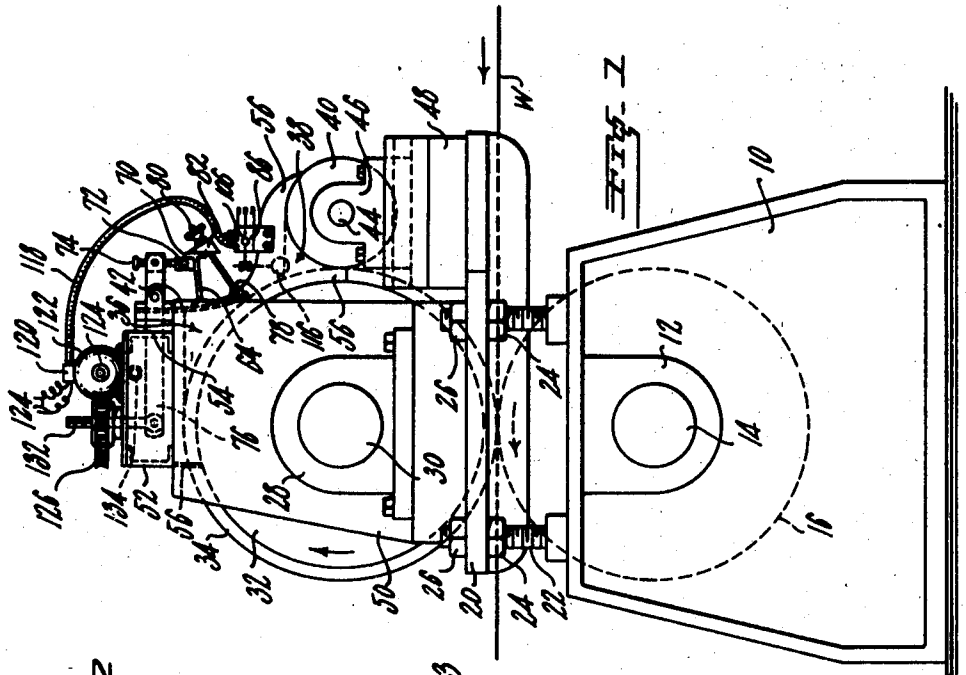
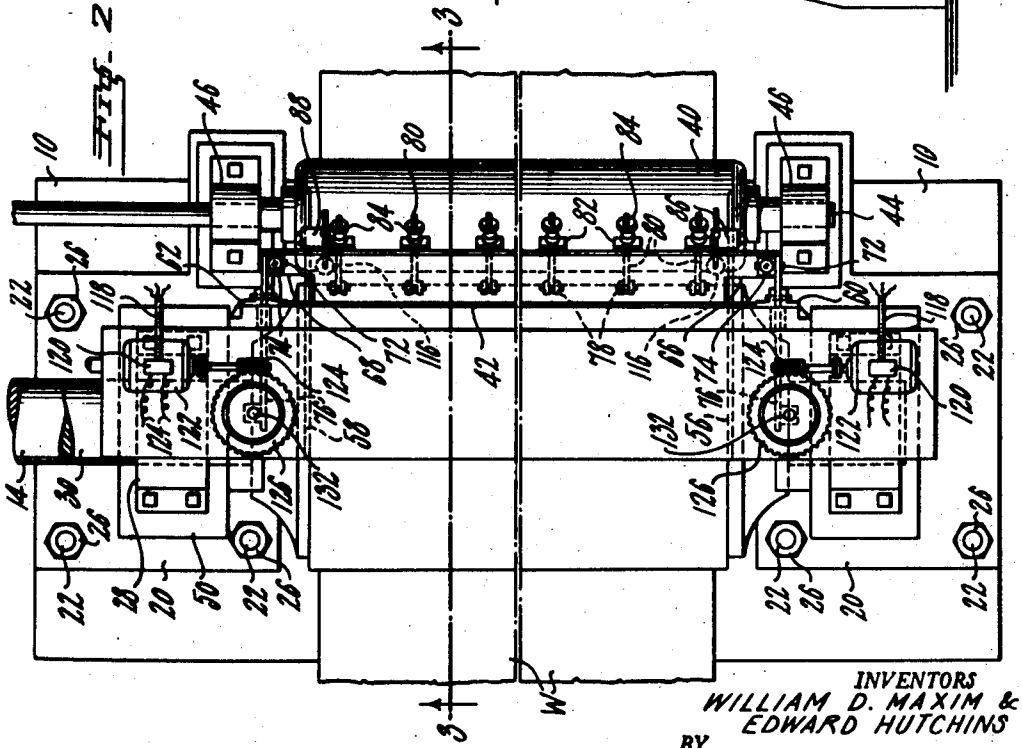
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COATING APPARATUS

Filed April 4, 1944 2 Sheets-Sheet 1





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FIG. 3

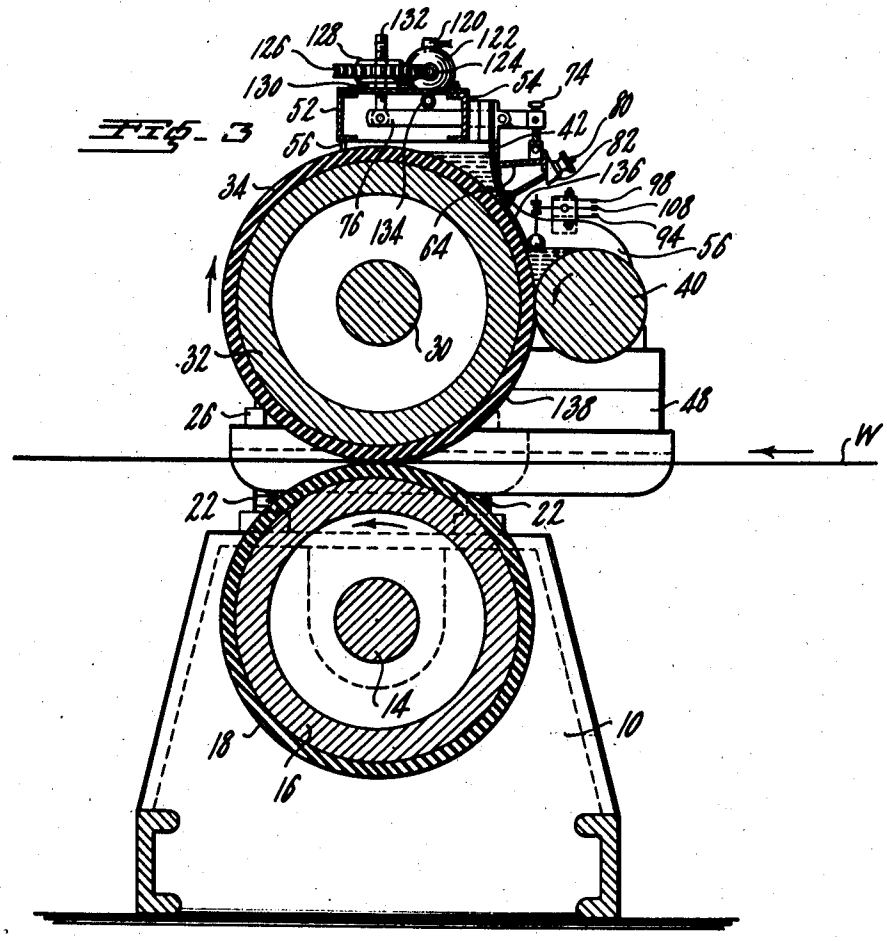
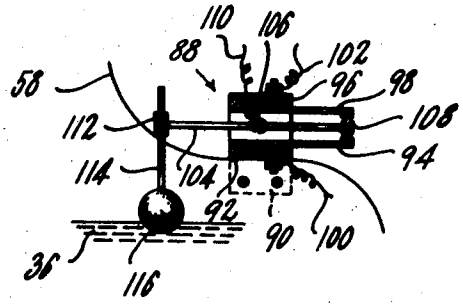


FIG. 4



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COATING APPARATUS

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7 Claims. (Cl. 91—49)

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The present invention relates to coating, and more particularly relates to improved apparatus for the continuous formation of a highly uniform film of coating material.

More specifically, the apparatus herein provided is adapted for the coating of a continuous web of paper. The invention provides for the formation of a film of coating material which film may be accurately controlled as to thickness and which film is exceedingly uniform whereby to provide for even application of the film throughout the width and length of a web of paper.

The apparatus of the present invention is designed to form a film of coating material which is unusually uniform in thickness throughout its width and length. To this end a particular arrangement of parts will be described herein which constitutes a preferred form of apparatus. The method of forming such a uniform film may be performed upon the specific apparatus herein disclosed and obviously may be performed on other forms of apparatus embodying the general features of the preferred form.

The preferred form of apparatus disclosed herein comprises a film-forming roll with which are associated two separate fountains of coating material. One of these fountains carries a supply of coating material which has extensive contact with the surface of the film-forming roll, and this area of contact, dependent in the preferred form upon the depth of coating material within the fountain, is maintained within reasonable limits of uniformity during operation of the apparatus. A film of material is thus spread upon the surface of the film-forming roll, and this film of material is carried by the roll into a second fountain in which the area of contact between the material in such second fountain and the surface of the backing roll is held within extremely precise limits. A suitable film gate is provided and in the preferred form this gate comprises a gate roll, a portion of which serves also as a part of the second fountain. The high degree of uniformity achieved by this arrangement of parts results from the successive action of the two fountains. The two fountains provide an unusual area of contact between the coating material and the film-forming roll, but the advantages achieved go considerably beyond that which is obtained as a result of increased area of contact.

The first fountain serves to wet the entire surface of the film-forming roll and also serves as an extremely accurate source of supply for the second fountain. When the surface of the film-

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forming roll reaches the second fountain it has already been wetted by the coating material and is in condition to have formed thereon the extremely accurate film which the second fountain has been designed to produce.

The highly uniform film of coating material is then transferred to a web of paper. In the preferred form the fountain roll serves also as an applicator roll, and to this end the web of paper is brought directly into contact therewith. It is obvious that the film need not be directly transferred to the web and that it may be transferred to one or more intermediate transfer rolls if so desired. The present invention is directed to the novel film-forming apparatus, and for the purposes of simplicity of disclosure the direct transfer to the web has been selected.

It is an object of the present invention to provide an apparatus for the coating of a web of sheet material with a film or layer of coating material of extreme uniformity and surface smoothness.

It is a further object of the present invention to provide an apparatus for forming a film of aqueous coating material of the type employed in the coating of paper, which film is highly uniform in thickness and which presents a surface of unusual smoothness.

It is a further object of the present invention to provide an apparatus comprising a film-forming roll and two fountains supplying coating material to the surface of said film-forming roll in successive steps.

It is a further object of the present invention to provide an apparatus comprising a film-forming roll and two fountains supplying coating material to the surface of said forming roll in successive steps and to provide apparatus for controlling the quantity of coating material maintained in each of these fountains.

It is a further object of the present invention to provide apparatus for maintaining in a fountain a supply of coating material which supply is held uniform within extremely precise limits.

Other and further objects will in part be obvious and will in part become more apparent from a consideration of the following description of a preferred, but not necessarily the only, form of apparatus embodying the invention and upon which applicants' novel method may be practiced, taken in connection with the accompanying drawings.

In the drawings,

Fig. 1 is an elevational view of apparatus embodying the present invention;

Fig. 2 is a plan view of said apparatus;

Fig. 3 is a section taken along the line 3—3 of Fig. 2 and looking in the direction of the arrows associated with said line;

Fig. 4 is a detailed sectional view of sensitive float apparatus forming a part of said invention.

Similar characters of reference indicate similar parts throughout the several views.

Referring now to the drawings, Fig. 1, the apparatus comprises a base 10 at each end of which is mounted a bearing 12 receiving opposite end portions of a shaft 14 upon which is carried a roll 16. The roll 16 may be formed of any suitable material. Preferably it is provided with a jacket 18 (see Fig. 3) of a relatively hard, resilient material such as rubber. The roll 16 serves as a supporting roll against which a web of paper W is pressed during the coating operation.

The base 10 also supports a secondary frame 20 upon which the film-forming roll and film-forming apparatus may be mounted. The secondary frame 20 may comprise two separate end plates as shown in Fig. 2 which are supported entirely upon a plurality of upright bolts 22 secured to the base 10. The bolts 22 threadably receive nuts 24 and 26 located respectively below and above the end plates of the secondary frame 20. The vertical position of the end plates may be established by movement of the nuts 24 to suitable position, and the parts may be located in adjusted position by tightening the nuts 26.

The secondary frame 20 carries at its opposite ends bearings 28 which receive the opposite ends of a shaft 30. The shaft 30 carries a film-forming roll 32 which may be provided with a jacket 34 of rubber similar to the jacket 18. Preferably the film-forming roll 32 is of substantially the same diameter as the supporting roll 16 and the position of the frame 20 is so chosen as to bring the surface of the rolls 16 and 32 into contact along a line throughout the width of the rolls. The pressure exerted along this line of contact may be adjusted by suitable adjustment of the nuts 24 and 26, and of course such adjustment may be availed of to establish uniform pressure throughout the length of the area of contact between the rolls. The web of paper W is conducted through the nip of the rolls 16 and 32, and it is in this nip that the coating is applied to the surface of the web which comes into contact with the film-forming roll 32.

The apparatus for forming a film of coating material upon the surface of the roll 32 comprises in general an upper fountain 36, a lower fountain 38 and a gate roll 40. In the upper fountain 36 a pond of coating material is retained between the surface of the jacket 34 of roll 32 and a plate 42 extending transversely of said surface. In the lower fountain a pond of coating material is maintained between the surface of the jacket 34 and a portion of the surface of the gate roll 40.

The gate roll 40 is mounted upon a shaft 44 rotatably received in bearings 46 adjacent the opposite ends of the shaft 44. The bearings 46 are slidably supported upon brackets 48 which are in turn supported upon the end plates 20 of the secondary frame. Sliding of the bearings 46 may be availed of to move the gate roll 40 toward and from the film-forming roll 32 to establish uniform pressure contact throughout the lengths of the respective rolls.

The end plates 20 each carry vertically disposed side plates 50 which extend above the upper surface of the film-forming roll 32 and which serve as supports for the two fountain structures. The upper edges of the plates 50 are connected by two

transversely extending channels 52 and 54. Adjacent the opposite ends of the surface of the roll 32 there are secured to the lower legs of the channels 52 and 54 a plate 56 and a plate 58 (see Fig. 2). As shown in Fig. 1 the plate 56 which is identical to the plate 58 is contoured along its lower edge to bear against the edge of the jacket 34 of the roll 32. The upper edge of the plate 56 extends to the right as viewed in Fig. 1 to a point somewhat beyond the plate 42. The plate 56 extends downwardly of the roll 32 and somewhat below the nip between the gate roll 40 and the roll 32. The plate 56 is then contoured to the surface of the gate roll 40 and terminates at a point somewhat to the right of a vertical plane passing through the center of the shaft 44. The plates 56 and 58 thus constitute end walls for the upper and lower fountains and serve to confine the coating material within the ponds described above.

Brackets 60 and 62 are secured adjacent the opposite ends of the channel 54, and the plate 42 is fastened at its opposite ends to these brackets. Only the upper portion of the plate 42 is thus secured, and the lower portion extends below the brackets between the plates 56 and 58. The plate 42 fits closely against the plates 56 and 58 whereby to form a substantially leakproof joint. The plate 42 is made of flexible material and is curved outwardly as shown in Fig. 1 in order that its lower edge may be substantially tangential to the surface of the jacket 34. Approximately midway of the height of the plate 42 there is secured, as by welding, a transversely extending I beam 64. As shown in Fig. 2 a portion of the I beam 64 is cut away at 66 and 68 in order to clear the fountain end plates 56 and 58. On the outer ends of the cut away portion of the I beam 64 there are secured perforated lugs 70, only one of which is shown in Fig. 1. The lugs 70 receive pivot pins 72 which pivotally receive suitable fittings carried at the lower ends of adjustment screws 74 threaded through suitable fittings pivotally secured to one end of levers 76 which are in turn pivoted upon the brackets 60 and 62, respectively. Assuming that the levers 76 are held stationary, it will be understood that turning of the screws 74 will produce upward and downward movement of the I beam 64. Since the I beam 64 is welded to the plate 42, turning of the screws 74 will actually result in longitudinal bending of the plate 42 to move the lower edge thereof toward and from the surface of the jacket 34. In practice, however, turning of the screws 74 is a matter of preliminary adjustment and the levers 76 are rocked about their pivots by mechanism to be hereinafter described for the purpose of moving the lower edge of the plate 42 toward and from the film-forming roll.

It will be understood that the mechanism just described serves to move the lower edge of the plate 42 substantially uniformly throughout its width. It has been found desirable to provide mechanism to individually flex small portions of the lower edge of the plate 42 in order to assure that the edge will be exactly parallel to the surface of the jacket 34. For example, the roll 32 may be slightly crowned to make up for sag and it will be necessary to distort the edge of the plate 42 to match the crown. To this end there is secured very close to the lower edge of the plate 42 a plurality of pivot lugs 78 to each of which is pivotally attached a threaded rod 80. Each of the threaded rods 80 extends through an apertured lug 82 secured to the outer flange of the I beam 64. Thumb nuts 84 are threaded upon each

of the rods 80 and are brought to bear upon the lugs 82. It will be observed that adjustment units of the type just described are located every few inches throughout the width of the plate 42. Thus by suitable adjustment of certain of the thumb nuts 84 the desired contour may be imparted to the lower edge of the plate 42. In normal operation individual adjustment of the thumb nuts 84 is necessary when the machine is set up and at infrequent intervals thereafter to compensate for wear and the like. Thus it will be apparent that there is provided apparatus for establishing an orifice of unusual uniformity through which the coating material in the upper pond is discharged upon rotation of the film-forming roll 32. Adjustments of the thumb nuts 84 establish the uniformity of width of the orifice while movement of the levers 76 will result in increase or decrease of the width of the orifice all the way across the machine. Obviously, increase in width of the orifice will result in a greater quantity of the coating material emerging from the upper fountain. The coating material thus emerging forms a film of roughly uniform distribution upon the surface of the film-forming roll. As the roll rotates a portion of its surface enters the upper fountain and is wetted by the coating material therein. By the time this surface moves beyond the lower edge of the plate 42 it will have been quite thoroughly wetted, and the film of coating material will adhere thereto with fair uniformity.

The film of coating material is carried by the roll 32 into the lower fountain 38. The level of the material in the lower fountain is held within extremely precise limits in order that the head will be uniform at all times and throughout the width of the fountain. With such uniform head it is possible to form a film of material emerging from the second fountain of a uniformity heretofore unattained.

The level of fluid within the lower fountain 38 is maintained by means of sensitive float mechanism. This mechanism comprises a float at each end of the lower fountain. As a matter of convenience the float mechanisms may be supported on the end plates 56 and 58. The mechanisms are duplicates except that certain parts are reversed for proper operation on the opposite ends of the fountain. The float mechanisms are identified generally by the reference numerals 86 and 88 in Figs. 1 and 2, and the float mechanism 88 is shown in sectional detail in Fig. 4. In Fig. 4 there is shown a bracket 90 secured to the plate 58. The bracket 90 carries an insulating block 92 upon which is supported an electrical contact arm 94 and a second insulating block 96 upon which is supported an electrical contact arm 98. The arms 94 and 98 are connected respectively with wires 100 and 102. A lever 104 is pivoted at 106 on the bracket 90. One end of the lever is provided with electrical contact points 108 arranged for alternate contact with the arms 94 and 98. The contacts 108 are connected to a wire 110. At its other end the lever 104 pivotally carries a fitting 112 into which is threaded a rod 114 carrying at its lower end a float 116. The float 116 is positioned within the liquid located in the lower fountain, and the apparatus is so adjusted that with the liquid at proper level the electrical contact 108 is out of contact with either of the contacts 94 and 98. Upon a rise in level of the liquid the contact 108 will engage the contact 94, and upon a drop in level the contact 108 will engage the contact 98. The wires 100 and 102 and 110 are conducted through a cable 118 (see Fig. 1) to the reversing mechanism 120 of a small electrical motor 122 connected by wires 124 to a suitable source of electrical energy. The arrangement just described is such that upon a drop in level of the fluid within the lower fountain 38 the motor 122 will be energized to rotate in one direction and upon a rise in level above the predetermined proper level the motor 122 will be energized for rotation in the opposite direction.

As mentioned above, there is a sensitive float mechanism adjacent each end of the lower fountain. Similarly, there is a motor 122 located at each end of the apparatus. Each of the motors is controlled by its associated sensitive float mechanism.

The motors 122 are preferably reduction gear motors and their protruding shafts are arranged to rotate at a relatively slow rate of speed. As shown in the drawings, the motors 122 are each equipped with a worm gear 125 meshing with a worm wheel 126. Referring now to Fig. 3 it will be observed that the worm wheel 126 shown therein is supported upon a threaded hub 128 which is in turn supported upon a plate 130 bridging the channels 52 and 54. A threaded rod 132 is engaged within the hub 128, passes through an enlarged opening (not shown) in the plate 130 and is pivotally attached at its lower end to the lever 76. The mechanism just described is so arranged that upon energization of the motor for rotation in one direction the worm wheel 126 will be turned and the threaded hub thereof with produce a vertical movement of the rod 132. This in turn serves to rock the lever 76 and to enlarge or decrease the orifice between the plate 42 and the surface of the film-forming roll 32.

It will be understood that the mechanism just described is duplicated at the opposite sides of the machine. Provision is made therefore for accurate control of the level of the fluid within the lower fountain, and the tolerance within which such level is maintained may be extremely small. It will be understood that the switch mechanism in connection with the sensitive floats is illustrated in diagrammatic form and that the spacing between the contacts may be very slight whereby to establish tolerance of suitable amounts.

The upper fountain may be supplied by any conventional means. For example, a pipe 134 may extend throughout the width of the upper fountain and may be perforated at suitable intervals. The coating material is supplied to the pipe and emerges from the perforations therein to drop into the upper fountain. Any conventional control may be provided to adjust the flow of coating material into the pipe 134. By proper adjustment it is apparent that the coating material may be supplied at a rate which is sufficient to maintain the upper fountain at a reasonably constant level. While a fountain-supply means such as that which is described may be adjusted to maintain the level reasonably constant it is apparent that the level will not be uniform throughout the width of the fountain. Each of the perforations in the pipe 134 will form a stream or jet of coating material which will impinge upon the surface of the fluid within the fountain. Each such impingement will cause a local disturbance in level. This condition is accentuated by the rolling of the coating material within the fountain which occurs as an incident to rotation of the film-forming roll 32. The differences in level will of course produce differences in static head and the film of

material emerging through the opening between the film-forming roll 32 and the plate 42 will not be precisely uniform throughout its width.

While the film formed by the upper fountain is not precisely uniform throughout its width it should be observed that many coating machines are in commercial use in which a film of no greater accuracy is applied to the paper. According to the present invention the film thus formed is merely used as a supply for the second fountain. There is therefore provided an apparatus for supplying coating material to the second fountain which is exceedingly accurate in comparison to other known forms of fountain supply. The accurate fountain supply and the extensive area of contact within which wetting of the film-forming roll may occur mutually contribute to the ultimate formation by the second fountain of a film of uniformity heretofore unattained in the art.

The operation of the device will be largely apparent from the description above and it will be only briefly reviewed. A web of paper W is directed into the nip of the rolls 16 and 32. Fluid coating material of any suitable composition is supplied through the pipe 134 to the upper fountain. The orifice between the film-forming roll 32 and the plate 42 and the position of the gate roll 40 will have been so adjusted as to establish a supply of coating material sufficient to apply to the web a coating of desired thickness. Rotation of the film-forming roll 32 will draw a film 136 from the upper fountain into the lower fountain. Inasmuch as the film 136 is, from ordinary coating standards, a film of substantial uniformity throughout its width it will serve as a fountain supply of unusual accuracy. As the film 136 is brought into the lower fountain it will roll smoothly and uniformly throughout its width in contrast to the uneven rolling in ordinary fountains. The static head will therefore be substantially perfectly uniform throughout. Operation of the sensitive float mechanisms 86 and 86 will be such as to maintain the static head at constant height. The constancy and uniformity of this head throughout the width of the lower fountain thus establish conditions under which a film 138 emerging from between the film-forming roll 32 and the gate roll 40 will be of accuracy and uniformity heretofore unattained by fountain mechanisms. The film 138 is carried on the surface of the film-forming roll 32 into contact with the upper surface of the web W whereupon the usual operations of drying and reeling may be performed.

It will be understood that it is intended to cover all changes and modifications of the embodiment of the invention herein chosen for the purpose of illustration which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. In coating apparatus of the type in which a pond of coating material is maintained within the nip between a pair of tangentially contacting rolls, the combination of means for supplying to said pond coating material in the form of a film substantially evenly distributed throughout the width of one of said rolls and means for varying the thickness of said film in response to changes in level of said pond to maintain said level substantially constant.

2. In coating apparatus of the type in which a pond of coating material is maintained in the nip between tangentially contacting rolls, the combination of means for supplying coating material to said pond comprising a fountain, means mounted in spaced relation with the surface of one of said rolls to define with said surface a film-forming orifice through which coating material from said fountain emerges in the form of a film adhering to the surface of said roll, and means for changing the size of said orifice in response to changes in depth of coating material in said pond whereby to maintain a constant depth of coating material in said pond.

3. Coating apparatus comprising a pair of rollers, means to maintain said rollers in tangential contact, means for confining a pond of coating material in the nip between said rollers, means for rotating said rollers whereby to withdraw from said pond a film of coating material which emerges from said nip, means to supply to one of said rollers in a position in advance of said nip a film of coating material to act as a supply for said pond, and means responsive to the depth of coating material within said pond to control the thickness of said supply film whereby to maintain in said pond a constant depth of coating material.

4. In a coating apparatus, a film-carrying roll, a gate roll in tangential contact therewith, means for maintaining a pond of coating material in the nip between said film-carrying roll and said gate roll, means for supplying coating material to said pond comprising film-forming means, means for varying the thickness of film formed by said film-forming means, and means responsive to the depth of coating material within said pond for adjusting said film-thickness-varying means whereby to maintain a constant depth of coating material in said pond.

5. In a coating device, the combination of a film-forming roll, means associated with said roll for maintaining in contact therewith two separate fountains of coating material, one of said fountains supplying to the surface of said film-forming roll a film of material of controllable thickness which film is carried by said roll into the second fountain, and means responsive to the depth of coating material within said second fountain for controlling the thickness of said film whereby to maintain on said second fountain a constant static head uniform throughout the width thereof.

6. In coating apparatus of the type in which a pond of coating material is maintained in the nip between tangentially contacting rolls, the combination of means for supplying coating material to said pond comprising: means for forming a film of coating material on one of said rolls, including a flexible plate having an edge extending lengthwise of the roll upon which said film is to be formed and spaced from the surface thereof to define an elongated film-forming orifice; a plurality of individually adjustable means engaging said plate at points spaced along the length thereof, the adjustment of each of said means being effective to produce local flexure of said plate to vary the contour of said orifice; and means for moving said plate without changing the individual adjustment of said individually adjustable means to control the thickness of said supply film.

7. In coating apparatus of the type in which a pond of coating material is maintained in the nip between tangentially contacting rolls, the combination of means for supplying coating material to said pond comprising: means for forming a film of coating material on one of said rolls, in-

cluding a flexible plate having an edge extending lengthwise of the roll upon which said film is to be formed and spaced from the surface thereof to define an elongated film-forming orifice; a plurality of individually adjustable means engaging said plate at points spaced along the length thereof, the adjustment of each of said means being effective to produce local flexure of said plate to vary the contour of said orifice; and

means responsive to the depth of coating material within said pond for moving said plate without changing the individual adjustment of said individually adjustable means to control the thickness of said supply film whereby to maintain throughout the width of said pond a constant depth of coating material.

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