that a polymer belt is used as the calendering belt and the support belt is made of a felt material. Uniform thickness can be achieved easily in a unit composed of a calendering belt and of a support belt in particular made of a felt material. On the other hand, it can also be stated as an advantage that, owing to the compressibility of the belt, the calendering process is not so sensitive to little variations in thickness of the belt as it was earlier. The further advantages and characteristic features of the invention will come out from the following detailed description of the invention.

[0009] In the following, the invention will be described by way of example with reference to the figures in the accompanying drawing.

Figure 1 is a fully schematic side view of a single-nip calender in which a calendering belt is employed.

Figure 2 shows an enlarged detail from the area of the calendering nip in a calender as shown in Fig. 1.

Figure 3 is an illustration corresponding to Fig. 1 of a shoe calender.

Figure 4 is an enlarged detail from the nip area in a calender as shown in Fig. 3.

Figure 5 is a schematic side view of a belt calender in which, in accordance with the second embodiment of the invention, a combination consisting of a calendering belt and a support belt is employed.

Figure 6 shows an enlarged detail from the area of the calendering nip in a calender as shown in Fig. 5.

[0010] Thus, Figs. 1 and 2 illustrate a belt calender, in which the calendering nip N is formed between a hot calender roll 1 and a backup roll 3. Further, through the nip N, a calendering belt 10 has been passed to provide the nip N with the necessary elasticity so that the paper web W runs through the nip N between the calendering belt 10 and the face of the hot roll 1. Fig. 2 is a more detailed illustration of the conduct of the calendering belt 10 in the nip, whose length is denoted with the reference a. Thus, in the case of a belt calender, the calendering belt 10 consists of a support layer 12 of compressible volume and of a tight polymer layer 11 fitted on one face of said support layer 12. As is shown in Fig. 2, the polymer layer 11 is placed on the face of the support layer 12 placed facing the paper web W. The support layer 12 itself is placed against the backup roll 3. Thus, it is an essential feature of the belt 10 that the structure of the support layer 12 is such that it can be compressed in the nip N, i.e. its volume is reduced, in which case no wave of the sort formed in prior-art solutions can be formed ahead of the nip. The support layer 12 of compressible volume is favourably made of a felt material. The material of the tight polymer layer to be placed against the paper is, for example, thermosetting or thermoplastic resin, favourably polyurethane.

[0011] Figs. 3 and 4 illustrate a shoe calender, in which the extended calendering nip N is formed between a hot hard roll 1 and a shoe roll 2. The shoe roll 2 again comprises a press shoe 24 supported by a stationary beam 25 as well as a calendering belt 20, which has been passed around the press shoe 24 and the beam 25 and which has been formed as an endless loop. By means of the press shoe 24, the necessary load is produced in the nip N. As is illustrated in Fig. 4, in this embodiment the calendering belt 20 consists of three layers fitted one above the other, i.e. of a support layer 22 of compressible volume placed in the middle and of tight polymer layers 21, 23 placed at both sides of the support layer. The materials of the support layer 22 and of the polymer layers 21, 23 can be the same as in the embodiment shown in Figs. 1 and 2, so that the polymer

layers are preferably of polyurethane, and felt is employed as the support layer 22 of compressible volume. In the embodiment of Figs. 3 and 4, a tight polymer layer 23 is also required at the side of the press shoe 24, because it must be possible to make the friction between the press shoe 24 and the calendering belt 20 sufficiently low. The mode of reduction of friction that is known best and that is employed most commonly is producing an oil film between the press shoe and the calendering belt 20. Thus, the face of the calendering belt 20 that is placed against the press shoe 24 must be tight, in which case a polymer layer 23 is necessary. A similar belt can, of course, also be employed in connection with the embodiment shown in Figs. 1 and 2. As has been illustrated by means of Figs. 2 and 4, the support layer 12; 22 can be compressed over the length a of the nip N without causing any wave ahead of the nip.

[0012] Thus, Figs. 5 and 6 illustrate a belt calender, in which the calendering nip N is formed between a hot calender roll 1a and a backup roll 3a. Through the nip N, a calendering belt 30 as well as a support belt 40 of a material of compressible volume have been passed so as to provide the nip N with the necessary resilience, so that the web W runs through the nip N between the calendering belt 30 and the face of the hot roll 1a. Both the calendering belt 30 and the support belt 40 have been formed as endless loops by means of alignment and tensioning rolls. The calendering belt 30 and the support belt 40 are passed into the nip N between the calendering rolls 1a and 3a by means of a first alignment roll 4, and similarly they are passed out of the nip N by means of a second alignment roll 5, said first and second alignment roll 4 and 5 being, thus, common of the calendering belt 30 and of the support belt 40. Thus, the calendering belt 30 and the support belt 40 run from the first alignment roll 4 through the nip N to the second alignment roll 5 as a joint run and while fitted one above the other. After the second alignment roll 5, the calendering belt 30 and the support belt 40 are, however, separated from one another so that they form separate loops of their own.

[0013] From the second alignment roll 5, the support belt 40 is, thus, guided onto the alignment roll 6 of the support belt, from it onto the support belt tensioning roll 7, and from it further onto the first alignment roll 4, which is common of the support belt and the calendering belt, as was already described above. Similarly, the calendering belt 30 is guided from the second alignment roll 5 onto the belt alignment roll 8, from it further onto the belt tensioning roll 9, from which the calendering belt 30 is passed, in the case shown in Fig. 5, onto the support belt 40 at the support belt tensioning roll 7. In this respect, the arrangement can, however, also be such that the calendering belt 30 is passed from the belt tensioning roll 9 directly onto the first alignment roll 4 common of the calendering belt 30 and of the support belt 40. For each loop, i.e. for the calendering belt loop 30 and for the support belt loop 40, alignment rolls 6,8 and tensioning rolls 7,9 of their own are needed in order that the tension of the calendering belt 30 and of the support belt 40 could be regulated appropriately. A solution with two belts is in itself known, for example, from presses, but there the paper web is always placed against a porous belt for the purpose of removal of water, and the smooth support belt is placed underneath the porous belt.

[0014] Fig. 6 illustrates the conduct of the calendering belt 30 and of the support belt 40 in the nip N in more detail, the length of the nip being denoted with the reference a. Thus, through the nip N, the non-compressible calendering belt, favourably a polymer belt 30, and the support belt 40 of compressible volume, favourably a felt or a support belt of a similarly compressible material, are passed. In the way shown in Fig. 6, the polymer belt 30 has been arranged in the nip N at the side of the heatable calendering roll 1a, i.e. at the side of the web W to be calendered. The material of the polymer belt 30 is favourably polyurethane. The structure of the calendering belt 30 is such that it is provided with a thin fibre reinforcement and with a polyurethane layer at least at the side placed facing the heatable calendering roll 1a. The structure of the belt can also be such that the fibre reinforcement is placed, in relation to the thickness of the calendering belt 30, in the middle of the belt, and the smooth polyurethane layers are placed at each side of the calendering belt. Further, in the way shown in Fig. 6, the support belt that runs through the nip N, favourably a felt 40 or equivalent, is placed in the nip against the backup roll 3a. Thus, it is an essential feature of the invention that the belt 40 or equivalent can be compressed in the nip N, in other words, its volume is reduced, in which case a wave corresponding to that formed in the prior-art solutions cannot be formed ahead of the nip N. As was stated earlier, in stead of a felt material, it is also possible to use other materials, e.g. cellular rubbers, cellular plastics, and equivalent which are compressible.

[0015] In the illustration in Figs. 5 and 6, the web W to be calendered is introduced into the nip N so that it does not enter into contact with the calendering belt 30 until in the nip N, and similarly the web W is taken out from the nip N so that it is separated from the calendering belt 30 directly. The web W can also be passed into the nip so that it is brought onto the calendering belt 30 before the nip N, and similarly, after the nip, the web is transferred on the calendering nip 30, from which it is taken to further processing. Thus, the running of the web W can be accomplished as a what is called closed draw.

[0016] With a calendering belt of compressible volume in accordance with the invention, and similarly in an arrangement in which a tight calendering belt, in particular a polymer belt, and a support belt of compressible volume, such as a felt or equivalent, are employed, by means of a calender a thicker and stiffer paper or board can be calendered so that the gloss and smoothness of the calendered web are at an equally high level as with a non-compressible calendering belt alone. Also, it can

be established that the runnability with a felt or equivalent of compressible volume is better, because, in particular with thin paper grades, the frequency of web breaks is substantially lower than earlier. In the case of a compressible multi-layer belt, the improved runnability was ascertained in test runs. It can be suggested as a reason for this that, when a non-compressible calendering belt is used alone, the flow of the belt material parallel to the belt face strains the paper to such an extent that the frequency of web breaks becomes higher.

[0017] Above, the invention has been described by way of example with reference to the figures in the accompanying drawing. The invention is, however, not confined to the exemplifying embodiments illustrated in the figures alone, but a belt of compressible volume in accordance with the invention can also be used in other connections. As examples of such other applications can be mentioned various shoe presses, size presses that employ a belt, belt coating devices, belt winders, and equivalent. Also in the other respects, it must be stated that the invention can be varied within the scope of the invention defined in the accompanying claims.

Claims

1. A calender provided with an extended nip for calendering of a paper or board web, which calender comprises at least one calendering nip (N), which is formed between a heatable hard roll (1,1a), on one hand, and a calendering belt (10;20;30) which has been formed as an endless loop and which is loaded against the heatable hard roll (1;1a) by means of a backup roll (3;3a) or a press shoe (24), on the other hand, the paper or board web (W) to be calendered being arranged to run through said calendering nip (N), whereby through the nip (N), at the side of the backup roll (3;3a) or of the press shoe (24), respectively, in relation to the web (W), a belt (10;20;40) has been passed which is, in respect of at least a part of its thickness, made of a material of compressible volume, **characterized in that** the belt of a material of compressible volume is either a calendering belt (10;20) provided with a multi-layer structure, which comprises a support layer (12; 22) of compressible volume and, at least on its face to be placed against the material web (W) to be calendered, a tight polymer layer (11, 21) or a support belt (40) formed as an endless loop and running at the side facing the backup roll (3a) in relation to the calendering belt (30).

2. A calender as claimed in claim 1, **characterized in that**, in the calendering belt (20), in the direction of thickness, there is a tight polymer layer (21,23) at both sides of the support layer (22).

3. A calender as claimed in claim 1 or 2, **characterized in that** the material of the support layer (12; 22) of compressible volume in the calendering belt (10;20) is felt.

4. A calender as claimed in claim 1 or 2, **characterized in that** the material of the support layer (12; 22) of compressible volume in the calendering belt (10;20) is cellular rubber, cellular plastic, or equivalent.

5. A calender as claimed in any of the preceding claims, **characterized in that** the tight polymer layer (11) or tight polymer layers (21;23) in the calendering belt is/are made of thermosetting or thermoplastic resin.

6. A calender as claimed in any of the claims 1 to 4, **characterized in that** the material of the tight polymer layer (11) or of the tight polymer layers (21; 23) in the calendering belt is polyurethane.

7. A calender as claimed in claim 1, **characterized in that** the calendering belt (30) and the support belt (40) of compressible volume have been formed as separate endless loops by means of alignment and tensioning rolls (4...9).

8. A calender as claimed in claim 1 or 7, **characterized in that** the calendering belt (30) and the support belt (40) have been passed through the nip (N) so that the calendering belt (30) and the support belt (40) run from the first alignment roll (4), preceding the nip (N), into the nip (N) and from the nip further onto the second alignment roll (5), following after the nip, as a joint run.

9. A calender as claimed in any of the claims 1, 7 or 8, **characterized in that** the support belt (40) of compressible volume is made of a felt material.

10. A belt calender as claimed in any of the claims 1, 7 or 8, **characterized in that** the material of the support belt (40) of compressible volume is cellular rubber, cellular plastic, or an equivalent material.

11. A calender as claimed in any of the claims 1, 7 to 10, **characterized in that** the material of the calendering belt (30) is polyurethane, and the belt is provided with a fibre reinforcement.

Patentansprüche

1. Kalander mit einem Langspalt zum Kalendrieren einer Papierbahn oder Kartonbahn, wobei der Kalander zumindest einen Kalendrierspalt (N) aufweist, der ausgebildet ist zwischen einerseits einer erwärmbaren harten Walze (1, 1a), und andererseits

einem Kalendrierriemen (10; 20; 30), der als eine endlose Schleife ausgebildet ist und der gegen die erwärmbare harte Walze (1; 1a) mittels einer Gegenwalze (3; 3a) oder einem Pressschuh (24) belastet wird, wobei die zu kalendrierende Papierbahn oder Kartonbahn (W) so eingerichtet ist, dass sie durch den Kalendrierspalt (N) läuft, wobei durch den Spalt (N) an der Seite der Gegenwalze (3; 3a) oder des Pressschuhs (24) jeweils in Bezug auf die Bahn (W) ein Riemen (10; 20; 40) tritt, der in Bezug auf zumindest einen Teil seiner Dicke aus einem Material mit einem komprimierbaren Volumen gestaltet ist,

dadurch gekennzeichnet, dass

der Riemen aus einem Material mit einem komprimierbaren Volumen entweder ein Kalendrieriemen (10; 20) ist, der mit einem Mehrlagenaufbau versehen ist und der eine Stützlage (12; 22) mit einem komprimierbaren Volumen und zumindest an einer Seite von ihm, an der die zu kalendrierende Materialbahn (W) anzuordnen ist, eine Dichtpolymerlage (11, 21) aufweist, oder ein Stützriemen (40) ist, der als eine endlose Schleife ausgebildet ist und an der Seite, die der Gegenwalze (3a) in Bezug auf den Kalendrieriemen (30) zugewandt ist, läuft.

2. Kalander gemäß Anspruch 1,
dadurch gekennzeichnet, dass

in dem Kalendrieriemen (20) in der Richtung der Dicke eine Dichtpolymerlage (21, 23) an beiden Seiten der Stützlage (22) vorhanden ist.

3. Kalander gemäß Anspruch 1 oder 2,
dadurch gekennzeichnet, dass

das Material der Stützlage (12; 22) mit einem komprimierbaren Volumen in dem Kalendrieriemen (10; 20) Filz ist.

4. Kalander gemäß Anspruch 1 oder 2,
dadurch gekennzeichnet, dass

das Material der Stützlage (12; 22) mit dem komprimierbaren Volumen in dem Kalendrieriemen (10; 20) Schaumgummi, Schaumstoff oder dergleichen ist.

5. Kalander gemäß einem der vorherigen Ansprüche,
dadurch gekennzeichnet, dass

die Dichtpolymerlage (11) oder die Dichtpolymerlagen (21; 23) in dem Kalendrieriemen aus bei Wärme aushärtendem Harz oder Thermoplastharz hergestellt ist / sind.

6. Kalander gemäß einem der Ansprüche 1 bis 4,
dadurch gekennzeichnet, dass

das Material der Dichtpolymerlage (11) oder der Dichtpolymerlagen (21; 23) in dem Kalendrrieriemen Polyurethan ist.

7. Kalander gemäß Anspruch 1,
dadurch gekennzeichnet, dass

der Kalendrierriemen (30) und der Stützriemen (40) mit dem komprimierbaren Volumen als separate endlose Schleifen mittels Ausricht- und Spannwalzen (4 ... 9) ausgebildet sind.

8. Kalander gemäß Anspruch 1 oder 7,
dadurch gekennzeichnet, dass

der Kalendrierriemen (30) und der Stützriemen (40) durch den Spalt (N) so treten, dass der Kalendrieriemen (30) und der Stützriemen (40) von der ersten Ausrichtwalze (4), die dem Spalt (N) vorangeht, in den Spalt (N) und von dem Spalt weiter zu der zweiten Ausrichtwalze (5), die nach dem Spalt folgt, als ein gemeinsamer Lauf laufen.

9. Kalander gemäß einem der Ansprüche 1, 7 oder 8,
dadurch gekennzeichnet, dass

der Stützriemen (40) mit dem komprimierbaren Volumen aus einem Filzmaterial hergestellt ist.

10. Riemenkalander gemäß einem der Ansprüche 1, 7 oder 8,
dadurch gekennzeichnet, dass

das Material des Stützriemens (40) mit dem komprimierbaren Volumen Schaumgummi, Schaumstoff oder ein gleichwertiges Material ist.

11. Kalander gemäß einem der Ansprüche 1, 7 bis 10,
dadurch gekennzeichnet, dass

das Material des Kalendrierriemens (30) Polyurethan ist und der Riemen mit einer Faserverstärkung versehen ist.

Revendications

1. Calandre munie d'une pince allongée pour le calandrage d'une bande continue de papier ou de carton, laquelle calandre comprend au moins une pince de calandrage (N) qui est formée entre un cylindre dur pouvant être chauffé (1,1a) d'une part, et une courroie de calandrage (10 ;20 ;30) qui a été formée en tant que boucle sans fin et qui est contrainte contre le cylindre dur pouvant être chauffé (1 ;1a) au moyen d'un cylindre d'appui (3 ;3a) ou un sabot de presse (24) d'autre part, la bande continue de papier ou de carton (W) à calandrer étant agencée pour défiler à travers ladite pince de calandrage (N), tandis qu'à travers la pince (N), sur le côté du cylindre d'appui (3 ;3a) ou du sabot de presse (24), il a été disposé respectivement par rapport à la bande continue (W), une courroie (10 ;20 ;40), laquelle, en ce qui concerne au moins une partie de son épaisseur est réalisée en un matériau de volume compressible,

caractérisée en ce que,

la courroie en matériau de volume compressible est soit une courroie de calandrage (10 ;20) dotée d'une structure multicouche qui comprend une couche de support (12 ;22) de volume compressible et, au moins sur sa face devant être placée contre la bande continue (W) à calandrer, une couche de polymère dense (11,21) ou une courroie de support (40) formée en tant que boucle sans fin et défilant sur le côté en regard du cylindre d'appui (3a) par rapport à la courroie de calandrage (30).

2. Calandre selon la revendication 1, **caractérisée en ce que**, dans la courroie de calandrage (20), dans la direction de l'épaisseur, il est prévu une couche de polymère dense (21,23) des deux côtés de la couche de support (22).

3. Calandre selon la revendication 1 ou 2, **caractérisée en ce que** le matériau de la couche de support (12 ;22) de volume compressible dans la courroie de calandrage (10 ;20) est du feutre.

4. Calandre selon la revendication 1 ou 2, **caractérisée en ce que** le matériau de la couche de support (12 ;22) de volume compressible dans la courroie de calandrage (10 ;20) est du caoutchouc alvéolaire, du plastique alvéolaire, ou équivalent.

5. Calandre selon l'une quelconque des revendications précédentes,
caractérisée en ce que la couche de polymère dense (11) ou les couches de polymère dense (21 ; 23) dans la courroie de calandrage est/sont réalisée (s) en résine thermoplastique ou thermodurcissable.

6. Calandre selon l'une quelconque des revendications 1 à 4,
caractérisée en ce que le matériau de la couche de polymère dense (11) ou des couches de polymère dense (21 ;23) dans la courroie de calandrage est du polyuréthanne.

7. Calandre selon la revendication 1,
caractérisée en ce que la courroie de calandrage (30) et la courroie de support (40) de volume compressible ont été formées en tant que boucles sans fin séparées au moyens de cylindres d'alignement et de tension (4...9).

8. Calandre selon la revendication 1 ou 7,
caractérisée en ce que la courroie de calandrage (30) et la courroie de support (40) ont été menées à travers la pince (N) de sorte que la courroie de calandrage (34) et la courroie de support (40) défilent à partir du premier cylindre d'alignement (4), précédant la pince (N), jusque dans la pince (N) et à partir de la pince jusque dans le second cylindre d'alignement (5), et en continuant après la pince, en tant que tronçon conjoint.

9. Calandre selon l'une quelconque des revendications 1,7 ou 8,
caractérisée en ce que la courroie de support (40) de volume compressible est réalisée à partir d'un matériau de feutre.

10. Calandre selon l'une quelconque des revendications 1,7 ou 8,
caractérisée en ce que le matériau de la bande de support (40) de volume compressible est du caoutchouc cellulaire, du plastique cellulaire ou un matériau équivalent.

11. Calandre selon l'une quelconque des revendications 1, 7 à 10,
caractérisée en ce que le matériau de la courroie de calandrage (30) est en polyuréthanne, et la courroie est dotée d'un renforcement de fibre.

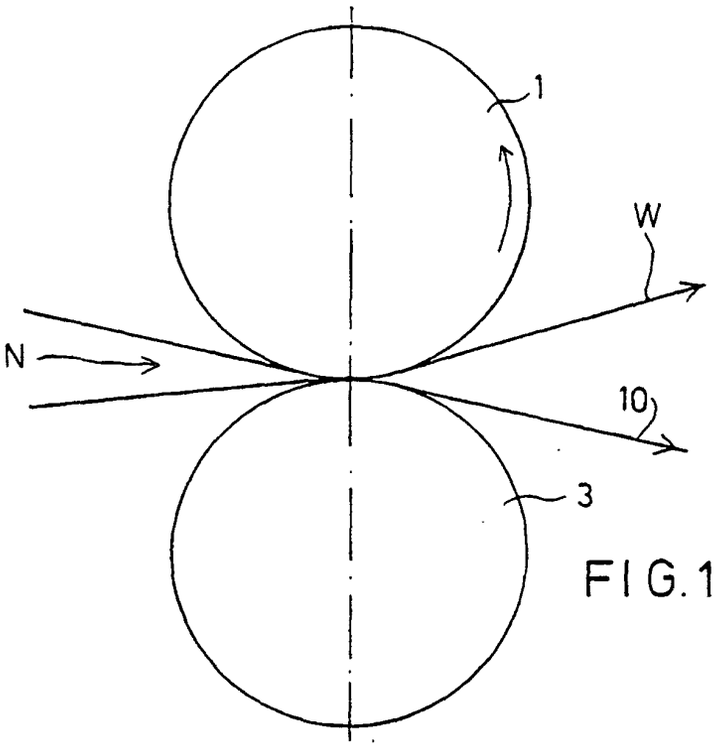


FIG.1

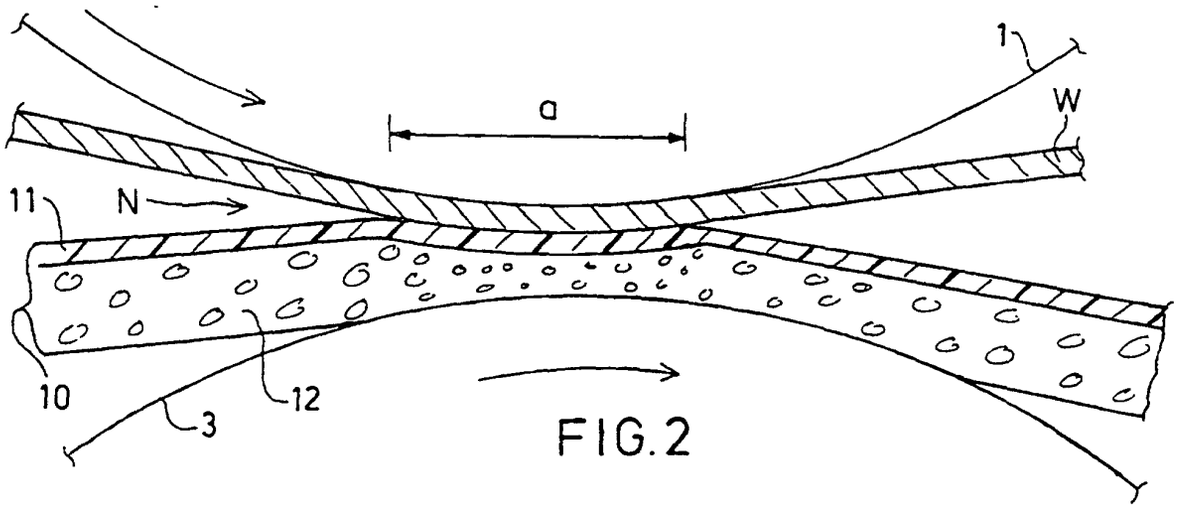


FIG.2

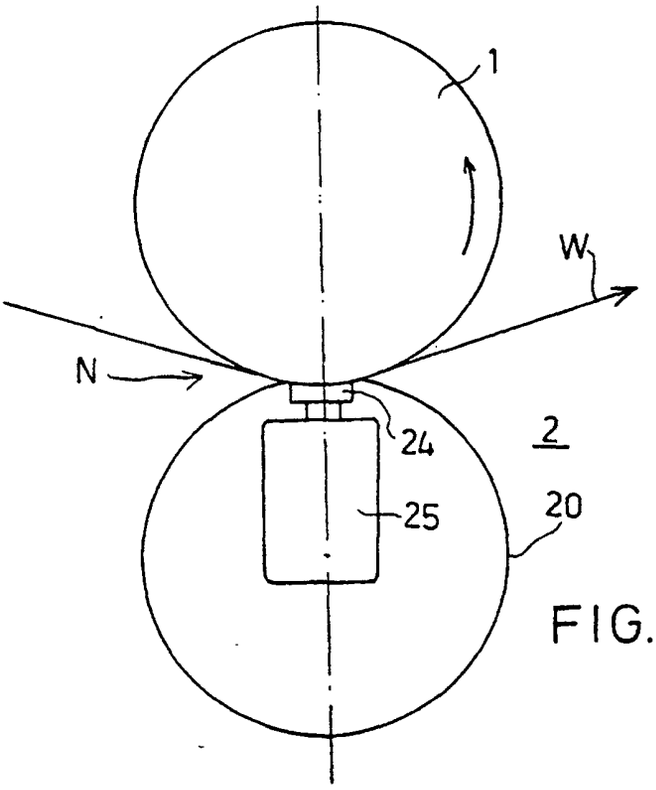


FIG. 3

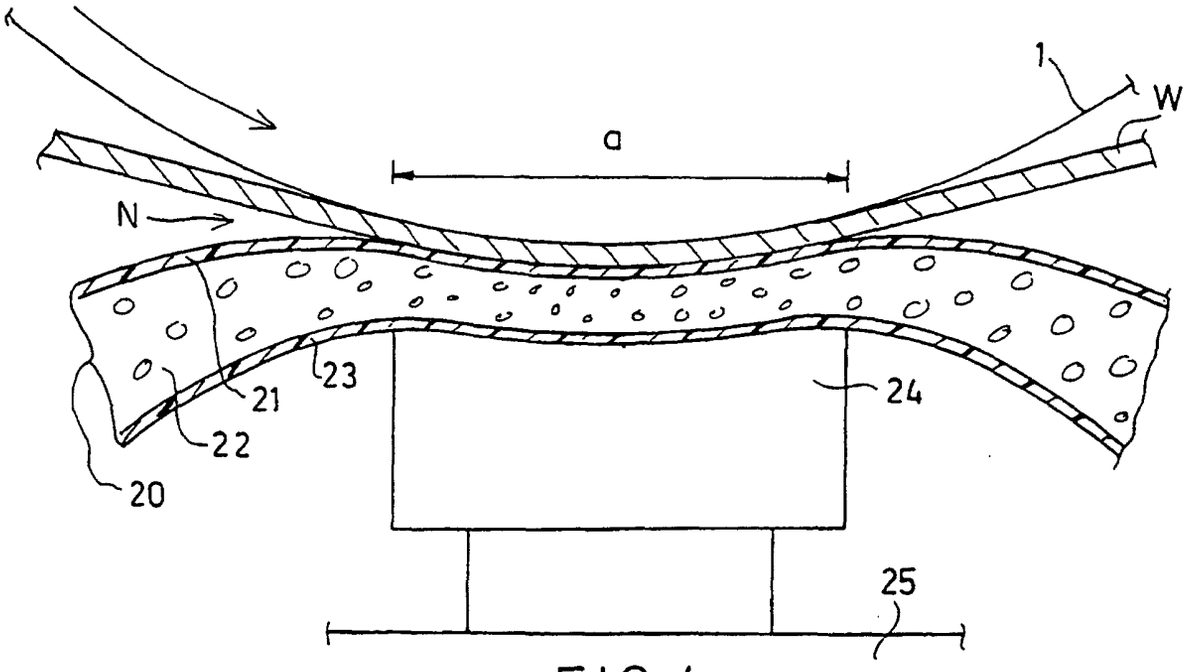


FIG. 4

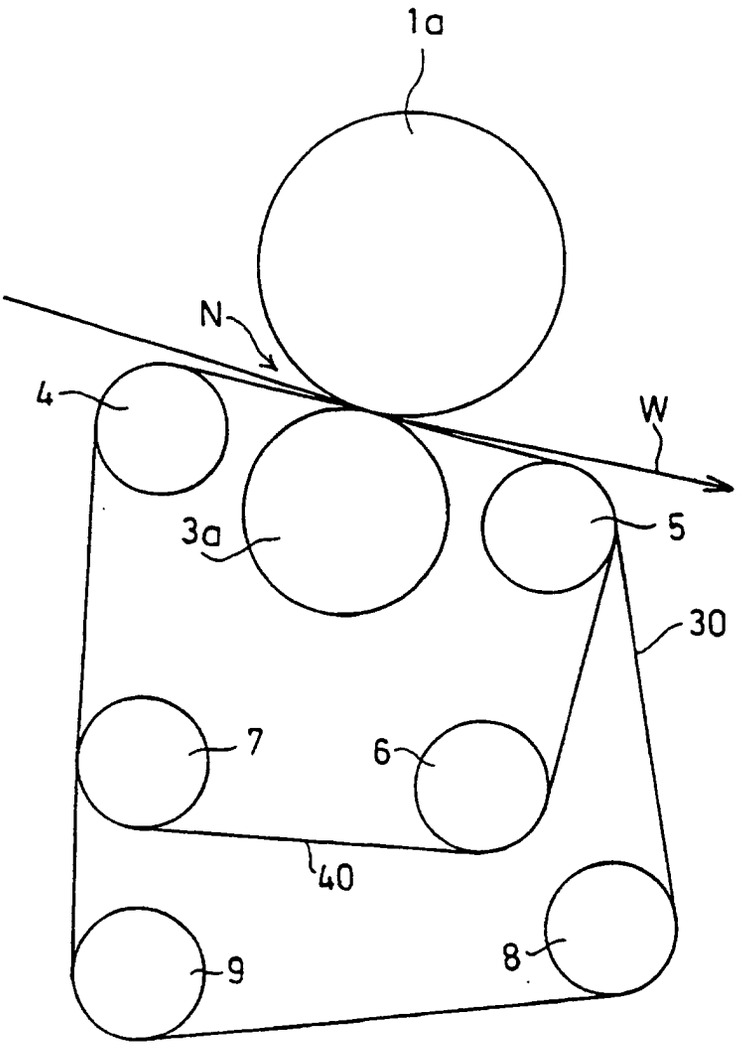


FIG.5

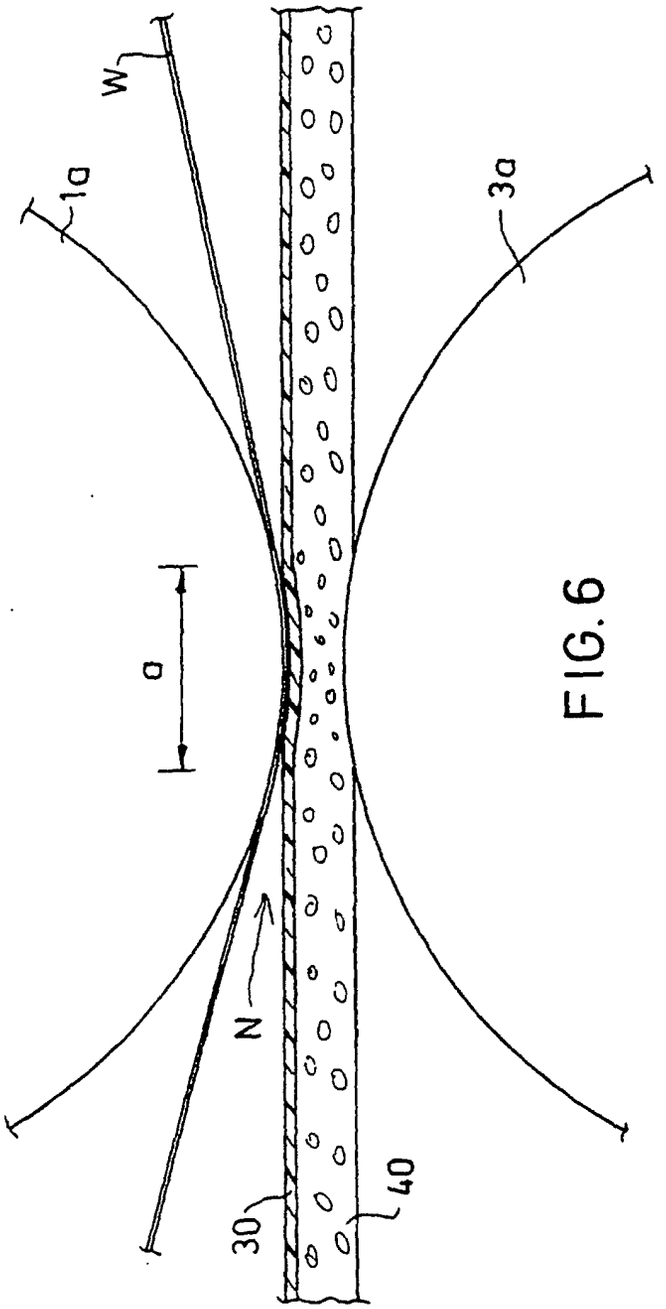


FIG.6