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(71) Applicant: **ECC INTERNATIONAL LIMITED**
Theale, Reading, Berkshire RG7 4SA (GB)

(72) Inventor: **Ranson, Anthony David Shelley**
4432 Alleur (BE)

(74) Representative: **McCormack, Derek James et al**
ECC International Ltd,
Patents Department,
c/o John Keay House
St Austell, Cornwall PL25 4DJ (GB)

(54) Reducing doctor blade wear in a paper coating

(57) A method of cooling one or more selected regions of a doctor blade in a paper coating machine which includes delivering to the selected region or regions a coolant liquid wherein the liquid is in the form of a mist of droplets having an average droplet size not greater than 100 microns, eg from 20 microns to 60 microns.

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Description

The present invention concerns a method and apparatus for reducing the rate of wear of a doctor blade in a paper coating machine.

A doctor blade is employed in a paper coating machine for removing surplus coating composition and smoothing and levelling the film of coating composition which has been applied to a surface of a moving web of paper.

Many commercial paper coating machines employ a doctor blade which is usually made of spring steel and is relatively thin so that it has a degree of flexibility which enables it to conform approximately to the coated surface of the paper web and to bend to open up a narrow slit between the upper surface of the paper web and the edge of the blade which determines the thickness of the film of coating composition which is allowed to remain on the surface of the web. The edge of the blade is biased by suitable means against the upper surface of the web, which is supported on a roll which is generally provided with an outer surface of a resilient material such as rubber or other elastomeric material. The magnitude of the biasing force which is applied determines the width of the slit which opens up, and hence the thickness, or weight per unit area, of the coating which remains on the surface of the paper web. The coating composition is applied to the paper web, before it passes under the doctor blade, in the form of a relatively concentrated aqueous suspension, which comprises one or more pigments, a dispersing agent for the pigments, an adhesive system and possibly one or more further additives. This composition may be applied, for example, by allowing the paper web to pass through a bath or trough containing the composition, by applying the composition to a rotating roll which in turns transfers the composition to the surface of the paper web, or by an applicator of the short dwell time type.

The length of the doctor blade is generally made to be greater than the length of the backing roll on which the moving paper web is supported. Typically, the ends of the doctor blade might overhang the ends of the backing roll by about 10mm on each side. Also, the width of the paper web is generally arranged to be less than the length of the backing roll. Again, typically, the edges of the paper web fall short of the ends of the backing roll by about 10mm. Furthermore, the width of the area of the web of paper which is actually coated with the wet coating composition is less than the width of the paper web. An uncoated margin usually of approximately 10mm in width generally exists at each of the edges of the paper web.

Over most of its width the edge of the doctor blade is in contact with wet coating composition on the surface of the moving paper web. This wet coating composition acts as a lubricant which reduces the friction, and hence the generation of heat, in the region of the blade edge. However, there are two regions at or near the ends of the blade where the blade edge is in contact with rapidly moving dry paper. The friction between the paper web and the blade edge in these regions is very much greater than where the blade edge contacts wet coating composition, and a considerable amount of heat is generated as a result. The local temperature at the extreme tip of the blade edge in these regions can rise to such a level that the material, eg spring steel, of which the blade is constructed can degrade, with the result that wear of the blade in these regions is greatly accelerated. When wear in these edge regions of the blade has reached a certain state, an excessive amount of coating composition may be required to be applied near the edges of the web, and this can lead to adhesion between successive turns of the paper web on a reel, and can render it necessary to clean some of the rolls of the paper coating machine. When wear of the blade has progressed to this extent, the complete blade must be replaced, and this necessitates a shutdown of the paper coating machine with a consequent expensive break in production.

Known devices for overcoming the generation of heat by friction in regions where the edge of a doctor blade contacts a rapidly moving paper web, include apparatus which sprays water onto the surface of the backing roll which supports the paper web as it passes under the doctor blade. Spray heads are located to direct water on to the surface of the roll so that the roll surface is thoroughly wetted before it comes into contact with the web of paper. This application of water serves to reduce friction between the paper web and the blade edge, and thus to reduce the amount of heat which is generated at the extreme edge of the blade. However, the apparatus suffers from the disadvantage that it uses a relatively large quantity of water, some of which is absorbed into the paper web, thus increasing the amount of water which must be evaporated in the subsequent web drying stage, and also changing the handling characteristics of the paper, so that difficulties are often encountered in reeling up the paper.

EP-A-460,771 describes a process and apparatus for eliminating or alleviating the problem of 'stalagmite' formation on the immediate downstream side of a doctor blade. The solution is to supply a fluid which will inhibit the formation of stalagmites. The fluid, steam, water or a steam/water mixture is supplied in an evenly distributed manner across substantially the width of the downstream side of the doctor blade. No special treatment at the ends of the doctor blade is suggested.

US-A-5081950 describes a paper coating machine in which doctor blade wear can be more uniform by providing the doctor blade in the form of a flexible band which can be moved transversely to the paper web direction. Water sprays are described which are brought to bear on the doctor bond after it has moved out of contact with the paper web. The device described provides no special treatment at the ends of a doctor blade.

Thus, the prior art does not provide a satisfactory solution to the problem of heat generation in the regions

where the edges of the doctor blade in a paper coating machine contacts dry regions of a moving paper web.

The object of the present invention is to therefore provide a method and apparatus which will in an improved manner reduce the amount of heat generated in the regions where the edge of the doctor blade in a paper coating machine contacts dry regions of a moving paper web, and thus prolong the useful life of the blade, and decrease the frequency of shut-downs of the machine for the purpose of changing blades.

According to the present invention in a first aspect a method of cooling one or more selected regions of a doctor blade in a paper coating machine includes delivering to the selected region or regions a coolant liquid in the form of a mist of droplets having an average droplet size not greater than 100μm (micrometers), especially not greater than 60μm. The droplet size may be generally in the inclusive range 20μm to 60μm. The said mist may be formed by a so-called atomiser head through which a supply of the coolant liquid is forced by a pressurised gas.

According to the present invention in a second aspect apparatus for cooling a selected region of a doctor blade of a paper coating machine comprises an atomiser head which is rigidly mountable in such a way as to direct a mist of coolant liquid droplets on to the selected region of the doctor blade, means for supplying a gas and a coolant liquid to the atomiser head under controlled conditions of flow rate and pressure to form the said mist and facing wall members mounted so as to enclose the atomiser head and define a region in which the blade is to be contacted by the mist of liquid droplets.

In use the doctor blade is biased against a backing roll which supports a web of paper to which a coating composition has been applied by known means. The atomiser head is preferably mounted at a distance of not more than about 150mm, and more preferably not more than 100mm, from the surface of the doctor blade in the region to be cooled. The gas supplied to the atomiser head is most conveniently air, and the liquid may comprise, for example, water. The wall members are preferably provided with flexible strips which abut the cylindrical surface of the backing roll, and/or the web of paper supported thereon, to form seals which prevent the lateral spread of the liquid out of the selected region.

Preferably a stream of a gas, the temperature of which has been reduced to below about 0°C, eg to a temperature in the range -5°C to -25°C, is also directed on to the selected region of the doctor blade. The gas is conveniently air from a compressed air supply which is passed through a suitable device which removes energy from a stream of the air and thus lowers the temperature thereof.

The method and apparatus in accordance with the present invention provide a suitable solution to the problem to be solved, namely continuous cooling of the selected regions of the doctor blade. The said mist also serves as a lubricant between the blade and the uncoated area of paper. The method according to the invention has the advantage that only a relatively small quantity of liquid is required to achieve the required cooling effect in the selected region of the doctor blade. The mist may be directed toward the blade in the precise locations where the highest temperatures are generated by friction with dry paper. Thus, there may be two said selected regions of the doctor blade which are cooled in accordance with the invention, the regions being near the respective ends of the blade where the blade is to be in contact with an area of dry, uncoated paper.

Two pieces of the apparatus for cooling according to the second aspect of the invention may be provided, each one arranged to cool one of the said selected regions of the blade.

The liquid which does contact the paper web is in the form of small atomised droplets, rather than a substantially continuous film, and it is found that liquid is less readily absorbed in this form into the paper being coated by the machine. Also, when a stream of cooled gas is also directed on to the selected region of the doctor blade, and when the liquid is water, the droplets of water freeze on contact with the paper web, and absorption is thus still further reduced.

The atomiser head of each apparatus according to the second aspect of the present invention is, in use, desirably located relative to the doctor blade in such a manner that the coolant mist provided from the atomiser head of each apparatus is directed onto the blade in its selected regions on the underside surface of the blade, ie the surface facing the paper passing under the blade.

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

Figure 1 is a diagrammatic side view of a part of a paper coating machine.

Figure 2 is a perspective view of a cooling device embodying the invention.

Figure 3 is a diagrammatic sectional side view, as seen on A - A of Figure 2, of the cooling device embodying the invention.

Figure 4 is a front view of the part of the coating machine shown in Figure 1 showing location of cooling devices of the type shown in Figures 2 and 3.

As seen in Figure 1, a device 1 for cooling a selected region of the doctor blade 2 of a paper coating machine is mounted on a top edge of a wall 3 of a pan 4 which contains a paper coating composition. A web of paper (not shown) is supported and advanced in a clockwise direction by a backing roll 5, and coating composition is applied to one surface of the web of paper by means of an applicator device which is indicated diagrammatically at 6. The device 1 is arranged to cool the underside of the blade 2, ie the surface of the blade 2 facing the roll 5 in the selected region of the blade 2. The doctor blade

2 is mounted on supporting means 7 which can also apply a force which biases the blade against the backing roll and against the web of paper supported thereon.

With reference to Figures 2 and 3, the cooling device 1 comprises an enclosure 8 in the form of an open-topped box having two side walls 9 and 10, a front wall 11, a rear wall 12 and a base plate 13. Flexible rubber sealing strips 14 and 15 are sandwiched between the side walls 9 and 10 and side plates 16 and 17, the sealing strips 14, 15 each having a bevelled edge 18 which contacts the surface of the backing roll 5, and makes a waterproof seal therewith. On each side the assembly of side wall, sealing strip and side plate is held together by a nut and bolt assembly 19. The rear wall 12 of the enclosure 8 is provided with two fixing holes 20, which enable the cooling device 1 to be secured to the supporting means 7 for the doctor blade 2. An atomiser nozzle 21 is rigidly mounted on the base plate 13 at a location such that its orifice is located at a distance of approximately 20mm from the surface of the doctor blade 2 (Figure 1) at its nearest point, and about 100mm from the blade edge. The atomiser nozzle 21 is provided with water through an inlet 22, and air under pressure through an inlet 23, the inlets 22 and 23 being mounted on the base plate 13. The water supply to the inlet 22 is adjusted by means of a valve mounted on a control panel (not shown). Also mounted on the same control panel are a flow meter and pressure gauge for the water supply and a control valve, a flow meter and a pressure gauge for the supply of air to the inlet 23. A supply of chilled air is introduced through an inlet 24, the temperature of the air being reduced to below 0°C, eg to a temperature of from -5°C to -25°C, by passing a supply of compressed air through a cooling device which creates a vortex A semi-cylindrical groove 25 is provided in the base plate 13 in order to distribute the flow of chilled air as uniformly as possible across the width of the cooling device. A drain 26 is provided to recover and recirculate surplus water.

Figure 4 shows the position of the cooling device relative to the blade 2 and roll 5 and paper thereon. As shown in Figure 4 the blade 2 contacts paper 31 of a moving web running over the roll 5. The ends of the roll 5 overlap the width of the paper 31. The paper 31 has a region 33 which has been coated and has dry, uncoated edges 35, 37 at the sides of the region 33. The blade 2 which is longer than the roll 5 becomes hot and wears especially where it contacts the dry paper edges 35, 37.

Two coolant devices having the construction of the device 1 shown in Figures 2 and 3 are indicated in Figure 4 as devices 39 and 41 respectively and are arranged adjacent to the blade 2 in selective regions thereof respectively where the blade 2 overlies the dry paper edges 35, 37. The devices 39 and 41 are arranged to be in a space adjacent to the underside of the blade 2 and the roll 5 (in the manner illustrated in Figure 1) whereby the coolant mist from the atomiser head 21 of each is directed in the selected regions of the blade 2 onto the underside surface of the blade 2 facing the roll 5. The positions of the devices 39 and 41 may be adjustable laterally, ie along an axis parallel to the blade 2, so that the atomiser head 21 of each can be suitably located relative to the selected regions of the blade 2 to be cooled.

In operation it is found that the cooling device and method embodying the invention substantially lubricates and reduces the temperature of the blade edge where it is in contact with rapidly moving dry paper, and the effective life of a blade is thus considerably prolonged so that a very advantageous reduction in the frequency of shut-downs of the paper coating machine is achieved without the use of excessive amounts of coolant liquid.

Claims

1. A method of cooling one or more selected regions of a doctor blade in a paper coating machine which includes delivering to the selected region or regions a coolant liquid wherein the liquid is in the form of a mist of droplets having an average droplet size not greater than 100 microns.

2. A method as claimed in claim 1 and wherein the said mist is formed by an atomiser head through which a supply of the coolant liquid is forced by a pressurised gas.

3. A method as claimed in claim 1 or claim 2 and wherein the coolant liquid comprises water.

4. A method as claimed in claim 2 or claim 3 and wherein the pressurised gas comprises air.

5. A method as claimed in any one of the preceding claims and wherein the coolant liquid is cooled by contact with a coolant gas.

6. A method as claimed in claim 5 and wherein the coolant gas comprises air having a temperature of less than 0°C.

7. A method as claimed in claim 5 or claim 6 and wherein the coolant liquid and coolant gas are combined adjacent to the selected region of the blade to be cooled.

8. A method as claimed in any one of claims 1 to 7 and wherein the blade is cooled by the coolant liquid in two regions adjacent respectively to dry edges of paper being coated on the machine.

9. A method as claimed in claim 8 and wherein the mist of coolant liquid is directed in the selected regions onto the blade on the underside surface thereof facing the paper on the roll.

10. A method as claimed in any one of the preceding claims and wherein the average size of the droplets of the coolant liquid is in the inclusive range 20μm to 60μm.

11. Apparatus for cooling a selected region of a doctor blade of a paper coating machine which comprises an atomiser head which is rigidly mountable in such a way as to direct a mist of coolant liquid droplets onto the selected region of the doctor blade, means for supplying a gas and a coolant liquid to the atomiser head under controlled conditions of flow rate and pressure to form the said mist and facing wall members mounted so as to enclose the atomiser head and define a region in which the blade is to be contacted by the mist of liquid droplets.

12. Apparatus as claimed in claim 11 and wherein the atomiser head is mounted on the paper coating machine at a distance of not more than 150 mm from the surface of the blade to be cooled.

13. Apparatus as claimed in claim 11 or claim 12 and wherein the said wall members comprise side walls of an enclosure having also a rear wall and a base, the atomiser head being attached to the base, the top of the enclosure and the front of the enclosure facing the blade being open.

14. Apparatus as claimed in claim 11, claim 12 or claim 13 and including means for delivering a stream of coolant gas into the mist of droplets emitted by the atomiser head.

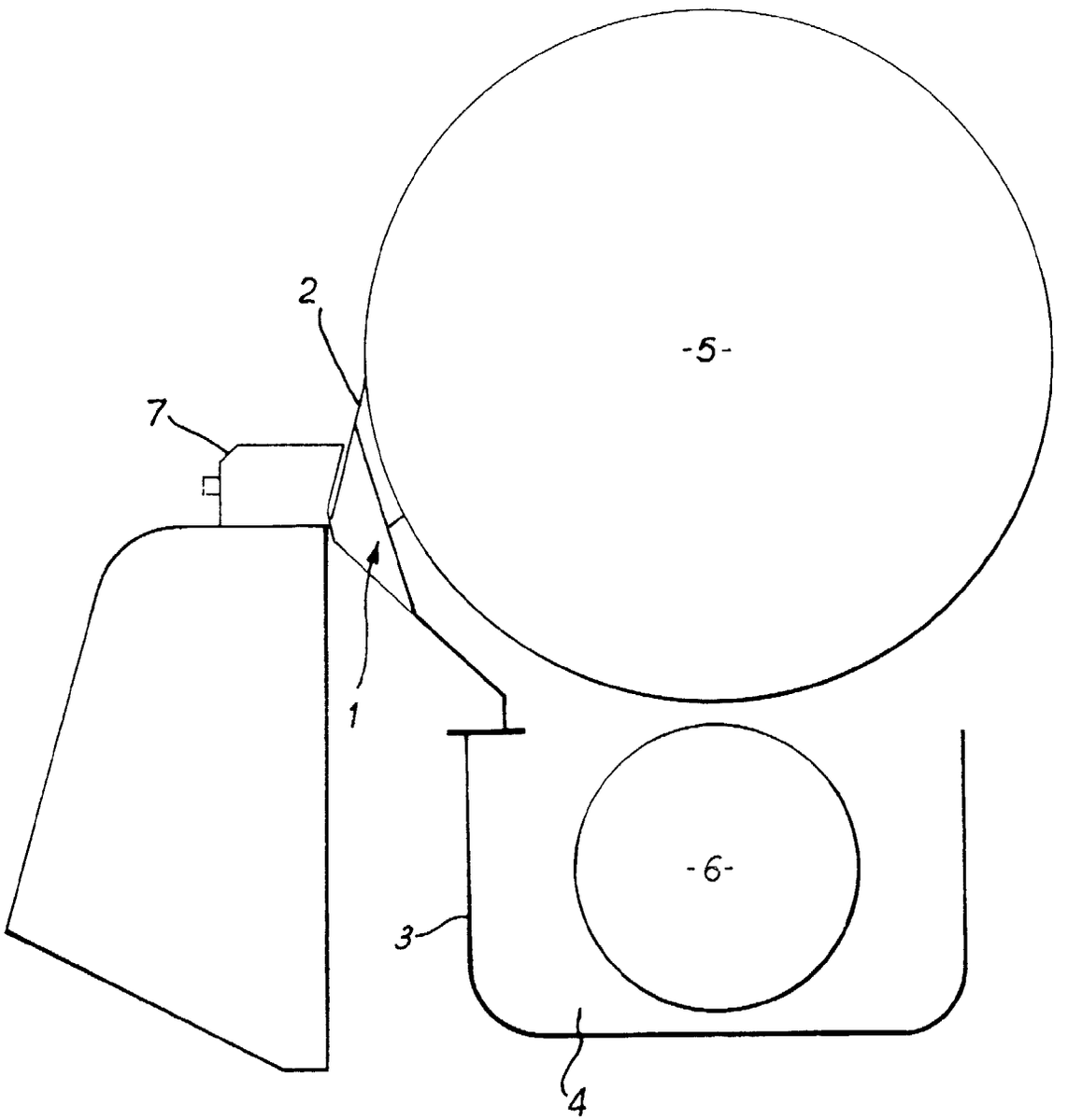

FIG. 1

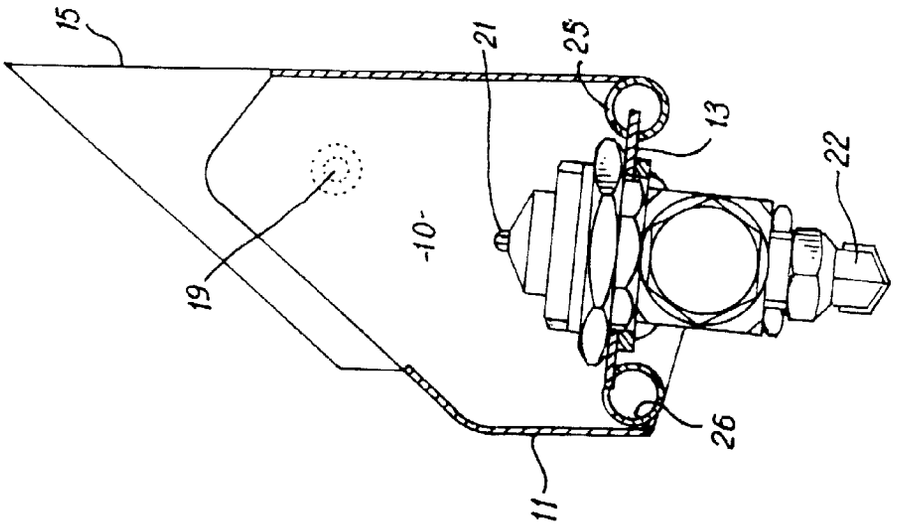
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Fig.3

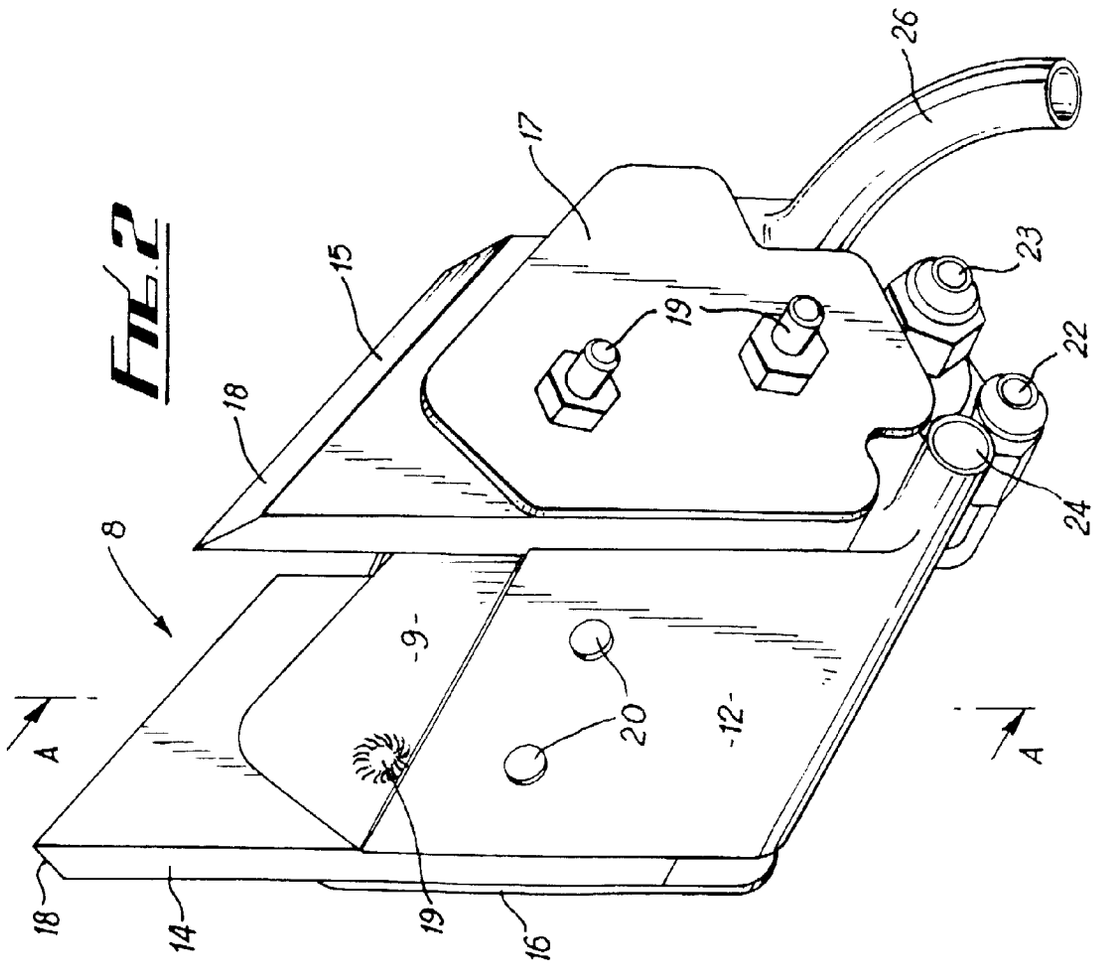
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Fig.2

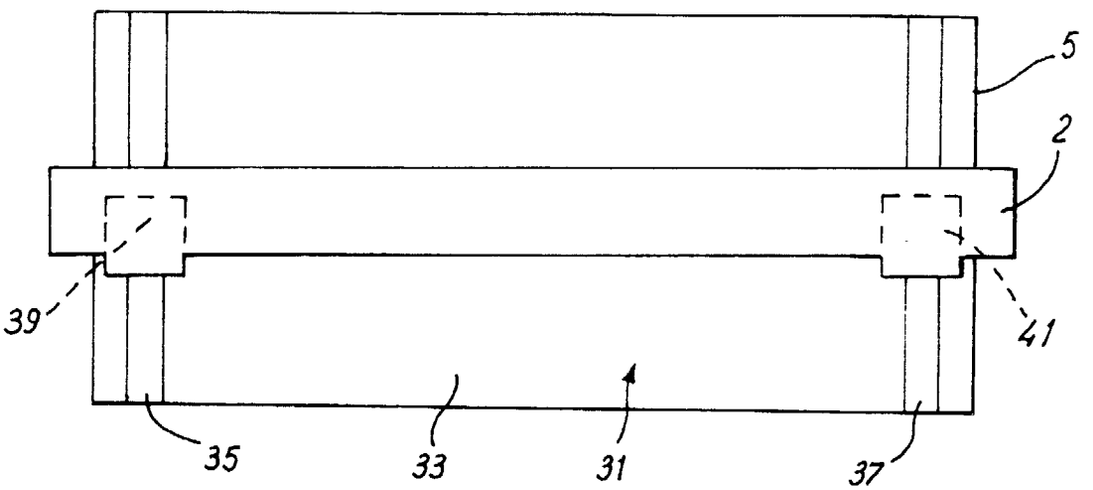

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 1538

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 603 145 A (VALMET PAPER MACHINERY INC.) 22 June 1994 * column 6, line 46 - column 7, line 8; claims 1-3; figure 4 *	1-14	D21H25/10 B05C11/04
A	EP 0 645 490 A (VALMET PAPER MACHINERY INC) 29 March 1995 * the whole document *	1-14	
A,D	EP 0 460 771 A (KNP PAPIER BV) 11 December 1991 * the whole document *	1-14	
A	DE 43 03 315 A (VOITH GMBH J M) 24 June 1993 * figure 4 *	1-14	
A,P	PATENT ABSTRACTS OF JAPAN vol. 097, no. 012, 25 December 1997 & JP 09 209286 A (ISHIKAWAJIMA HARIMA HEAVY IND CO LTD), 12 August 1997, * abstract *	1,11	
A	PATENT ABSTRACTS OF JAPAN vol. 015, no. 488 (C-0893), 11 December 1991 & JP 03 213599 A (ISHIKAWAJIMA HARIMA HEAVY IND CO LTD), 18 September 1991, * abstract *	1,11	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

D21H
B05C
D21G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 June 1998	Barathe, R

CATEGORY OF CITED DOCUMENTS

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