

[54] COATING APPARATUS FOR SHEET MATERIAL

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118/117, 118, 122, 121, 119, 123, 126, 262;
117/102 L, 102 M, 64 R, 64 C; 15/256.5

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[57] **ABSTRACT**

The doctor blade assembly of a coating apparatus has a metal rod rotatable about its longitudinal axis and partly received in the operating portion of an elongated, unitary holder body of elastomeric material which also has a plate-shaped mounting portion, a part of the mounting portion remote from the operating portion being fastened to a fixed support for flexing of another part of the mounting portion for resilient movement of the operating portion and of the rod received therein toward and away from a backing roll for the sheet material to be coated.

10 Claims, 2 Drawing Figures

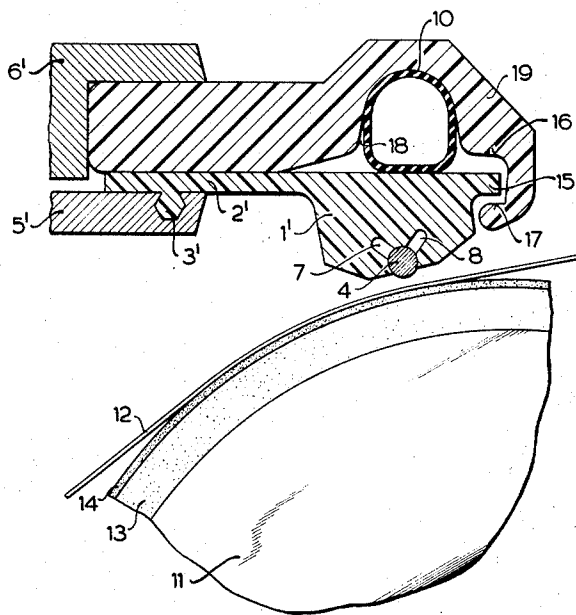


FIG. 1

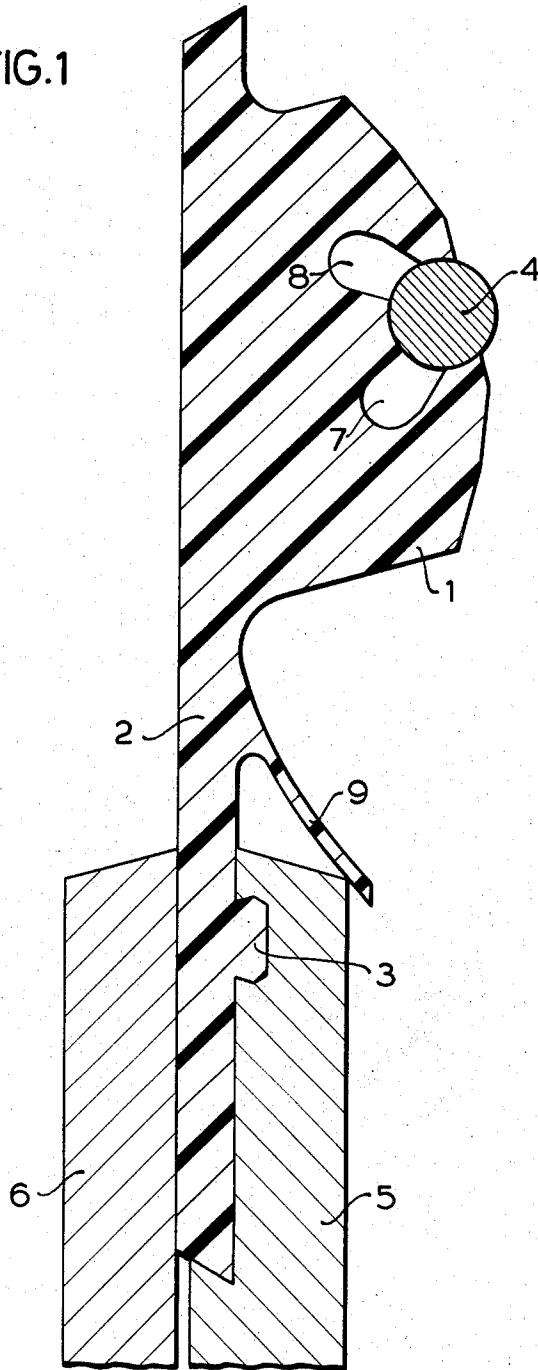
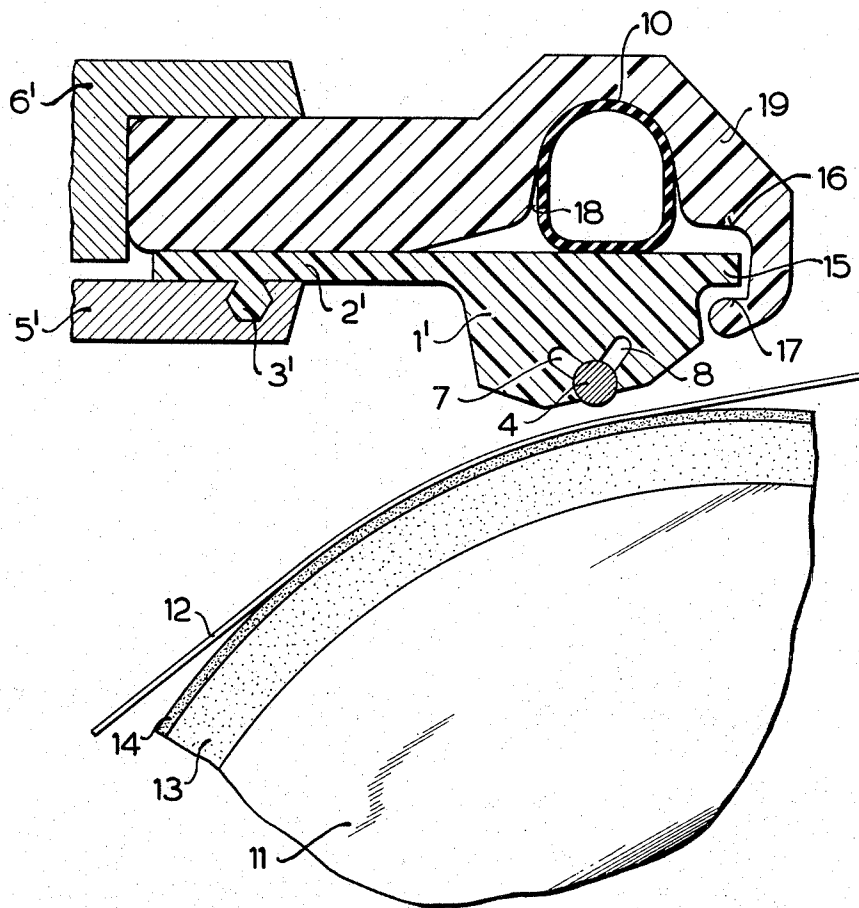


FIG. 2



COATING APPARATUS FOR SHEET MATERIAL

This invention relates to coating apparatus for sheet material, and particularly to an improvement in the doctor blade assembly of the apparatus disclosed and claimed by one of us in application Ser. No. 114,845, filed on Feb. 12, 1971, now U.S. Pat. No. 3,701,335.

The doctor blade assembly of the earlier invention included a metal rod largely received in a receptacle defined by an elongated holder bar of elastomeric material, the bar being received in a rigid, stationary guide structure and backed by a row of pressure-fluid operated jacks acting on a thin steel plate extending over the length of the holder bar. While this apparatus has been operated successfully and permitted a web of paper or other sheet material to be coated uniformly over its entire width even if that width was of the order of five meters, it is relatively complex and requires substantial skill on the part of an operator who must adjust the pressure of the jacks to specific operating conditions.

An object of the instant invention is an improved coating apparatus whose doctor blade assembly combines the advantages of the earlier invention with a structure which is built and operated at lower cost.

With this object and others in view, as will become apparent hereinafter, the present invention employs a rotatable backing roll and a doctor blade assembly co-extensive with the roll in the direction of its axis of rotation. The assembly includes an elongated rod member and a holder arrangement supporting the rod member for rotation about an axis extending in the direction of elongation of the rod member and substantially parallel to the axis of the backing roll while sheet material is engaged by the rod member. The holder arrangement includes a body of elastomeric material whose operating portion defines therein a receptacle elongated in the common direction of the afore-mentioned axes and partly receiving the rod member. The structure described so far is common to the apparatus of the earlier invention.

The improvement now provided resides in the holder arrangement and provides the body of elastomeric material with an integral mounting portion which extends in a direction away from the operating portion. A fastening device fastens a part of the mounting portion remote from the rod-receiving receptacle in the operating portion to a normally stationary support for resilient movement of the receptacle toward and away from the backing roll when another part of the mounting portion intermediate the remote part and the receptacle is flexed.

Other features and many of the attendant advantages of this invention will readily become apparent from the following detailed description of preferred embodiments when considered in connection with the appended drawing in which:

FIG. 1 shows the doctor blade assembly of coating apparatus of the invention in side-elevational section; and

FIG. 2 shows a modified coating apparatus of the invention in a view corresponding to that of FIG. 1.

Referring now to the drawing in detail, and initially to FIG. 1, there is shown only as much of a coating apparatus for continuous webs of paper and like sheet material as is necessary for an understanding of the in-

vention, the non-illustrated portion being of the type disclosed in the afore-mentioned patent and partly shown in FIG. 2.

The illustrated doctor blade assembly includes a unitary holder body of elastomeric polyurethane resin composition which has an operating portion 1 and a plate-shaped mounting portion 2 extending away from the operating portion. The elastomeric body has a length at right angles to the plane of FIG. 1 which is a multiple of all dimensions seen in the drawing and is of uniform cross section, as illustrated, over practically its entire length which may be of the order of several meters.

A longitudinally elongated, integral rib 3 projects from the mounting portion. The operating portion 1 defines therein a receptacle which is largely occupied by a cylindrical, stainless steel rod 4, the remainder of the receptacle constituting longitudinal grooves 7, 8 circumferentially offset about the rod 4. As is known in itself, the rod 4 is rotated about its longitudinal axis during operation of the coating apparatus and distributes a coating composition over the surface of an engaged web of sheet material. Any small amount of coating composition that may penetrate between the rod 4 and the elastomeric operating portion is removed by a cleaning and lubricating liquid, such as water, passing through the grooves 7, 8.

The normally stationary support structure of the apparatus has been largely omitted from the showing of FIG. 1 and is represented only by a fixed clamping jaw 5. The mounting portion 2 of the elastomeric holder body is fastened to the support structure partly by the rib 3, which is conformingly received in a groove of the jaw 5, and partly by a movable jaw 6 cooperating with the fixed jaw 5 in a conventional manner for clamping the part of the mounting portion 2 which is remotest from the rod 4 and the receptacle in which the rod is received. The illustrated arrangement permits the operating portion 1 to move toward the left and right, as viewed in FIG. 1, when a part of the mounting portion 2 intermediate the clamped, remote part and the operating portion 1 is flexed, as will become clearer from the following description of FIG. 2.

An integral skirt 9 depends from the mounting portion 2 and shields the fixed jaw 5 and other stationary support structure, not explicitly shown, against contamination with coating composition splashing from the rod 4.

In the more fully illustrated, modified coating apparatus shown in FIG. 2, the holder body of elastomeric polyurethane resin composition has an operating portion 1' and a plate-shaped mounting portion 2' closely similar to the corresponding elements described with reference to FIG. 1, a rib 3' projecting from the mounting portion. A stainless steel rod 4 is partly received in a longitudinally elongated receptacle of the operating portion 1', substantially as described above, leaving grooves 7 and 8 for a stream of water or other cleaning and lubricating liquid.

A groove in a fixed jaw 5' conformingly receives the rib 3' for fastening the holder body to the normally stationary support structure of the apparatus, not otherwise shown. A jaw 6' movable relative to the fixed jaw 5' in a conventional manner, not explicitly shown, fastens the mounting portion 2' to the support structure and simultaneously secures a bracket 19 elongated at right angles to the plane of FIG. 2, longitudinally coex-

tensive with the rod 4, and of uniform approximately J-shaped cross-section over its entire length.

The coating apparatus includes a backing roll 11, omitted from the showing of FIG. 1, over which a web 12 of paper or like sheet material passes during operation of the apparatus for engagement by the rod 4. As described in more detail in the earlier patent, the roll has a cast iron core carrying a relatively thick soft rubber layer 13 covered by an exposed harder rubber layer 14.

The mounting portion 2' has a face directed toward the roll 11 and another face directed away from the roll and coplanar with a corresponding face of the operating portion 1' in the illustrated condition of the apparatus. The bracket 19 is superposed in area contact on the last mentioned face of the mounting portion 2' and formed with a groove 18 which is open toward the operating portion 1'. The groove receives a pliable rubber tube 10 connected to a source of compressed air, not shown, which permits the tube to be inflated. A gas pressure of less than 10 p.s.i.g. is normally maintained in the tube for flexing the mounting portion 2' and thereby bringing the rod 4 into contact with the paper web 12.

A rail 15 integral with the operating portion 1' of the holder body provides an abutment which may cooperate with abutment faces 16, 17 on the bracket 19 for limiting movement of the rod 4 toward and away from the roll 11, and thereby to avoid oscillation of the rod which is sometimes observed in coating apparatus of this type.

The unitary holder body 1', 2', 3', 15, the roll 11, and the bracket 19 extend over the full width of the coating apparatus at right angles to the plane of FIG. 2, and are each of uniform cross section over the entire length. The elastomeric holder body is preferably prepared by casting a urethane resin composition in an aluminum mold extruded from a die whose configuration will be obvious from FIG. 2. The mold thus does not have any seams, and the holder body is precisely uniform in cross section. An elastomer successfully employed has been prepared from a polyester of ethyleneglycol and adipic ester and 1,5-diisocyanato-naphthalene, using a polyhydric alcohol as a cross-linking agent.

Suitable polyurethane resin compositions capable of being cast in the desired shape are staple articles of commerce, and they may be prepared, for example, from a polyester having available hydroxyl groups and a diisocyanate. Such elastomeric polyurethane compositions have good wear resistance and excellent elasticity, and are cast with relative ease. When lubricated with water and other liquids, they have a very small coefficient of friction in contact with stainless steel, the preferred material of construction for the rod 4. The operating portion 1 is held by the rod 4 under compressive stress so that the coating composition normally flooding the exposed portion of the rod 4 cannot readily penetrate into the receptacle of the operating portion, the exposed rod portion having an angular width of about 120°.

The mounting portion 2,2' provides at least a portion of the resilient contact pressure holding the rod 4 engaged with a web 12 traveling over the roll 11 as is shown in FIG. 2, but also inherent in the apparatus only partly shown in FIG. 1. The arrangement is extremely simple and automatically adjusts itself to variations in the thickness of the web 12 over its width and similar

minor irregularities of the material to be coated without requiring intervention of an operator after the holder body is properly positioned between the fastening jaws 5, 6 or 5', 6'. The damping properties of the elastomeric material in the mounting portion 1, 1' are normally sufficient to prevent oscillation of the operating portion 1, 1' toward and away from the backing roll 11 after the rod 4 was pushed away from the roll 11 by an irregular portion of the web 12. Accidental major oscillations are prevented by the cooperating abutments 15, 16, 17 shown in FIG. 2 and capable of being provided in the apparatus of FIG. 1 in an obvious manner between the operating portion 1 and the stationary supporting structure of the apparatus.

While a skirt corresponding to that shown at 9 in FIG. 1 has not been illustrated explicitly in FIG. 2, it is preferably provided to prevent pigment particles and other ingredients of a coating composition from entering the area about the fastening and securing jaws 5', 6', thereby interfering with precise positioning of the mounting portion 2' between the jaws 5', 6' in a subsequent run. The bracket 19 together with the entire holder body is readily removed for cleaning and adjustment between runs from the jaws 5', 6'. The bracket 19 is preferably a body of extruded aluminum alloy, inherently uniform over its entire length. Due to its approximate J-shape it is rigid enough over its entire length of several meters to permit its position to be defined with the necessary precision by the jaws 5', 6' in cooperation with non-illustrated fasteners at the longitudinal ends of the bracket.

The tube 10, when charged with air or another gas at a pressure slightly higher than atmospheric pressure further compensates for irregularities in the substrate being coated and damps vibrations of the rod 4 that may otherwise be caused by such irregularities. For best performance, it is necessary that the diameter of the tube 10 be several times greater than that of the rod 4. The gas pressure in the tube may be selected between about 1 and 12 p.s.i.g., but is normally lower than 10 p.s.i.g. To some extent, the thickness of the applied coating may be varied by varying the internal pressure in the tube 10, a suitable pressure-reducing valve, not illustrated and conventional, being interposed between the tube 10 and a compressed-air line or similar source of gas under pressure higher than atmospheric pressure.

The rib 3, 3', which extends over the full length of the holder body and is received in a conforming groove of the stationary support structure, permits the clamping pressure of the jaws 5, 6 and 5', 6' to be held at a moderate value without risking withdrawal of the mounting portion 2, 2' from the jaws under the substantial stresses acting on the mounting portion during start-up in the plane tangential to a cylinder about the axis of the roll 11 in which the mounting portion is located, particularly after a temporary interruption of the coating operation in which some coating composition may have gelled or otherwise partly solidified near the rod 4.

As is conventional, and has been described in the earlier patent, the rod 4 and the roll 11 are driven in the same direction of rotation so that their proximal surface portions move in opposite directions, and the surface of the rod 4 moves against the direction of travel of the web 12. During start-up, and before the rod 4 engages the web 12, the holder body bends toward the

roll 11, whereby oscillations of the doctor blade assembly may be generated. The cooperating abutment faces 15, 16, 17 are also effective in preventing or quickly damping such oscillations.

The improved apparatus of the invention has been found to produce uniform coatings on paper and similar sheet material under favorable conditions not always successfully tackled by the apparatus of the earlier patent unless operated by a very skillful man. The improved apparatus is built and operated at lower cost and is self-adjusting to an extent not previously available.

It should be understood, of course, that the foregoing disclosure relates only to preferred embodiments of the invention, and that it is intended to cover all changes and modifications of the examples of the invention chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

What is claimed is:

1. In a coating apparatus for paper and like sheet material including a rotatable backing roll having an axis of rotation and a doctor blade assembly axially coextensive with the roll, the 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 said axis of rotation while sheet material backed by said roll is engaged by said rod member, the holder arrangement including a body essentially consisting of elastomeric material having an operating portion defining therein a receptacle elongated in the common direction of said axes and open toward said roll, said receptacle partly receiving said rod member, the improvement in said holder arrangement which comprises:

- a. a normally stationary support,
 - 1. said body of elastomeric material having an integral mounting portion extending in a direction away from said operating portion;
- b. fastening means fastening a part of said mounting portion remote from said receptacle to said support for movement of said receptacle toward and away from said roll when another part of said mounting portion intermediate said remote part and said receptacle is flexed.

2. In an apparatus as set forth in claim 1, said mounting portion being substantially plate-shaped, elongated

in said common direction, and extending in a plane tangential to a cylinder about said axis of rotation.

3. In an apparatus as set forth in claim 2, said support being formed with a groove elongated in said common direction, and said fastening means including a rib integral with said remote portion and conformingly received in said groove.

4. In an apparatus as set forth in claim 3, said body having an integral skirt portion projecting from said intermediate part and interposed between said rod member and said support.

5. In an apparatus as set forth in claim 3, said operating portion, said mounting portion, and said rib being coextensive with said roll in said common direction, and of uniform cross section over the entire length thereof.

6. In an apparatus as set forth in claim 2, a bracket member, said mounting portion having a face directed toward said roll and another face directed away from said roll, and securing means securing said bracket member to said support in a position in which said bracket member is superposed on said mounting portion in area contact with said other face and limits flexing of said intermediate part and the movement of said receptacle away from said roll.

7. In an apparatus as set forth in claim 6, a clamping member, said bracket member and said remote part of said mounting portion being received under clamping pressure between said clamping member and said support, said clamping member constituting an element of said fastening means and of said securing means.

8. In an apparatus as set forth in claim 6, said bracket member being elongated in said common direction, of uniform cross section over the length thereof, and formed with a longitudinal groove open toward said roll, and pressure means in said groove engaging said operating portion for urging the same toward said roll.

9. In an apparatus as set forth in claim 8, said pressure means including a pliable tube in said groove and a body of gas in said tube under a pressure higher than atmospheric pressure.

10. In an apparatus as set forth in claim 6, cooperating abutment means on said bracket member and on said operating portion for limiting movement of said receptacle toward and away from said roll.

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