

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 0 850 334 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

27.03.2002 Bulletin 2002/13

(21) Application number: **96930244.7**

(22) Date of filing: **10.09.1996**

(51) Int Cl.7: **D21F 1/48**

(86) International application number:
PCT/GB96/02235

(87) International publication number:
WO 97/10381 (20.03.1997 Gazette 1997/13)

(54) **WEAR-RESISTANT BLADE ELEMENT**

ABRIEBFESTES SCHABERELEMENT

ELEMENT DE LAME RESISTANT A L'USURE

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

(30) Priority: **13.09.1995 GB 9518713**

(43) Date of publication of application:
01.07.1998 Bulletin 1998/27

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Description

[0001] This invention relates to a wear-resistant blade element for use in the assembly of wear-resistant blades in a de-watering section of a paper-making machine.

[0002] Such wear-resistant blades are required to extend for the full width of the paper-making machine and so need to have a length of typically up to 10 metres. In order to impart the required degree of wear-resistance, it is known to form the blade from a multiplicity of ceramic (alumina, zirconia or zirconia-toughened alumina) blade elements held together in end-to-end relationship by two or more stainless steel rods. These rods extend through respective aligned holes passing through the blade elements from one end to the other. The rods pass through common end clamping elements which can be tightened down using clamping nuts engaging screw-threaded ends of the clamping rods to clamp the blade elements together. Such an assembly of clamped blade elements is mounted in a synthetic resin carrier which has been machined to the correct size to suit the machine. The upper surfaces of the assembled blade elements are then polished *in situ* using a tracked grinding machine to a high surface finish to provide a smooth working surface to the blade.

[0003] With this known form of blade, the individual blade elements are relatively short, ie the distance between their ends is typically less than the distance between leading and trailing edges thereof. The leading and trailing edges of the blade elements are those which, in use, are located respectively upstream and downstream relative to the direction of travel of pulp through the de-watering section of the paper-making machine. Thus, as many as 300 to 400 blade elements may be required for a 10 metre length of blade. Although the ceramic blade elements can be produced relatively cheaply by means of a die pressing operation, the mutually abutting end faces thereof need to be machined so that they can accurately abut against the end faces of adjacent blade elements upon assembly. Such machining operations are relatively time consuming and add considerably to the overall cost of the assembled blade. Also, in use, these relatively short blades can twist out of line (so-called 'piano-keying') and thereby hinder de-watering of the pulp.

[0004] GB-A-1232681 discloses a device for extracting water from the paper or pulp in a paper making or wet pulp machine. The device has an upper surface for sliding cooperation with the wire or felt of the machine with at least substantial parts of the surface being formed by elements made of hard oxide ceramic material. The elements are embedded into or supported by support means made of a water-repellent non-brittle synthetic plastics material which is softer than the oxide ceramic material. AT-A-294560 also relates to components such as suction plates, suction bars, sieve table coats, stripping bars or foil bars which are in sliding contact with the sieve or felt of a paper machine or cellulose-

draining machine. The components have a sliding surface which is formed from hard elements, particularly oxide ceramic elements with each hard element having a groove extending along its longitudinal direction. The hard elements are connected together by aligning the grooves of adjacent hard elements and at least partially filling them with a plastic filling such as epoxide resin.

[0005] It is an object of the present invention to mitigate these disadvantages.

[0006] According to a first aspect of the present invention, there is provided a wear-resistant blade element for use in the assembly of a wear-resistant blade in a de-watering section of a paper-making machine, said blade element comprising a unitary ceramic body having (a) an upper region defining an upper, working surface, (b) ends, (c) leading and trailing edges, and (d) a lower region shaped so as to be engageable with a carrier for a multiplicity of blade elements assembled in end-to-end relationship, wherein the body is elongated between said ends so that the length of the ceramic body between said ends is no less than three times the width thereof between said leading and trailing edges; characterised in that the ceramic body is formed of silicon aluminium oxynitride.

[0007] Preferably, the lower region of the body is provided with a hollow or a recess therein which extends longitudinally of the body between said ends and which is of a size to receive a plurality of clamping rods for use in clamping adjacent blade elements together in end-to-end relationship.

[0008] According to a second aspect of the present invention, there is provided a wear-resistant blade comprising a multiplicity of wear-resistant blade elements disposed in end-to-end relationship in a row, and securing means for the row of blade elements; characterised in that the blade elements are in accordance with said first aspect of the invention.

[0009] Preferably, the securing means comprises a plurality of clamping rods extending through said hollows or recesses in said blade elements to engage clamping elements at the ends of the row of blade elements to clamp said row together.

[0010] Preferably, the blade elements are slip-cast elements, although they may be isostatically-pressed or extruded elements, if desired.

[0011] It is found that the blade elements can be produced in lengths of up to about 1200mm, typically 300 to 1200mm. Thus, as few as 9 or 10 blade elements may be all that is required to span a 10 metre wide paper making machine.

[0012] It is preferred for the ceramic body to have a substantially constant wall thickness of typically about 4 to 8mm, most preferably about 6mm.

[0013] Where the hollow is provided in the body for receiving the clamping rods, such hollow is preferably located mainly in said lower region of the body and preferably has a cross-sectional shape such that its dimension widthwise of the body exceeds its dimension

heightwise of the body. In a particularly convenient embodiment, the hollow communicates with the underside of the body by means of a slot extending longitudinally through a bottom wall of the body.

[0014] Where the recess is provided in the body for receiving the rods, said recess is preferably defined between longitudinally extending legs in the lower region of the body, said legs being shaped to be engageable with the carrier.

[0015] Whilst the upper region of the body may be solid, it is within the scope of the present invention to provide one or more longitudinally extending hollows or recesses therein to reduce the quantity of ceramic material needed to form the body and/or to facilitate formation of the body.

[0016] Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Fig 1 is a cross-sectional view through one embodiment of blade element according to the present invention,

Fig 2 is a plan view showing the underside of the blade element of Fig 1,

Figs 3 and 4 are cross-sectional views of second and third embodiments of blade element,

Fig 5 is a cross-sectional view showing the manner in which the blade elements illustrated in Fig.1 are held in a carrier to form a blade, and

Fig. 6 is a cross-sectional view of a fourth embodiment of blade element.

[0017] Referring now to Figs 1 and 2 of the drawings, the blade element illustrated therein comprises a unitary ceramic body 10 formed by a horizontal drain slip casting operation out of SYALON 101 available from International Syalons Newcastle Limited of Wallsend, United Kingdom. Following slip casting, the body 10 is sintered at temperatures above 1690 °C and generally below 1800 °C to produce a body formed of silicon aluminium oxynitride of the formula $\text{Si}_{6-x}\text{Al}_x\text{N}_{8-x}\text{O}_x$ (where x can vary from a small positive number to approximately 4, but which is typically 0 - 2) together with a minor amount of a glassy phase.

[0018] The ceramic body 10 comprises an upper region 10a, a dovetail-shaped lower region 10b including a bottom wall. The upper region 10a defines an upper, working surface 10c of the body 10. The body 10 has leading and trailing edges 10d and 10e, respectively and opposite ends 10f and 10g, respectively. The working surface 10c is that surface of the element over which paper pulp passes for de-watering. The leading and trailing edges 10d and 10e are those edges which lie respectively upstream and downstream relative to the direction of travel of the pulp through the de-watering section. The paper-making process is well known in the art and so will not be described in any detail herein.

[0019] The body 10 is formed with a relatively large

hollow 12 therein which extends longitudinally through the body 10 between and through the ends 10f and 10g (See Fig 2). As can be seen from Fig 1, the hollow 12 is of approximately oval cross-section and has an as-cast surface finish whereby its dimension widthwise of the body 10 exceeds its dimension heightwise of the body 10. The hollow 12 is of a size such that the resultant body 10 has an approximately constant wall section. This facilitates slip casting and subsequent sintering of the body 10 and also assists in minimising the amount of material used to produce the body.

[0020] The ends 10f and 10g are accurately machined after sintering so as to ensure that they mate closely with the respective ends of adjacent blade elements. The external surfaces of the upper and lower regions 10a and 10b, including the upper surface 10c and the leading and trailing edges 10d and 10e are likewise machined after sintering.

[0021] The length of each blade element between the ends 10f and 10g is typically in the range of 300 to 1200mm whilst the width thereof between the edges 10d and 10e is typically about 40 to 70mm.

[0022] As can be seen from Fig 1, the lower region 10b is of dovetail section for engagement with a correspondingly dovetailed recess in a polyethylene carrier 16 illustrated in Fig 5.

[0023] In the alternative embodiment illustrated in Fig 3, the lower region 10b is formed without a bottom wall so as to define splayed legs extending longitudinally of the body 10. Thus, recess 12 is defined between the splayed legs.

[0024] In the alternative embodiment of Fig 4, recess 12 is formed so that it extends widthwise of the body 10 within the upper region 10a towards the leading and trailing edges 10d and 10e.

[0025] Referring now to Fig. 5, a multiplicity of the blade elements (only one shown in Fig.5) of the type described above in relation to Fig. 1 are assembled together in end-to-end abutment in a row, and a pair of stainless steel clamping rods 18 is passed through the hollows 12 in the bodies 10 of these blade elements and engaged with end plates (only one shown -see dotted line 20) and nuts (not shown) which engage screw-threaded ends of the rods 18 to clamp the row of blade elements together. Following this, the clamped blade elements are engaged with their dovetail-shaped lower regions 10b in a correspondingly dovetail-shaped groove 22 in a synthetic resin carrier 16 which has been previously machined to the required size having regard to the paper-making machine to which it is to be fitted. Then, the blade elements are bonded to the carrier 16 by means of epoxy resin injected through a longitudinal extending row of holes 24 in a bottom wall 26 of the carrier 16. Finally, the carrier 16 with elements bonded thereto is machined on the upper surfaces 10c of the bodies 10 to produce the required smooth flat working surface over which the pulp passes for de-watering during the paper-making process.

[0026] In Fig. 6, the body 10 of the blade element has an interior hollow 12 which communicates with the underside of the element 10 via a central slot 10h extending longitudinally of the body 10 through the bottom wall of lower region 10b.

Claims

1. A wear-resistant blade element for use in the assembly of a wear-resistant blade in a de-watering section of a paper-making machine, said blade element comprising a unitary ceramic body (10) having (i) an upper region (10a) defining an upper, working surface (10c), (ii) ends (10f, 10g), (iii) leading and trailing edges (10d, 10e), and (iv) a lower region (10b) shaped so as to be engageable with a carrier (16) for a multiplicity of blade elements assembled in end-to-end relationship, wherein the body (10) is elongated between said ends (10f, 10g) so that the length of the ceramic body (10) between said ends (10f, 10g) is no less than three times the width thereof between said leading and trailing edges (10d, 10e); **characterised in that** the ceramic body (10) is formed of silicon aluminium oxynitride.
2. A blade element as claimed in claim 1, wherein the body (10) is a slip-cast body.
3. A blade element as claimed in claim 1 or 2, wherein the lower region (10c) of the body is provided with a hollow (12) or a recess therein which extends longitudinally of the body (10) between said ends (10f, 10g) and which is of a size to receive a plurality of clamping rods (18) for use in clamping adjacent blade elements together in end-to-end relationship.
4. A blade element as claimed in claim 3, wherein the hollow (12) is located mainly in said lower region (10b) of the body (10).
5. A blade element as claimed in claim 4, wherein the hollow (12) has a cross-sectional shape such that its dimension widthwise of the body (10) exceeds its dimension heightwise of the body (10).
6. A blade element as claimed in claim 3, 4 or 5, wherein the hollow (12) communicates with the underside of the body (10) by means of a slot (10h) extending longitudinally through a bottom wall of the body.
7. A blade element as claimed in claim 3, wherein the recess is defined between longitudinally extending legs in the lower region (10b) of the body (10), said legs being shaped to be engageable with the carrier (16).

8. A blade element as claimed in any preceding claim, wherein the ceramic body (10) has a substantially constant wall thickness.

9. A blade element as claimed in claim 8, wherein the wall of the ceramic body has a thickness of about 4 to 8 mm.

10. A blade element as claimed in claim 8, wherein the wall of the ceramic body (10) has a thickness of about 6 mm.

11. A wear-resistant blade comprising a multiplicity of wear-resistant blade elements disposed in end-to-end relationship in a row, and securing means (18) for the row of blade elements; **characterised in that** the blade elements are as claimed in any preceding claim.

12. A wear-resistant blade as claimed in claim 11, wherein each blade element is as defined in claim 3, wherein the securing means comprises a plurality of clamping rods extending through said hollows (12) or recesses in said blade elements to engage clamping elements at the ends of the row of blade elements to clamp said row together.

Patentansprüche

1. Verschleißfestes Schaberelement für eine Verwendung in der Baugruppe eines verschleißfesten Schabers in einem Entwässerungsabschnitt einer Papiermaschine, wobei das Schaberelement einen einheitlichen keramischen Körper (10) aufweist, der aufweist: (i) einen oberen Bereich (10a), der eine obere Arbeitsfläche (10c) definiert; (ii) Enden (10f, 10g); (iii) Vorder- und Hinterkanten (10d, 10e); und (iv) einen unteren Bereich (10b), der so geformt ist, daß er mit einem Träger (16) für eine Vielzahl von Schaberelementen in Eingriff kommen kann, die in einer Beziehung Ende an Ende montiert werden, worin der Körper (10) zwischen den Enden (10f, 10g) länglich ist, so daß die Länge des keramischen Körpers (10) zwischen den Enden (10f, 10g) nicht kleiner ist als das 3-fache der Breite davon zwischen der Vorder- und Hinterkante (10d, 10e); **dadurch gekennzeichnet, daß** der keramische Körper (10) aus Silicium-Aluminiumoxynitrid gebildet wird.
2. Schaberelement nach Anspruch 1, bei dem der Körper (10) ein Schlickergußkörper ist.
3. Schaberelement nach Anspruch 1 oder 2, bei dem der untere Bereich (10c) des Körpers mit einem Hohlraum (12) oder einer Aussparung darin versehen ist, der sich in Längsrichtung des Körpers (10)

zwischen den Enden (10f, 10g) erstreckt und eine Größe aufweist, um eine Vielzahl von Klemmstangen (18) für eine Verwendung beim Zusammenklemmen benachbarter Schaberelemente in einer Beziehung Ende an Ende aufzunehmen.

4. Schaberelement nach Anspruch 3, bei dem der Hohlraum (12) hauptsächlich im unteren Bereich (10b) des Körpers (10) zu finden ist.

5. Schaberelement nach Anspruch 4, bei dem der Hohlraum (12) eine derartige Querschnittsform aufweist, daß seine Abmessung in der Breitenrichtung des Körpers (10) seine Abmessung in der Höhenrichtung des Körpers (10) übersteigt.

6. Schaberelement nach Anspruch 3, 4 oder 5, bei dem der Hohlraum (12) mit der Unterseite des Körpers (10) mittels eines Schlitzes (10h) in Verbindung steht, der sich in Längsrichtung durch eine untere Wand des Körpers erstreckt.

7. Schaberelement nach Anspruch 3, bei dem die Aussparung zwischen sich in Längsrichtung erstreckenden Schenkeln im unteren Bereich (10b) des Körpers (10) definiert wird, wobei die Schenkel so geformt sind, daß sie mit dem Träger (16) in Eingriff kommen können.

8. Schaberelement nach vorhergehenden Ansprüchen, bei dem der keramische Körper (10) eine im wesentlichen konstante Wanddicke aufweist.

9. Schaberelement nach Anspruch 8, bei dem die Wand des keramischen Körpers eine Dicke von etwa 4 bis 8 mm aufweist.

10. Schaberelement nach Anspruch 8, bei dem die Wand des keramischen Körpers (10) eine Dicke von etwa 6 mm aufweist.

11. Verschleißfester Schaber, der aufweist: eine Vielzahl von verschleißfesten Schaberelementen, die in einer Beziehung Ende an Ende in einer Reihe angeordnet sind; und eine Sicherungseinrichtung (18) für die Reihe der Schaberelemente; **dadurch gekennzeichnet, daß** die Schaberelemente die sind, die in den vorhergehenden Ansprüchen beansprucht werden.

12. Verschleißfester Schaber nach Anspruch 11, bei dem jedes Schaberelement so ist, wie es im Anspruch 3 definiert wird, bei dem die Sicherungseinrichtung eine Vielzahl von Klemmstangen aufweist, die sich durch Hohlräume (12) oder Aussparungen in den Schaberelementen erstrecken, um mit den Klemmelementen an den Enden der Reihe von Schaberelementen in Eingriff zu kommen, um die

Reihe zusammen festzuklemmen.

Revendications

1. Élément de lame résistant à l'usure devant être utilisé dans l'ensemble constitué d'une lame résistant à l'usure dans une section d'égouttage d'une machine à fabriquer le papier, ledit élément de lame comprenant un corps unitaire en céramique (10) comportant (i) une zone supérieure (10a) définissant une surface de travail supérieure (10c), (ii) des extrémités (10f, 10g), (iii) des bords d'attaque et de fuite (10d, 10e), et (iv) une zone inférieure (10b) façonnée de façon à pouvoir coopérer avec un support (16) destiné à supporter une pluralité d'éléments de lame assemblés de bout en bout, dans lequel le corps (10) s'étend entre lesdites extrémités (10f, 10g) de sorte que la longueur du corps en céramique (10) entre lesdites extrémités (10f, 10g) est supérieure à au moins trois fois sa largeur entre lesdits bord d'attaque et bord de fuite (10d, 10e); **caractérisé en ce que** le corps en céramique (10) est constitué d'oxynitride de silicium et d'aluminium.
2. Élément de lame selon la revendication 1, dans lequel le corps (10) est un corps coulé en barbotine.
3. Élément de lame selon la revendication 1 ou 2, dans lequel la zone inférieure (10c) du corps est pourvue en son sein d'un creux (12) ou d'un évidement qui s'étend dans la direction longitudinale du corps (10) entre lesdites extrémités (10f, 10g) et qui est de taille à recevoir une pluralité de tiges de fixation (18) devant être utilisées pour fixer ensemble des éléments de lame adjacents de bout en bout.
4. Élément de lame selon la revendication 3, dans lequel le creux (12) est situé principalement dans ladite zone inférieure (10b) du corps (10).
5. Élément de lame selon la revendication 4, dans lequel la section transversale du creux (12) a une forme telle que sa dimension dans le sens de la largeur du corps (10) dépasse sa dimension dans le sens de la hauteur du corps (10).
6. Élément de lame selon la revendication 3, 4 ou 5, dans lequel le creux (12) communique avec la surface inférieure du corps (10) au moyen d'une fente (10h) s'étendant longitudinalement à travers une paroi inférieure du corps.
7. Élément de lame selon la revendication 3, dans lequel l'évidement est défini entre des pattes s'étendant longitudinalement dans la zone inférieure (10b) du corps (10), lesdites pattes étant façonnées

de façon à pouvoir coopérer avec le support (16).

8. Élément de lame selon l'une quelconque des revendications précédentes, dans lequel le corps en céramique (10) a une épaisseur de paroi sensiblement constante. 5
9. Élément de lame selon la revendication 8, dans lequel la paroi du corps en céramique a une épaisseur d'environ 4 à 8 mm. 10
10. Élément de lame selon la revendication 8, dans lequel la paroi du corps en céramique (10) a une épaisseur d'environ 6 mm. 15
11. Lame résistant à l'usure comprenant une pluralité d'éléments de lame résistant à l'usure disposés de bout en bout sur une rangée, et un moyen de fixation (18) destiné à fixer la rangée d'éléments de lame; **caractérisée en ce que** les éléments de lame sont ceux selon l'une quelconque des revendications précédentes. 20
12. Lame résistant à l'usure selon la revendication 11, dans laquelle chaque élément de lame est tel que celui défini dans la revendication 3, dans laquelle le moyen de fixation comprend une pluralité de tiges de fixation s'étendant à travers lesdits creux (12) ou évidements dans lesdits éléments de lame de façon à coopérer avec des éléments de fixation aux extrémités de la rangée d'éléments de lame afin d'assembler et de fixer ladite rangée. 25 30

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