United States Patent

Barnscheidt

[15] **3,701,335**

[45] **Oct. 31, 1972**

[54] **COATING APPARATUS FOR SHEET MATERIAL**

[72] Inventor: **Wolfgang Barnscheidt,** Straberg/ Neuss, Germany

[73] Assignee: **Feldmuhle Aktiengesellschaft,** Dusseldorf, Germany

[22] Filed: **Feb. 12, 1971**

[21] Appl. No.: **114,845**

[30] **Foreign Application Priority Data**

Feb. 17, 1970 Germany.....P 20 07 067.1
July 9, 1970 Germany.....P 20 34 004.9

[52] **U.S. Cl.** **118/104,** 118/262, 15/256.52
[51] **Int. Cl.** **B05c 11/02,** B05c 1/08
[58] **Field of Search**.....118/262, 104, 118, 119, 110, 118/203; 15/256.52

[56] **References Cited**

UNITED STATES PATENTS

2,695,004	11/1954	Montgomery et al.	118/262
3,029,779	4/1962	Hornboster	118/104
3,021,307	2/1962	Csendes	260/72
3,179,083	4/1965	Warner	118/104
3,195,500	7/1965	Kuhnel	118/104 X
3,084,663	4/1963	Warner	118/104
3,143,438	8/1964	Campbell	118/104
3,031,872	5/1962	Kusters	118/104 UX
2,398,844	4/1946	Muggleton et al.	118/262 X

Primary Examiner—James Kee Chi
Attorney—Kelman & Berman

[57] **ABSTRACT**

In an apparatus in which the thickness of a coating on sheet material is controlled by passing the material between a backing roll and a thin, rotating rod of a doctor blade assembly, the rod is rotatably embedded in a confined body of elastomeric polyurethane or synthetic rubber. A circumferential portion of the rod is exposed between two lips of the body which is under compressive stress between the confining walls and the rod. Lubricant and cooling liquid is fed to an axial groove open toward the receptacle of the body, mainly discharged axially from the groove and partly withdrawn by suction from another groove circumferentially spaced from the first groove in the direction of rod rotation.

9 Claims, 4 Drawing Figures

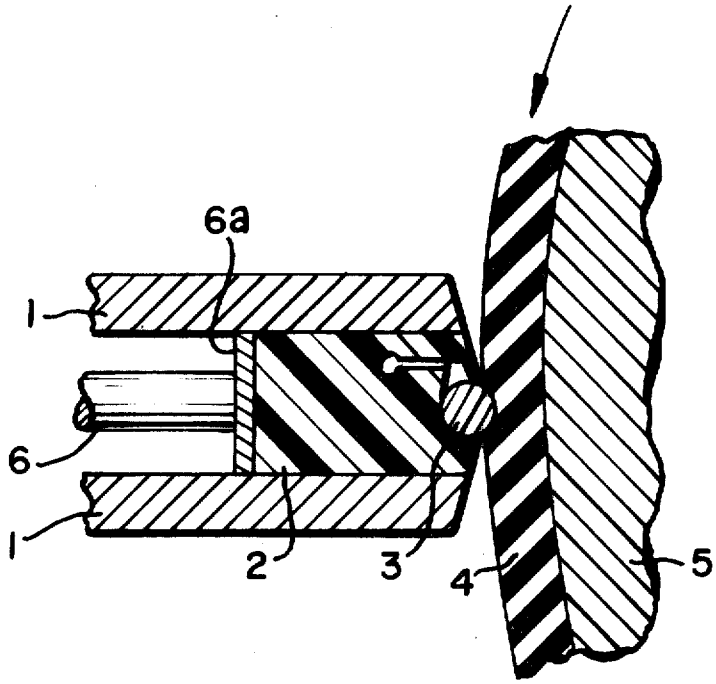
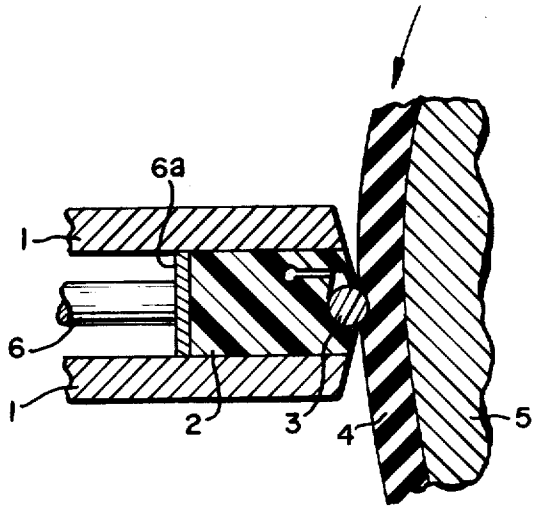


FIG.1



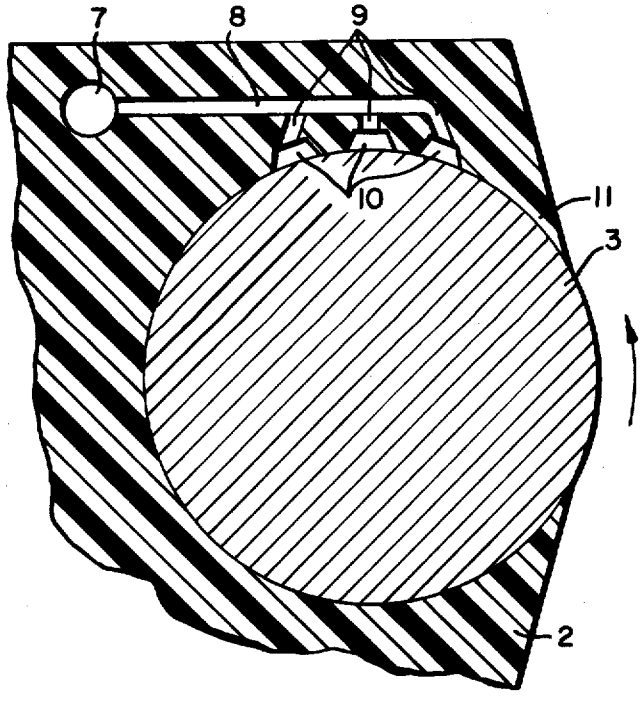


FIG.2

INVENTOR.
WOLFGANG BARNSCHEIDT
BY Kilman and Berman

AGENTS

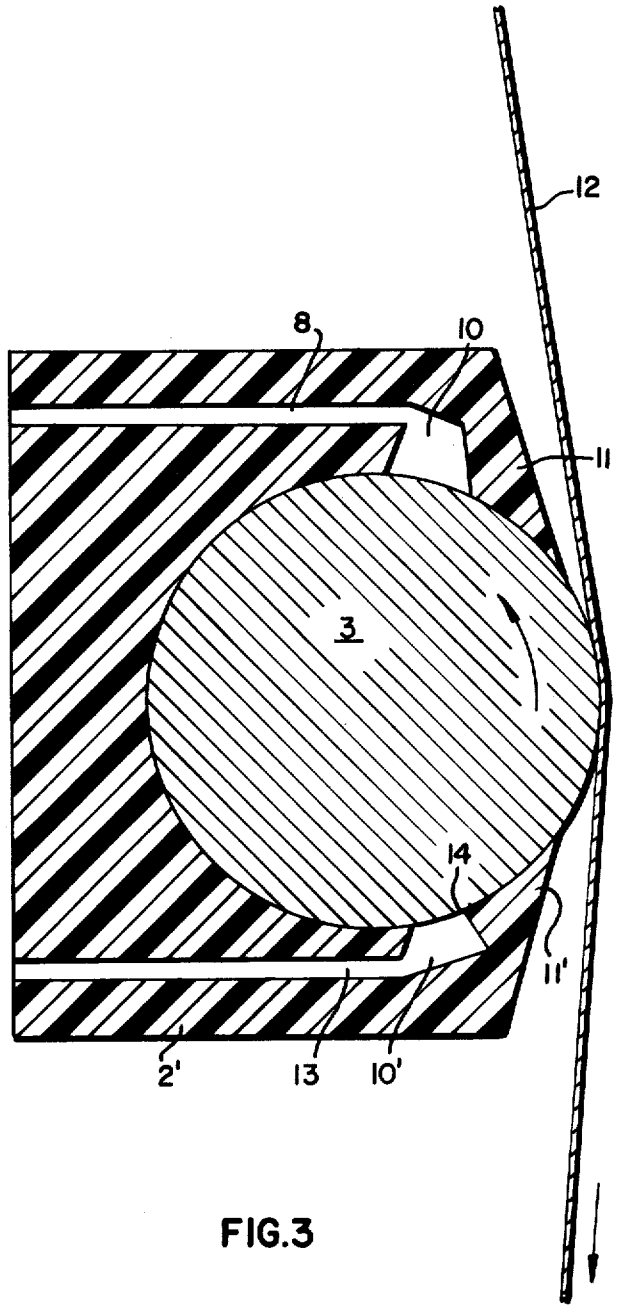


FIG.3

INVENTOR.
WOLFGANG BARNSCHEIDT
BY Kilman and Berman

AGENTS

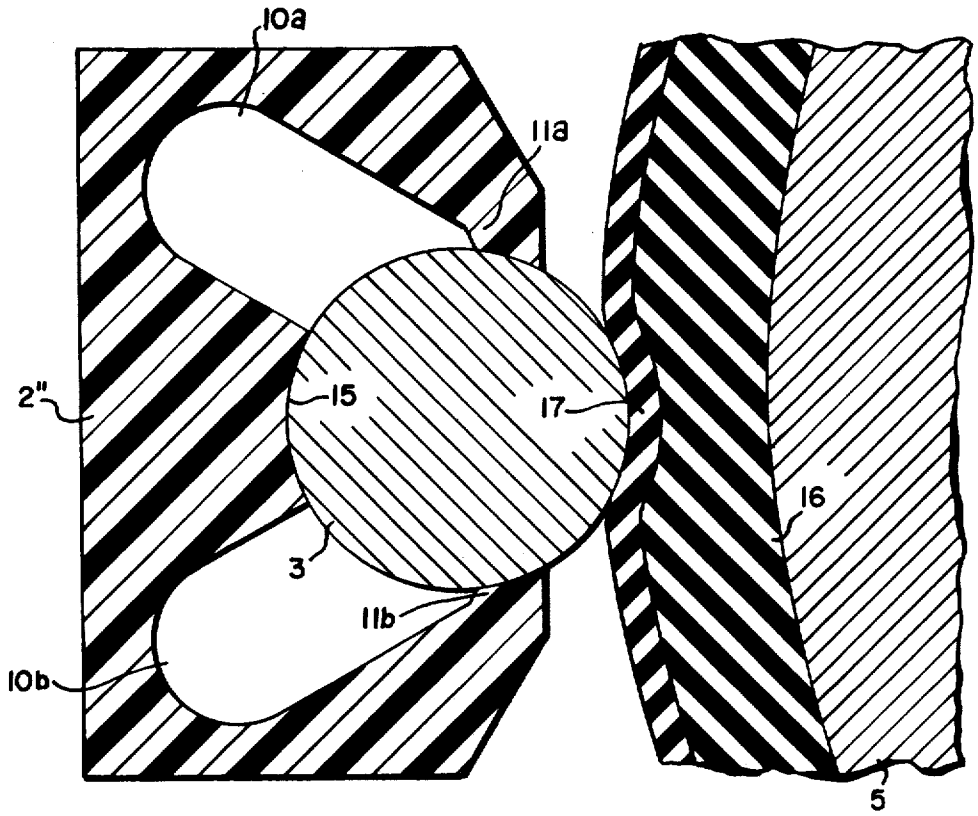


FIG.4

INVENTOR.
WOLFGANG BARNSCHEIDT
BY Kilman and Berman

AGENTS

COATING APPARATUS FOR SHEET MATERIAL

This invention relates to coating apparatus for sheet material, and more particularly to improvements in doctor blade assemblies and in their cooperation with other elements of coating machines.

In it more specific aspects, the invention is concerned with the cooperation between a backing roll tangentially a doctor blade whose edge is constituted by an elongated rod member rotating about its longitudinal axis while tangentally engaging coated sheet material supported by the backing roll.

The rod member is thin enough to be flexible even when made of stainless steel, the usual material of construction, and its spacing from the backing roll must be maintained in a well-defined manner in order to control the thickness of the coating on the sheet material.

It has been proposed in U.S. Pat. No.2,695,004 to have the rod member mounted in a cavity of a holder at least as flexible as the rod member itself. The several portions of the rod member are held at a desired distance from the backing roll by adjusting screws.

The recommended material of construction for the holder is fabric-laminated phenol-formaldehyde resin. While this material is somewhat flexible, and sufficiently so for the intended purpose, it does not yield under the pressure exerted by pigment particles which unavoidably find their way to the bearing face of the holder normally in contact with the rod member. The pigment particles increase friction between the holder and rod member, and cause relatively rapid wear. Tight sealing engagement between the relatively rigid holder and the rod member cannot be maintained under such wear.

It has now been found that the durability of a doctor blade assembly employing a rotating rod member can be greatly increased, and other advantages can be gained by conformingly receiving the rotating rod member in a receptable defined by a body of elastomeric material confined in a guide channel of much more rigid walls. The dimensions of the receptacle are chosen in such a manner that the receptacle is smaller transversely of the longitudinal axis of the rod member than the latter when the rod member is removed, the arrangement being such that the body is in compressive strain between the rod member and the confining walls.

Two lip portions of the body, which are elongated in the direction of the axis of rod rotation, bound the open side of the receptacle and a face in the receptacle which connects the lip portions and has a circumferential width relative to the axis of the rod member which is substantially greater than 180°.

Other features, additional objects, and many of the attendant advantages of this invention will readily become apparent as the same is better understood by reference to the following description of preferred embodiments when considered in connection with the appended drawing in which:

FIG. 1 shows a coating apparatus of the invention in fragmentary side elevational section;

FIG. 2 shows a portion of the apparatus of FIG. 1 on a larger scale and in more detail;

FIG. 3 illustrates a first modification of the apparatus of FIG. 1; and

FIG. 4 shows a second modification, the views of FIGS. 3 and 4 being on a scale similar to that of FIG. 2.

Referring now to the drawing in detail, and initially to FIG. 1, there is shown only as much of an otherwise conventional coating machine for paper and like sheet material as is needed for an understanding of the invention.

Rigid metal plates 1 fixedly mounted on the machine frame, not itself seen, form a guide channel in which a holder bar 2 of elastomeric polyurethane is received. The guide channel and the bar 2 extend over the full width of the coating machine at right angles to the plane of FIG. 1, and such width will be understood to be many times greater than any dimension seen in FIG. 1.

A stainless steel rod 3 of generally cylindrical shape is conformingly embedded in the bar 2, and only a small circumferential portion of the rod projects from a face of the bar which is directed outward of the open side of the guide channel between the plates 1 and toward a rubber coating 4 on the core 5 of a backing roll, the core essentially consisting of steel or cast iron.

Only the piston rod 6 of a pneumatic jack is seen in FIG. 1. The non-illustrated cylinder is mounted on the machine frame, and thereby fixedly connected with the plates 1. A transverse steel plate 6a on the free end of the piston rod 6 in the guide channel abuttingly engages the face of the bar 2 directed away from the roll 5. It will be understood, that other jacks, not seen in the drawing are arranged along the plates 1 as will presently be explained.

As is better seen in FIG. 2, a distributor conduit 7 connected to a non-illustrated water line extends through almost the full length of the bar 2. Multiple branch channels 8 extend from longitudinally spaced portions of the distributor conduit 7 at right angles toward the roll 5 and connect the conduit 7 with three sets of orifices 9 in respective grooves 10 formed in a cylindrically arcuate inner face about a receptacle in the bar 2. The receptacle is practically filled with the rod 3 in the assembled condition of the apparatus, and the elastomeric material of the bar 2 would expand and reduce the size of the receptacle if the rod 3 were removed.

The rod is enveloped by the inner face of the bar 2 in an arc of about 300°, **and is normally rotated by a mechanism, not shown but known in itself, in the direction of the curved arrow in FIG. 2, which is opposite to the direction of movement of the backing roll, as indicated by an arrow in FIG.1. The rod 3 moves toward an integral, acutely angular, leading lip portion 11 of the bar 2 which is firmly held against the surface of the steel rod 3 by stresses in the resiliently deformed bar 2. Pigment particles are not likely to penetrate the seal formed by the lip portion 11. If they do, no permanent damage is done to the seal which again closes behind the pigment particles.**

Water is fed through the distributor conduit 7 into the grooves 10 which are trapezoidal in cross section and flare toward the receptacle containing the rod 3. The obtuse angles formed between the arcuate inner face of the bar 2 and the side walls of the grooves 10 facilitate entry of captured pigment particles into the grooves. They also prevent concentration of stresses in the relatively weak lip portion 11.

Most of the water supplied to the grooves 10 flows along the grooves and is ultimately discharged with the

entrained pigment particles beyond the sides of the apparatus in a manner obvious and not specifically illustrated. The flowing water keeps the lip portion 11 cool and thereby protects it against wear to which this portion is most exposed during normal operation of the apparatus. Some water is carried as a thin film along the interface of the bar 2 and the rod 3 during the rotary movement of the latter.

Water is an excellent lubricant for interfaces of most elastomers and stainless steel, but other lubricant and cooling liquids may be employed if the presence of water is not compatible with the coating material applied to the sheet material processed, or if the materials of construction so require.

In the modified apparatus of the invention partly illustrated in FIG.3, and identical with that seen in FIGS. 1 and 2, as far as not explicitly shown, a single flaring groove 10 in the polyurethane bar 2' extends over the entire working length of the rod 3 and is supplied with water or other lubricant and coolant from a branch channel 8 as described above. The liquid film formed at the groove 10 between the rod 3 and the resilient bar 2', generally closely similar to the bar 2, is carried in a cylindrically arcuate path by rotating bar 3 until it is almost completely removed at a groove 10' near the trailing lip portion 11' of the bar 2'. The groove 10' is a trapezoidal cross section and tapers toward the receptacle for the rod 3 so that it presents an acutely angular edge 14 of the lip portion 11' to the moving rod 3. The edge 14 wipes the liquid film from the rod surface, and the liquid collected in the groove 10' is drawn off by a suction circuit of which only a branch conduit 13 is seen in FIG.3. The vacuum in the groove 10' enhances the contact pressure between the edge 14 and the rod 3. No significant amounts of lubricant can reach the sheet material 12 which is being engaged by the rod 3.

With some lubricants, particularly those having relatively high viscosity, the arrangement shown in FIG. 4 is preferred. The polyurethane elastomer bar 2'', identical with or closely similar to the bars 2,2', as far as not illustrated, is formed with relatively large and wide grooves 10*a*,10*b* respectively contiguous to the lip portions 11a,11b which bound the open side of the receptacle for the rod 3. In the instant case, the grooves are so dimensioned that they divide the inner arcuate face of the receptacle into a backing portion 15 and two marginal portions between the acutely angular edges of the lip portions and the grooves. -rooves. The marginal portions have each a circumferential width of about 30°, and the backing portion 15 is about 60° wide. FIG. 4 illustrates a limiting condition, and it is usually preferred that the two marginal portions of the inner receptacle face have a combined circumferential width smaller than that of the face portion between the grooves. Friction between the rod 3 and bar 2'' is minimal.

As is better seen in FIG.4, and has been omited from FIG. 1 for the sake of clarity, the rubber coating 4 on the core 5 consists of two layers which are radially superimposed. The outer layer 17 consists of relatively hard rubber, and the inner layer 16 is much softer and its radial thickness is much greater than that of the layer 17. Best results are obtained when the thickness of the layer 16 is four to ten times that of the layer 17, the thickness of the outer layer being even smaller than the radius of the rod 3. The hardness of the elastomeric material in the bars 2,2',2'' is chosen so that the outer layer 17 is wrapped about a part of the exposed face of the rod 3 without significant distortion of the embedding bar 3, as is shown in FIG.4.

In typical coating apparatus of the invention, the polyurethane employed for making the bars 2,2',2'' had a Shore hardness of 90° – 95°, the outer layer 17 a hardness of 40° and a thickness of about 5 mm, and the inner layer a hardness of 20°. Generally, the Shore hardness of the elastomeric bodies 2,2',2'' should not be less than 70°, that of the outer layer 17 between 30° and 70°, and that of the inner layer 10° to 30°. Under these conditions, the coated sheet material travels through a relatively long nip between the backing roll and the rod 3, as is evident from FIG.4, without excessive wear of the relatively hard outer layer 17 whose thickness should be between 3 and 10 mm, depending on its hardness within the range mentioned above.

Wear of the backing roll is also held to a minimum by the resiliency of the pneumatic jacks represented in FIG. 1 by the piston rod 6. The jacks are closely spaced along the bar 2, typically 5 cm apart, and are preferably connected with a compressed air line by individual pressure reducing valves which permit close control of the force with which the several plates 6*a* urge the bar 2 to move in the guide channel between the plates 1 toward the backing roll. Once the jacks are suitably adjusted, the apparatus of the invention produces long runs of coated paper having an entirely uniform finish without any trace of striping in the direction of paper movement through the coating apparatus.

The unitary polyurethane bars 2,2'2''2'' have a long useful life. If required, they are replaced after fully retracting the piston rods 6 and withdrawing the rod 3 between the resilient lips. A new bar is inserted by reversing the sequence of withdrawal operations.

Elastomeric materials other than polyurethane may be employed for embedding the rod 3, and wear resistant synthetic rubber has been used to advantage in the bars 2,2',2''.

Other changes and modifications in the apparatus of the invention will readily suggest themselves to those skilled in the art, and it should be understood that, within the scope of the appended claims, the invention may be practiced otherwise than is specifically disclosed.

What is claimed is:

1. In a coating apparatus for paper and like sheet material including a rotatable backing roll and a doctor blade assembly axially coextensive with the roll, said assembly including an elongated rod member and a holder arrangement supporting the rod member for rotation about an axis extending in the direction of elongation of said rod member and substantially parallel to the axis of said roll while sheet material backed by said roll is engaged by said rod member, the improvement which comprises:

a. wall means in said holder arrangement defining a guide channel open toward said roll; and

b. a body of elastomeric material conformingly received in said channel,

1. said body defining therein a receptacle elongated in said direction and transversely open toward said roll, said receptacle conformingly receiving said rod member,

2. the transverse dimensions of said receptacle in the absence of said rod member being smaller than the corresponding dimensions of said rod member in such a manner that said body is under compressive stress between said wall means and said rod member,

3. said body having two lip portions elongated in said direction, said lip portion bounding the open side of said receptacle, and a face in said receptacle connecting said lip portions,

4. the circumferential width of said face relative to said axis of the rod member being substantially greater than 180°.

2. In an apparatus as set forth in claim **1**, said face being formed with one groove adjacent one of said lip portions and remote from the other lip portion, and with another groove adjacent said other lip portion and remote from said one lip portion, said grooves being elongated in said direction, means for supplying a liquid to said one groove, and suction means for withdrawing said liquid from said other groove.

3. In an apparatus as set forth in claim **1**, the resiliency of said elastomeric material being sufficient to permit said rod member to be withdrawn between said lip portions through the open side of said receptacle, and to be inserted between said lip portions into said receptacle.

4. In an apparatus as set forth in claim **2**, said other lip portion having an acutely angular edge bounding said other groove, the other groove tapering transversely toward said receptacle.

5. In an apparatus as set forth in claim **2**, said lip portions having respective oppositely spaced edges, said edges and said grooves circumferentially bounding respective marginal portions of said face, the circumferential width of said face between said grooves being at least equal to the combined circumferential width of said marginal portions.

6. In an apparatus as set forth in claim **1**, said body essentially consisting of polyurethane or synthetic rubber.

7. In an apparatus as set forth in claim **1**, said roll having a substantially rigid core and two radially superposed layers of elastomeric coating material on said core, the material of the outer layer being substantially harder than the material of the inner layer, and the radial thickness of the inner layer being four to ten times the radial thickness of the outer layer.

8. In an apparatus as set forth in claim **7**, said thickness of the outer layer being substantially smaller than the radius of said rod member.

9. In an apparatus as set forth in claim **1**, a plurality of pneumatic motor means on said wall means yielding urging said body to move in said channel toward said roll.

* * * * *