

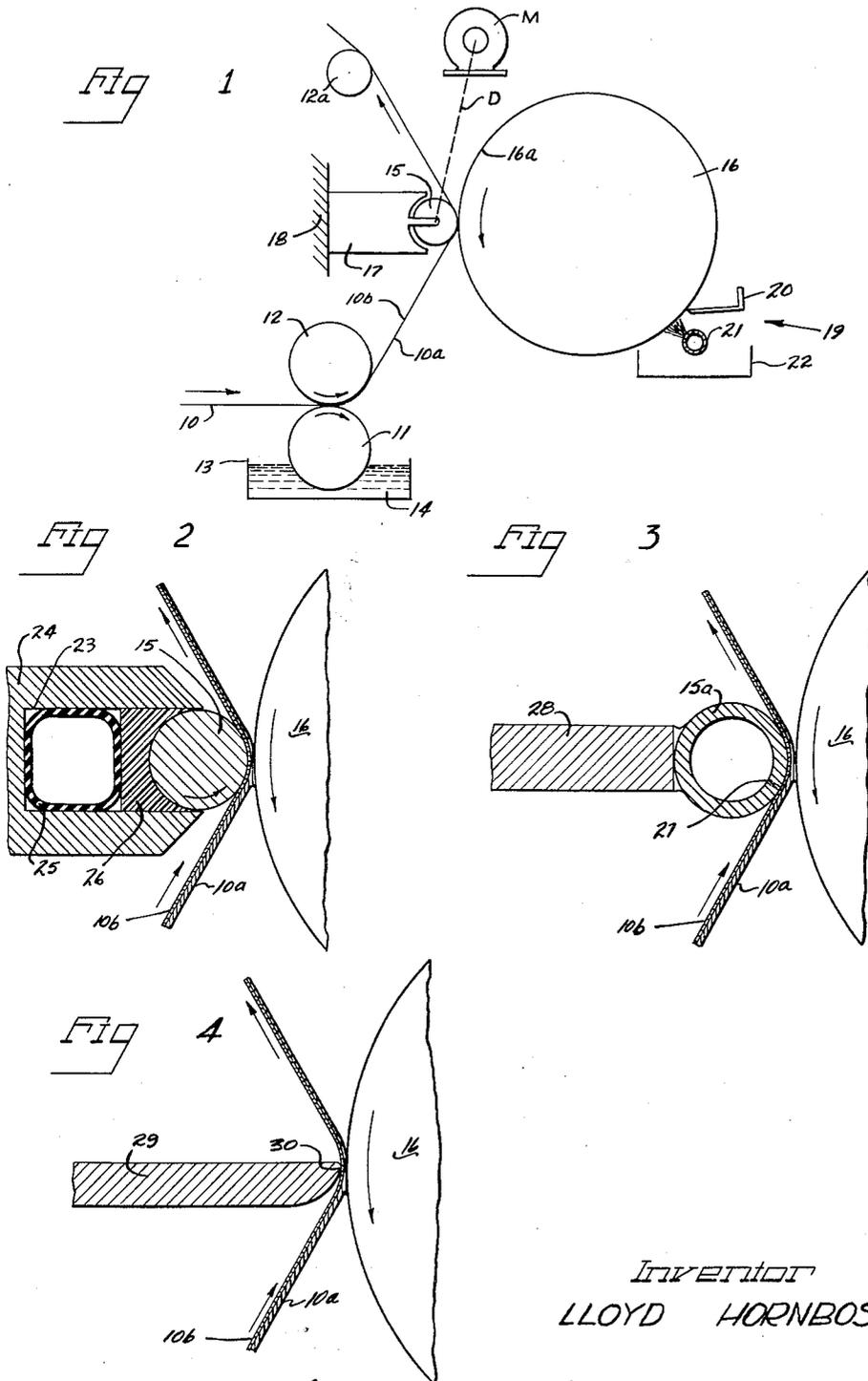
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REVERSE BAR COATER

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3,029,779

REVERSE BAR COATER

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This invention relates to apparatus for coating a flexible sheet or the like, and more particularly, to apparatus for applying a uniform coating to a travelling sheet such as a paper web by first applying a coating material to the travelling web which is then passed through a nip formed by a relatively large radiused doctor roll and a relatively small radius bar or roll about which the travelling sheet may be wrapped.

Ordinarily, in the coating of a travelling sheet or web of fabric, plastic film, paper or the like, the sheet is backed by a supporting surface and the coating is applied to the exposed side thereof using a "doctor" to smooth the coating material on the sheet and insure uniform application thereof. Although the instant invention may have use in the coating of any of such sheets, it is particularly useful in the coating of paper webs and will be described primarily with respect to this use.

It has been common in apparatus of the type described herein to train the travelling paper web over a relatively large radius backing roll and to use a smoothing blade or other small diameter rod or wire as a doctoring means. Such a procedure has a number of advantages, but also has certain disadvantages. For example, the small radiused smoothing means is not readily cleaned, is subject to damage and rapid wear, and more importantly, tends to result in marking of the coating due to what is termed "split." This behavior is common to all types of coating apparatus, at least to a degree. It is a result of the fact that the coating material wets both the surface of the web and the surface of the smoothing means and as the surfaces separate, the fluid itself must be pulled apart. This separation never occurs uniformly. This causes undesirable marks called tracks in the finished product.

It is an object of the present invention to provide a mechanical apparatus adapted to permit the smoothing of a coating material without the loss of a part of the coating material onto the smoothing means thereby avoiding the split described.

It is a further object of this invention to provide a coating apparatus wherein a flexible web travels over a small radiused supporting member such as a bar or roll which urges the web against a relatively large radiused doctor roll, the surface of which at the nip is travelling in a direction opposite to the direction of travel of the web and which is provided with a cleaning means after leaving the nip so that the doctor roll continually presents a clean surface to the coating as it leaves the nip.

It is a further object of this invention to provide a mechanical apparatus for smoothing a coating material on a travelling web which is wrapped around a relatively small radiused supporting member which urges the web into contact with a smoothing means.

Other objects, features and advantages of the present invention will be more fully apparent from the following detailed description taken in connection with the accompanying drawings in which like reference characters are used to refer to like parts throughout and wherein:

FIGURE 1 is a diagrammatic elevational view of a coating apparatus embodying the instant invention.

FIGURE 2 is a fragmentary detail view showing a second embodiment of the nip forming supporting member shown in FIGURE 1.

FIGURE 3 is a fragmentary detailed view similar to FIGURE 2 but showing a third embodiment.

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FIGURE 4 is a fragmentary detailed view similar to FIGURE 2 but showing a fourth embodiment.

Turning now to the drawing and in particular to FIGURE 1 thereof, there is shown a typical coater applying coating to the side 10a of a travelling web of paper 10. The coating may, for example, be initially applied by passing the web 10 through the nip of a pair of rollers 11 and 12, the lower roller 11 being partially immersed in a vat 13 of coating material 14. The side 10b of the web is then caused to wrap, by a small angle, the reverse bar roller 15 which serves as a supporting member to urge the coated side of the web into pressure contact with a doctor roller 16. The web passes over a roller 12a after leaving the roller 15 and the rollers 12 and 12a provide a carrying means for the sheet and are positioned to cause it to wrap around a portion of the surface of the roller 15. Similar carrying means are provided for the webs 10a shown in FIGURES 2, 3 and 4 and are not shown to simplify the drawings. After leaving the nip formed between supporting member 15 and doctor roller 16, the web carrying the smoothed coating may be fed to any suitable conventional drying apparatus.

The supporting member 15 as shown in FIGURE 1, may be a solid cylindrical bar, the ends of which are journaled in supporting arms 17, which in turn are attached to any fixed or adjustably fixed frame member 18. If desired, any conventional type of connection as by a flexible shaft, D, may be made from a motor M to the supporting member 15 in order to facilitate cleaning the supporting member or to adjust its position in order to distribute the wear thereon.

The supporting member or reverse bar 15 has a small radius so that the web 10 travels through a change in direction, almost a sharp corner. The size of the radius is not critical but is preferably within the range from $\frac{1}{20}$ to $\frac{1}{100}$ of the diameter of the doctor roll. Due to this relationship, the nip pressure between the bar and the roll may be quite high without requiring the use of heavy structure and large total loads. The angle of lap of the web about the reversing bar can be varied to suit the nature of the coating and the web being coated from nearly 0° to a turn of approximately 120°. The doctor roll presents a clean surface continually to the coating on the side 10a of the web 10 as it leaves the nip by virtue of the fact that the doctor roller 16 is mounted for rotation in such a direction that its surface at the nip is travelling in a direction opposite to the direction of travel of the web and by virtue of the further fact that cleaning means 19 are provided for the surface of the doctor roll after it leaves the nip and before returning thereto. The cleaning means 19 may, for example, comprise a scraper blade or second doctor 20 operating on the doctor roll 16 and a shower spray 21 in catch pan 22 which may be used to wash or otherwise condition the surface of the doctor roll 16. With certain coatings being applied to the web 10, it is desirable to treat the surface of the doctor roll with a release agent suited to the coating being used. With any coating, it is desirable to clean the surface as by spraying water from the shower means 21. It will, however, be understood that any desired cleaning means may be used.

In operation, the doctor roll 16 preferably rotates slowly in a direction such that the direction of travel of the surface of the roll at the smoothing nip is opposite to the direction of travel of the paper web. It is preferred that the speed of linear travel of the surface of the doctor roll be from 10% to 85% of the paper speed but in the opposite surface direction. It will, however, be understood that the most desirable speed for any particular application depends upon the type of coating being used. For any type of coating and for any speed, however, it is apparent that the relative sizes of the radii of the sup-

porting member 15 and the doctor roll 16, coating with the opposite direction of surface travel of the web 10 and doctor roll 16, and with the cleaning means 19, insures that the portion 16a of the surface of the doctor roll 16 entering the nip continually presents a clean surface to the coating as it leaves the nip and thereby greatly reduces the tendency of the fluid coating on the web to adhere to this surface. Since the angle of separation between the web as it leaves the nip and the incoming portion 16a of the doctor roll is relatively large, and since this portion 16a is an entirely clean surface, the above-discussed tendency of the coating material to adhere to the smoothing surface and thereby result in marking of the coating due to "split" is greatly reduced.

In FIGURE 2, there is shown an embodiment of the invention in which the rotatable rod or wire 15 shown in FIGURE 1 is resiliently mounted in a slot 23 at the end of an arm 24. At the rear of the slot 23 is a tube 25 of flexible material such as rubber which is adapted to expand or contract in accordance with the pressure variations of air passed through the tube. Tube 25 is positioned at the back of slot 23 and a block 26 of any suitable self-lubricating material such as graphite or a synthetic resinous plastic is interposed between the tube 25 and the rod 15. Block 26 is so shaped as to mate with the normal curvature of the surfaces of tube 25 and rod 15. The arm 24, tube 23 and rod 15 as well as the block 26, are shown in an elevational sectional view. It will, of course, be understood that the ends of the rod 15 are mounted in resilient or movable journal means in order to accommodate the slight motion to and away from the doctor roller 16 of the rod 15 in response to change of air pressure in the tube 23. As in the embodiment of FIGURE 1, the rod 15 can be rotated in order to distribute wear and to prevent the accumulation of fiber and other particles.

In FIGURE 3, there is illustrated another modification wherein the small radius rod consists of a rigid tube 15a having a hollow interior and having its outer wall provided with a series of small holes 27 drilled therein to provide an outlet for air under pressure which is supplied through the interior of the tube. A closely spaced series of these small drilled holes 27 permits air to be introduced under the side 10b of the web as a means of lubrication to reduce the friction of the travelling web over the bar 15a. In the embodiment of FIGURE 3, it will be noted that the bar 15a is rigidly mounted on the end of an adjustable arm 23.

In FIGURE 4, there is illustrated an embodiment of the invention in which the small radius rod 15 or 15a is replaced by a bar 29 having a tapered and rounded end portion 30 which affords a surface at the end of the rod contacted by the web 10 which has again a radius small by comparison to the diameter of the doctor roller 16. Except for the difference in the detailed nature of the supporting member affording the small radiused surface, the embodiments shown in FIGURES 2, 3 and 4 are the same as that shown completely in FIGURE 1. As will be noted from the various figures of the drawing, the small radiused supporting member may be either a rigidly fixed bar such as shown in FIGURE 4, a tube having air outlets for web lubrication purposes such as shown in FIGURE 3, a resiliently and rotatably mounted rod such as shown in FIGURE 2, or simply a rotatably mounted rod such as shown in FIGURE 1. In any of these embodiments, the advantages discussed above in connection with FIGURE 1 may readily be obtained.

While particular preferred exemplary embodiments of the invention have now been described, it will be understood that modifications and variations may be effected therein without departing from the spirit and scope of the novel concepts of the present invention as defined by the following claims.

I claim as my invention:

1. Apparatus for coating a travelling sheet compris-

ing, a doctor roll having a first radius of curvature, a sheet supporting member which has at least one surface with a second radius of curvature small by comparison to that of said doctor roll and which is wrapped by said sheet, said surface of said supporting member defining with said doctor roll a nip through which the sheet passes, means for carrying a traveling sheet wrapped over said surface of the sheet supporting member, coating means at the oncoming side of the nip and on the doctor roll side of the sheet to apply coating to the sheet, said supporting member urging said sheet into pressure contact with said doctor roll to smooth and level said coating, the surface of said doctor roll at said nip moving in a direction of travel opposite to the direction of travel of said sheet, and means to clean excess coating from the surface of said doctor roll after said surface leaves said nip.

2. Apparatus for coating a travelling sheet comprising, a doctor roll having a first radius of curvature, a sheet supporting member comprising a rotatable rod with a surface which has a second radius of curvature small by comparison to that of said doctor roll and which is wrapped by said sheet, said rod defining with said doctor roll a nip through which the sheet passes, means for carrying a traveling sheet wrapped over said surface, coating means at the oncoming side of the nip and on the doctor roll side of the sheet to apply coating to the sheet, said rod urging said sheet into pressure contact with said doctor roll to smooth and level said coating, the surface of said doctor roll at said nip moving in a direction of travel opposite to the direction of travel of said sheet, and cleaning means comprising a liquid spray and scraping means to clean excess coating from the surface of said doctor roll after said surface leaves said nip.

3. Apparatus for coating a travelling sheet comprising, a doctor roll having a first radius of curvature, a sheet supporting member comprising a resiliently mounted rod having a surface which has a second radius of curvature small by comparison to that of said doctor roll and which is wrapped by said sheet, said rod being mounted to define with said doctor roll a nip through which the sheet passes, means for carrying a sheet wrapped over said surface, coating means at the oncoming side of the nip and on the doctor roll side of the sheet to apply coating to the sheet, said rod urging said sheet into pressure contact with said doctor roll to smooth and level said coating, the surface of said doctor roll at said nip moving in a direction of travel opposite to the direction of travel of said sheet, and means to clean excess coating from the surface of said doctor roll after said surface leaves said nip.

4. Apparatus for coating a travelling sheet comprising, a doctor roll having a first radius of curvature, a sheet supporting member comprising a rigidly mounted tube with a surface which has a radius of curvature small by comparison to that of said doctor roll and which is wrapped by said sheet, said tube defining with said doctor roll a nip through which the sheet passes, said tube being provided with a plurality of pressurized air outlet holes to lubricate said travelling sheet, means for carrying a sheet wrapped over said surface, coating means at the oncoming side of the nip and on the doctor roll side of the sheet to apply coating to the sheet, said supporting tube urging said sheet into pressure contact with said doctor roll to smooth and level said coating, the surface of said doctor roll at said nip moving in a direction of travel opposite to the direction of travel of said sheet, and means to clean excess coating from the surface of said doctor roll after said surface leaves said nip.

5. Apparatus for coating a travelling sheet comprising, a doctor roll having a first radius of curvature, a sheet supporting member comprising a rigid bar having a tapered end which has a radius of curvature small

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by comparison to that of said doctor roll and which is wrapped by said sheet, said tapered end of said bar defining with said doctor roll a nip through which the sheet passes, means for carrying a sheet wrapped over said end, coating means at the oncoming side of the nip and on the doctor roll side of the sheet to apply coating to the sheet, said supporting bar urging said sheet into pressure contact with said doctor roll to smooth and level said coating, the surface of said doctor roll at said nip moving in a direction of travel opposite to the direction of travel of said sheet, and means to clean excess coating from the surface of said doctor roll after said surface leaves said nip.

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