EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent: 10.09.1997 Bulletin 1997/37

(51) Int.Cl.: D21H 23/34

(21) Application number: 94105082.5

(22) Date of filing: 30.03.1994

(54) Assembly for loading a doctor blade
Baugruppe zum Laden einer Rakel Klinge
Assemblage pour le chargement d’une plame racleur

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

(30) Priority: 16.04.1993 FI 931722


(73) Proprietor: VALMET CORPORATION
00620 Helsinki (FI)

(72) Inventors:
• Koskinen, Jukka
SF-00940 Helsinki (FI)

• Mannio, Aaron
SF-04430 Järvenpää (FI)

(74) Representative: Zipse + Habersack
Kemnatenstrasse 49
80639 München (DE)

(56) References cited:
DE-A- 3 017 274
GB-A- 1 112 443
GB-A- 2 138 326
US-A- 4 440 105

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).
Description

The present invention relates to an assembly according to the preamble of claim 1 for loading the blade of a doctoring unit used for coating, e.g., a paper web.

In coating of a paper web, the coat is smoothed onto the web most commonly using a doctor blade. The coat mix can first be applied onto the web using a separate applicator apparatus, whereby the doctor blade is placed at a distance in the machine direction from the point of application, or alternatively, a coating machine called a short-dwell coater can be used in which a coating chamber is situated immediately beside the doctor blade and the applied coat is smoothed immediately by the doctor blade.

The amount of coat mix adhering to the web being coated is adjusted by altering the loading of the doctor blade. When the blade loading is altered, also the actual angle of the doctor blade to the web changes, and the control of applied coat weight is temporarily unstable. This relates to the fact that the blade is contoured conformant with the web at the previously used blade tilt angle, and after the change of this angle, a certain time must elapse before the blade tip again wears conformant with the web. Changes in blade angle also cause other coat defects such as bleeding and uneven coat thickness. To avoid such defects, different types of systems have been developed suited for maintaining the blade angle as constant as possible irrespective of changes in blade loading.

A change in the doctor blade angle can be compensated for by either deflecting the blade so that the blade tip angle will not change, or alternatively, rotating the doctor blade support beam about the blade tip edge by an incremental angle corresponding to the change in the blade angle. Such a constant-angle control is easy to implement in doctor blade units removed from the applicator apparatus, because the doctor blade support beam does not carry other equipment related to the coating process. In the short-dwell coating process, the use of blade-deflecting arrangements is awkward, because the required apparatuses are difficult to adapt in conjunction with the extremely compact construction of the short-dwell coater. Therefore, the blade angle in short-dwell coaters is simply controlled by rotating the doctor blade support beam about the edge of the blade tip. Also in this manner the control of the blade angle in short-dwell coaters is complicated, because when the doctor blade support assembly is rotated about the edge of the blade tip, the gap of the coat metering edge of the applicator chamber to the web changes at the ingoing side of the web to the chamber. Obviously, this also changes the conditions in the applicator chamber and may permit the entry of air past the metering edge into the applicator chamber, which causes coat defects. Therefore, when doctor blade loading is changed in a short-dwell coater, the doctor blade support beam should also be rotated and simultaneously the coat metering edge adjusted, which operations are extremely cumbersome to implement and thus cannot provide a satisfactorily operating constant-angle doctor blade arrangement for a short-dwell coater. Major difficulties will also be encountered in designing the end dams, which control the coat width, so that they operate compatibly with the blade tip angle changes.

However, the tip angle of the doctor blade to the web being coated can be held extremely well constant, independently of blade loading changes if the doctor blade is loaded close to its tip. Such apparatuses are already in use and, e.g., US patent 4,440,105 discloses a short-dwell coater in which the doctor blade is loaded by means of a separate loading blade close to the doctor blade tip. The loading blade resembles the doctor blade in that it is a flexible blade pressed against the doctor blade by means of a resilient loading hose. While this design attains constant-tip-angle loading of the doctor blade with a relatively good accuracy, it yet has several drawbacks. During adjustment, the flexible blade slides along the rear surface of the doctor blade, and the friction causes uneven movement between the blades which disturbs blade control. Moreover, control of doctor blade profile by means of the flexible backing blade is difficult.

GB-A-2 138 326 discloses a coater apparatus where geometric relationships in the region of the wiping line (tip of the doctor blade) shall remain unchanged as far as possible when varying the pre-tension of the doctor blade. For this the doctor blade is supported rigidly in the central region along a support line arranged in an unchanging manner opposite the material web, whereas the lower edge of the doctor blade is guided so as to be raised towards the support line when pressing the doctor blade.

The WO 93/05887 discloses an apparatus wherein the doctor blade is loaded by means of a relatively stiff ledge, which is pressed against the back of the doctor blade relatively close to the tip of the blade. The ledge is attached on rocking cams which are pivotally mounted on the doctor blade support beam.

The ledge is continuous along the back of the blade and slots run from the side of the blade opposite said ledge towards said ledge.

It is an object of the present invention to achieve an assembly for loading a doctor blade, said assembly permitting loading the blade close to its tip without compromising the control of the blade. A further object of the invention is to achieve an assembly in which the doctor blade tip angle can be held constant even during the control of the doctor blade profile. Another further object of the invention is to achieve a loading assembly which besides the above-mentioned benefits provides the control of the doctor blade profile.

The invention is based on loading the doctor blade close to its tip by means of a backing member which is divided along its longitudinal axis by crosswise cuts to form segments, said cuts extending from the tip of the
backing member.

More specifically, the method according to the invention is characterized by what is stated in the characterizing part of claim 1.

Furthermore, the apparatus according to the invention is characterized by what is stated in the characterizing part of claim 3.

The invention offers significant benefits.

The principal benefit of the invention is that the tip angle of the doctor blade to the web stays constant during a change of the blade loading. Thus, the assembly according to the invention operates as a constant-tip-angle doctor blade, which provides the above-mentioned substantial benefits. An extremely important benefit is that the blade profile can be changed without causing a change in the tip angle through dividing the backing member along its longitudinal axis into comb-like segments. This approach assures maximum control accuracy in conjunction with automatic blade profile control. By making in this manner the backing member resilient in the direction of the applied blade loading force, the bending stiffness and straightness errors of the backing member have no effect on the evenness of the coat profile. The structure of the blade backing member is extremely simple and easy to manufacture and mount in conjunction with the doctor blade. Owing to its simple structure, the backing member operates in an inherently reliable manner. The loading assembly according to the invention can be readily adapted to existing coating stations. Particularly advantageous is the use of the loading assembly according to the invention in short-dwell coaters in which the constant-tip-angle control can be implemented in a simple and cost-effective manner.

The invention is next examined in greater detail with reference to the attached drawings, wherein:

Figure 1 is a sectional side view of a doctor blade having the blade loaded with a stiff backing member according to the invention;

Figure 2 is a backing member according to the invention in a partially sectional end view; and

Figure 3 is a side view of the backing member shown in Fig. 2.

In this application, the vertical direction of the blade is the direction from the tip of the blade to the mounting point of the same.

With reference to Fig. 1, the structure shown therein can be used as the doctor blade of a short-dwell coater or the loading assembly of a separate doctor blade. As shown, a doctor blade 7 is mounted in a doctor blade support beam 2, 3 comprised of two beams, and the doctor blade 7 is loaded and supported very close to the tip edge 9 of the doctor blade by means of the tip 10 of a backing member 8. The web 16 to be coated passes in the conventional manner supported by a backing roll

1. The backing member 8 is pressed against the doctor blade 7 by means of an adjustable loading apparatus mounted on the upper beam 3 of the doctor blade support assembly. The loading apparatus comprises a blade profile control beam 4 divided into segments along its longitudinal axis. Each segment of the blade profile control beam 4 has a nut 5 fixed to the segment and an adjustment screw 6 cooperating via the nut 5 with the control segment. The backing member 8 is pressed against the doctor blade 7 by means of a pressure-loaded hose 11.

The backing member 8 can be made from a shaped steel section, for instance. In the preferred embodiment shown in the diagrams, the backing member section is essentially Z-shaped. The lower surface of the base 13 of the section is flat and has along the length of the base 13 a plurality of mounting holes via which the backing member 8 is bolted in place. The waist 18 of the section turns toward the base 13, whereby the base 13 and the waist 18 form an acute angle. At the end of the waist 18, the section turns to form a tip 12 pointing upward and smoothly to an opposite direction relative to the base 13. The end of the tip 12 is tapered into an edge 10 acting as the backing-force-exerting line. A stiffness-reducing groove 19 is provided at the joining line of the base 13 of the backing member base 8 to its waist 18.

The backing member 8 is divided along its longitudinal axis into segments 20 by crosswise cuts 14. At the bottom of each cut is further fabricated a slot 15 which is aligned so as to transversely terminate the cut. The purpose of such cuts 14 and slots 15 is to make the backing member 8 extremely flexible in the loading direction of the doctor blade. The flexibility of the backing member 8 is additionally enhanced by a stiffness-reducing groove 19 at the joining line of the backing member base 13 to the waist 18. The cuts 14 and slots 15 can be filled with a suitable resilient sealant to avoid their fill-up by accumulated dirt. Suitable sealants are silicone and urethane polymers, for instance.

In the embodiment illustrated in Fig. 2, the backing member 8 is bolted through screw holes 17 in the base of the section to the upper beam 3 of the doctor blade support assembly so that the edge formed by the base 13 and waist 18 of the backing member 8 becomes resting against the doctor blade 7. The waist 18 of the backing member 8 bows away from the doctor blade 7, thus forming a cavity between these elements. A pressure-loaded hose 11 is adapted to rest against the backing member 8 at the upper end of its waist 18, just before the waist 18 deviates to form a loading tip 12, 10 pointed against the doctor blade 7. The tip 10 edge of the backing member 8 rests against the doctor blade 7 so as to provide a linear backing force 7. This design approach brings the pivotal joining point and the fixing point of the waist 18 to the base 13 of the backing member close to the plane of the doctor blade, thus reducing the movement of the backing member with respect to the doctor blade surface to a small value, whereby the relative pro-
portion of friction force to the exerted loading force remains also small.

The loading control of the doctor blade 7 takes place in the following manner. The actual loading force control is effected by altering the pressure in the pressure-loaded hose 11 which rests against the backing member 8. Because the tip 10 of the backing member presses the doctor blade 7 very close to the tip line 9 where the doctor blade 7 runs on the web 16 being coated, that is, the tip line of the doctor blade, the force imposed by the doctoring action on the doctor blade 7 is partially inflicted on the tip 10 of the backing member 8 and as the distance from the line of the doctor blade tip 9 to the line of the backing member tip 10 is small, the deviation at the tip of the doctor blade 7 due to a change in the loading remains small, and correspondingly, the bending moment acting on the blade 7 remains small, because the lever arm has a short length. Thus, the tip angle of the doctor blade 7 remains constant and the wear of the blade takes place tangentially with the web 16 being coated. Resultingly, the loading control operates with a constant tip angle.

The profile control of the doctor blade 7 occurs in a conventional manner through moving the segments of the doctor blade profile control beam 4 by means of the adjustment screws 6. As the backing member 8 is divided by cuts into narrow slats or segments, it conforms flexibly to the profile control when the shape of the profile control beam 4 is adjusted. The doctor blade profile control can be implemented by automatic or manual means, but owing to the extremely good control accuracy of the doctor blade profile by virtue of the backing member according to the invention, the benefits of automatic control can be optimally utilized.

The backing member can be fabricated from a suitable material, e.g., an extruded aluminum or plastic section. Required stiffness-reducing cuts can be made by a number of alternative machining methods such as a cutting laser or high-pressure water jet. The shape and dimensions of the backing member proper can be varied as required. For instance, the backing member can be adapted floatingly behind the doctor blade, whereby the base of the backing member can be omitted. Equally, the backing member can be fixed to any part of the doctor blade support assembly or loading apparatus provided that the backing-force-exerting line of the member is located close to the tip line of doctor blade and a suitable means is arranged for pressing the backing member against the blade. The backing member should be resilient in the acting direction of the blade loading force, while in the vertical direction of the doctor blade the backing member should have such a high stiffness that no essential deformation can occur in this direction. Because essentially no forces are imposed on the backing member in this vertical direction, the required condition is fulfilled by all such backing member designs which have an essentially zero displacement vertically in the plane of the doctor blade. Thus, the backing member could in principle be a stiff, wedge-shaped, longitudinally running member which is pressed against the doctor blade close to its tip line. However, such a support member is incompatible with doctor blade profile control.

Obviously, the design of the doctor blade beam and loading apparatus is dependent on the structure of the doctor blade support assembly in the concerned doctoring unit or short-dwell coater. The length of the backing member is made so long as to extend at least over the web being coated.

The dimensioning of the backing member is naturally different for each doctoring unit construction and doctor blade holder design; however, for a 0.2-0.6 mm thick blade having the blade tip at a distance of approx. 30-100 mm, typically 40-70 mm, from the blade fixing point, the distance of the backing member tip from the doctor blade tip is typically 0.5-5 mm, advantageously 1-3 mm.

Claims

1. An assembly for loading a doctor blade of a coater apparatus comprising
   - a doctor blade support beam (2,3),
   - a doctor blade (7) mounted to the support beam (2,3) and having a tip (9), and
   - a backing member (8) mounted to the support beam (2,3) which backing member (8) is stiff in the vertical direction of the doctor blade (7) but resilient in the acting direction of the blade loading force, a tip (10) of the backing member (8) adapted to rest against the doctor blade (7) substantially adjacent to the doctor blade tip (9), and
   - loading means (4,5,6,11) for pressing the backing member (8) against the doctor blade (7) for providing a force for loading the doctor blade (7), whereby
     - the backing member (8) is divided along its longitudinal axis by crosswise cuts (14) to form segments (20), characterised in that said cuts (14) extend from the tip (10) of the backing member (8), said cuts (14) making the backing member (8) flexibly conform to adjustable profile control loading means (4,5,6,11).

2. An assembly as defined in claim 1, characterized in that at the bottom of each cut (14) further is fabricated a slot (15) which is aligned so as to transversely terminate the cut (14).

3. An assembly as defined in one of claims 1 and 2,
characterized in
that said cuts (14, 19) are filled with a resilient sealant such as a silicone or urethane polymer.

4. An assembly as defined in one of claims 1-3, characterized in
that the backing member (8) is mounted pivotally to the support beam (2, 3) at a point close to the mounting of the doctor blade (7).

5. An assembly as defined in claim 4, characterized in
that the backing member (8) has a Z-shaped cross section formed of a base (13), a middle part (18) connected at one end (19) to the base, and a tip part (12) connected to another end of the middle part so as to point in an opposite direction relative to the base (13), the tip part (12) having an end (10) that tapers to an edge suited for pressing against the doctor blade (7).

6. An assembly as defined in claim 5, characterized in
that the flexibility of the backing member (8) is additionally enhanced by a stiffness-reducing groove (19) at the joining line of the backing member base (13) to the middle part (18).

7. An assembly as defined in one of claims 1-6, characterized in
that the loading means (4, 5, 6, 11) for pressing the backing member (8) against the doctor blade (7) comprises a pressure-loaded hose (11) mounted on a blade profile control beam (4) divided into segments along its longitudinal axis.

8. An assembly as defined in claim 7, characterized in
that each of the segments of the blade profile control beam (4) has a nut (5) fixed to the segment and an adjustment screw (6) cooperating via the nut (5) with the control segment.

9. A short dwell coater comprising an assembly as defined in one of claims 1-8.

Patentansprüche

1. Baugruppe zum Laden bzw. Beaufschlagen einer Rakeklinge einer Beschichtungsvorrichtung mit
   - einem Rakeklingen-Trägerbalken (2, 3);
   - einer an dem Trägerbalken (2, 3) befestigten und eine Spitze (9) aufweisenden Rakeklinge (7);
   - einem an dem Trägerbalken (2, 3) befestigten Stützglied (8), das in der vertikalen Richtung
der Rakeklinge (7) steif, in der Wirkungsrichung der Klingenladungskraft jedoch nachgiebig ist, wobei eine Spitze (10) des Stützgliedes (8) so gestaltet ist, daß sie an der Rakeklinge (7) im wesentlichen neben der Rakeklingen-
spitze (9) anliegt; und
   - Mitteln (4, 5, 6, 11) zum Andrücken des Stützgliedes (8) gegen die Rakeklinge (7), um eine Kraft für das Laden bzw. das Beaufschlagen der Rakeklinge (7) bereitzustellen, wobei
   - das Stützglied (8) entlang seiner Längsachse zur Bildung von Segmenten (20) durch Quereinschnitte (14) unterteilt ist, dadurch gekennzeichnet, daß sich die Einschnitte (14) von der Spitze (10) des Stützgliedes (8) erstrecken, wobei die Einschnitte (14) das Stützglied (8) biegsam an einstellbare Profilleistungs-Ladungs-
   mittel (4, 5, 6, 11) anpassen.

2. Baugruppe nach Anspruch 1, dadurch gekennzeichnet, daß am Boden jedes Einschnitts (14) außerdem ein Schlitzen (15) hergestellt ist, der so ausgerichtet ist, daß er die Einschnitte (14) in Querrichtung beendet.

3. Baugruppe nach einem der Ansprüche 1 und 2, dadurch gekennzeichnet, daß die Einschnitte (14, 19) mit einer nachgiebigen Dichtungsmasse wie Silikon oder Urethanpolym er gefüllt sind.

4. Baugruppe nach einem der Ansprüche 1 - 3, dadurch gekennzeichnet, daß das Stützglied (8) schwenkbar an dem Trägerbalken (2, 3) an einem Punkt nahe bei der Befestigung der Rakeklinge (7) gelagert ist.

5. Baugruppe nach Anspruch 4, dadurch gekennzeichnet, daß das Stützglied (8) einen Z-förmigen Querschnitt hat, der aus einer Basis (13), einem Mittelstück (18), das an einem Ende (19) mit der Basis verbunden ist, und einem Spitzstück (12) besteht, das mit einem anderen Ende des Mittelstücks verbunden ist, um in eine entgengesetzte Rich-
tung relativ zu der Basis (13) zu weisen, wobei das Spitzstück (12) ein Ende (10) hat, das sich zu ei-
er Kante hin verjüngt, die geeignet ist, um gegen die Rakeklinge (7) zu drücken.

6. Baugruppe nach Anspruch 5, dadurch gekennzeichnet, daß die Biegbarkeit des Stützgliedes (8) zusätzlich durch eine die Steifigkeit verringernde Rinne (19) an der Verbindungslinie der Stützgliedbas-
sis (13) zu dem Mittelstück (18) erhöht ist.

7. Baugruppe nach einem der Ansprüche 1 - 6, dadurch gekennzeichnet, daß die Ladungsmittel (4, 5, 6, 11) zum Andrücken des Stützgliedes (8) gegen die Rakeklinge (7) einen unter Druck stehenden
Schlauch (11) aufweisen, der an einem entlang seiner Längsrichtung in Segmente unterteilten Klingenprofil-Steuerungsbalken (4) montiert ist.


Revendications

1. Assemblage pour la chargement d'une lame racleuse d'un appareil de revêtement, comprenant :
   une poutre support de lame racleuse (2,3), une lame racleuse (7) montée sur la poutre support (2,3) et ayant un bout (9), un élément d'appui (8) monté sur la poutre support (2,3), cet élément d'appui (8) étant rigide dans la direction verticale de la lame racleuse (7) mais souple dans la direction d'action de la force de chargement de lame, un bout (10) de l'élément d'appui (8) étant prévu pour s'appliquer contre la lame racleuse (7) de façon sensiblement adjacente au bout (9) de la lame racleuse, et des moyens de chargement (4,5.6.11) pour presser l'élément d'appui (8) contre la lame racleuse (7) afin d'exercer une force de chargement de la lame racleuse (7), dans lequel l'élément d'appui (8) est divisé le long de son axe longitudinal par des incisions transversales (14) pour former des segments (20), caractérisé en ce que lesdites incisions (14) s'étendent à partir du bout (10) de l'élément d'appui (8), lesdites incisions (14) permettant à l'élément d'appui (8) de se conformer de façon flexible aux moyens de chargement (4,5.6.11) pour commande réglable du profil.

2. Assemblage suivant la revendication 1, caractérisé en ce que, à la base de chaque incision (14), il est prévu en outre une fente (15) qui est allignée de façon à terminer transversalement l'incision (14).

3. Assemblage suivant une des revendications 1 et 2, caractérisé en ce que lesdites incisions (14,19) sont remplies avec un produit d'étanchéité souple, tel qu'un polymère de type silicone ou uréthane.

4. Assemblage suivant une des revendications 1 à 3, caractérisé en ce que l'élément d'appui (8) est monté de façon pivotante sur la poutre support (2,3) à un point proche du montage de la lame racleuse (7).

5. Assemblage suivant la revendication 4, caractérisé en ce que l'élément d'appui (8) a une section en forme de Zformée d'une base (13), d'une partie intermédiaire (18) reliée à une extrémité (19) à la base, et un bout (12) connecté à une autre extrémité de la partie intermédiaire de façon à pointer dans une direction opposée par rapport à la base (13), le bout (12) ayant une extrémité (10) qui s'amincit vers un bord prévu pour exercer une pression contre la lame racleuse (7).

6. Assemblage suivant la revendication 5, caractérisé en ce que la flexibilité de l'élément d'appui (8) est encore augmentée par une rainure de réduction de rigidité (19) à l'endroit de la ligne de jonction de la base d'élément d'appui (13) à la partie intermédiaire (18).

7. Assemblage suivant une des revendications 1 à 6, caractérisé en ce que les moyens de chargement (4,5.6.11) pour presser l'élément d'appui (8) contre la lame racleuse (7) comprennent un tube flexible chargé par mise en pression (11), monté sur une poutre de commande de profil de lame (4) divisée en segments le long de son axe longitudinal.

8. Assemblage suivant la revendication 7, caractérisé en ce que chacun des segments de la poutre de commande de profil de lame (4) comporte un écrou (5) fixé au segment et une vis de réglage (6) qui coopère via l'écrou (5) avec le segment de commande.

9. Appareil de revêtement à court séjour, comprenant un assemblage suivant une des revendications 1 à 8.

45