

July 14, 1942.

G. F. NADEAU ET AL

2,289,798

COATING APPARATUS

Filed Feb. 8, 1940

2 Sheets-Sheet 1

FIG. 1

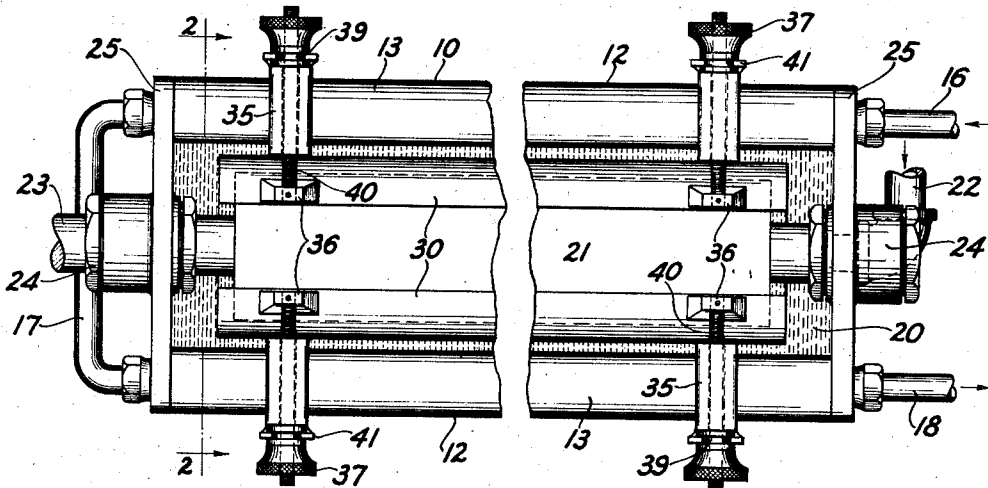
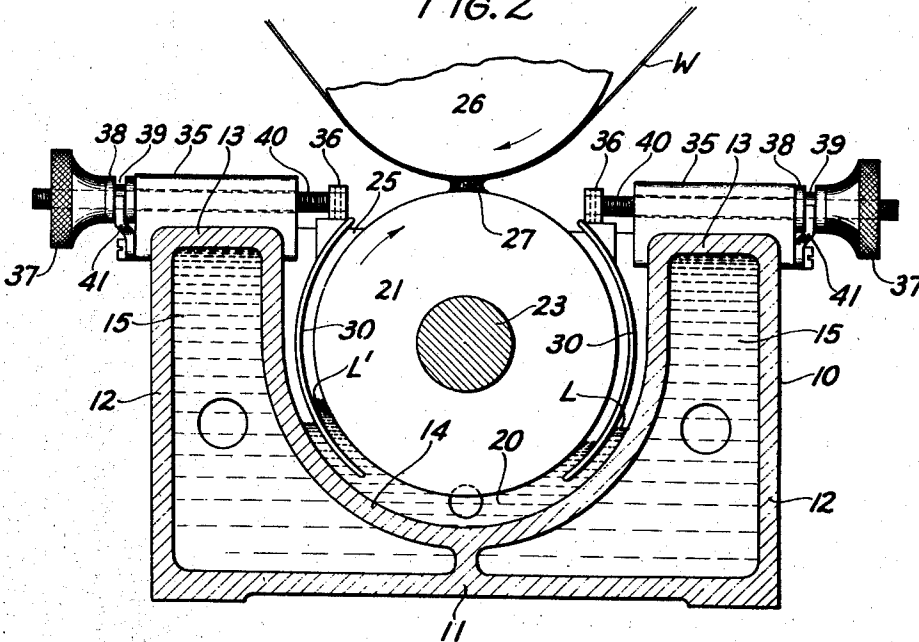


FIG. 2



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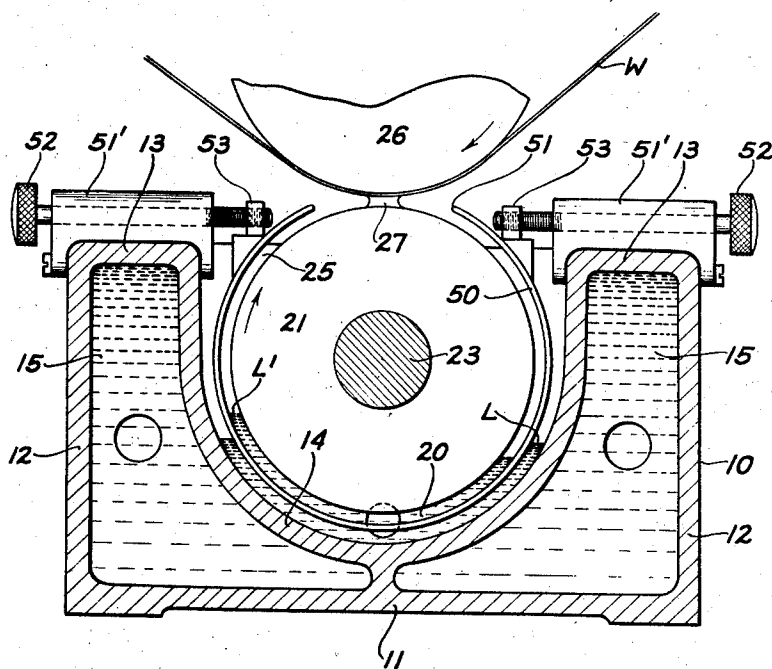
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FIG. 3



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COATING APPARATUS

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Application February 8, 1940, Serial No. 317,925

6 Claims. (Cl. 91-51)

The present invention relates to coating apparatus of the type wherein the coating solution is fed to the coating point by an applicator, or pick-up, roll rotatably mounted in a hopper and partly submerged in a coating solution contained in said hopper; and particularly to such a coating apparatus provided with means for protecting the major portion of the unsubmerged portion of the applicator roll from exposure to air circulating about the hopper mouth and for raising the effective level of the coating solution in the hopper.

The application of a dye, or subbing layer, to a photographic film is effectively carried out by the bead method of application, or by the direct application of a coating to the web to be coated from an applicator roll rotating partially submerged in a coating solution contained in a hopper, both of which procedures are well known in the art. The apparatus used in both procedures is substantially the same, and may constitute a hopper in which a constant level of the coating solution is maintained, and in which hopper an applicator roll is rotatably mounted partially submerged in the solution. The two procedures differ primarily in the fact that in the bead method of application the applicator roll is slightly spaced from the guide roll for the web and merely feeds the solution to a bead maintained between the two rolls and through which the web is passed, while in the other procedure the applicator roll directly contacts the surface of the web to be coated and deposits the coating solution directly thereon.

In order to secure a subbed, or dyed, film and maintain a low concentration of explosive vapors in the air, it has been found necessary to circulate fairly large quantities of air about the hopper mouth during the coating and subbing of a photographic film. When a bead application is being made, the disturbances caused by this air have been found to lead to the non-uniform application of the solution being applied. One of the two most serious defects arising from this disturbance is blotchy longitudinal lininess caused by the air blowing across the exposed periphery of the applicator roll. The second defect especially observed in gel subbing is a result of the removal from the sub of some of the lower boiling, and more active, solvents. The removal of these solvents leaves behind a higher concentration of water, and the sub accordingly loses strength, as its affinity for the film is often referred to by those skilled in the art. It is quite common, therefore, to find a given sub layer

showing unsatisfactory stripping from a film or paper to which it has been applied with a given quantity of air flowing across the hopper mouth, while the same sub layer would show satisfactory stripping qualities when the quantity of air was reduced.

We have found that these two difficulties can be greatly alleviated, or overcome, by reducing the exposure of the coating solution on the unsubmerged portion of the applicator roll to air circulating over the hopper mouth, and by raising the effective level of the solution in the hopper.

Therefore, one object of the present invention is to provide the hopper of a coating apparatus of the type described with means for protecting the major portion of the unsubmerged periphery of the applicator roll from exposure to air circulating around the mouth of said hopper.

Another object is to provide means of the type referred to which raises the effective level of the coating solution in the hopper, and thereby reduces the opportunity of separation of the solvents from the solution and the running back of the solution on the roll.

And another object is to provide a hopper in which the aforementioned means constitutes one or more arcuate shields suspended in the hopper concentric with, but spaced from, the periphery of the applicator roll, said shields being of a length to extend from the level of the solution in the hopper to a point outside of the mouth of said hopper.

And a further object is to provide shields of the type mentioned which are adapted to extend substantially below the level of the coating solution in the hopper so that the level of the solution rises somewhat, or is pumped, up into the narrow space between the shield and the roll whereby the level of the solution is effectively raised.

And yet another object is to provide means for mounting said shields in the hopper whereby they can be adjusted to and from the periphery of the application roll in accordance with the viscosity of the coating solution and the speed of the roll.

And still another object is to provide means of the type referred to for reducing the loss of active solvents in, and the running back on the roll of, the coating solution which is simple in construction, easy to manufacture, and is applicable to any existing hopper without necessitating any major alterations therein.

Briefly, the present invention comprises the

suspension of one, or more, arcuate shields in the sub hopper in concentric and spaced relation with the applicator roll. This type of shield is necessitated to even a greater extent when one attempts to use a lower level of coating solution in the hopper. For some time we have been experimenting with a hopper in which the level of the coating solution is maintained below the bearings of the applicator roll in order to eliminate the use of packing for the bearings which tends to produce non-uniform motion of the applicator roll. The relatively larger area of wet application roll exposed to the air in this instance results in bad lininess due to the fractionation of the mixed solvents used in the usual subbing or coloring solution. The use of the shields constituting the present invention, therefore, is essential to the use of lower levels of solution in the hopper.

The second feature of the shields in the use of the low level hopper arises from the fact that when the hopper shield is set close to the applicator roll and extends below the level of the solution, the solution rises somewhat, or is pumped, up into the narrow space between the shield and the roll; and due to this rise of solution the level of the solution adjacent the roll is effectively raised. In other words, it is possible by use of the low level hopper and shields to bring the level of the solution higher than the bearings if desired without necessitating the use of packing for said bearings. The desire to raise the level of the solution is twofold. First, the nearer the level of the coating solution to the coating point, the less opportunity there is for the separation of the solvents and run back of the solution on the applicator roll. The second consideration has to do with uniformity of application. It has been found that it is desirable, particularly in the bead method of application, to drive the applicator roll at the lowest speed possible to minimize mechanical disturbances and other defects. For example, when the applicator roll rotates relatively fast, a disturbance in the bead produces a defect known as "lap lines." These lines take the form of small wave-like patterns across the width of the support and can always be eliminated by reducing the applicator roll speed. This defect, of course, is quite likely to be had in the use of the low level hopper if it were not possible to use a shield of the type constituting the present invention which eliminates the necessity of packing for the bearings of the applicator roll which tends to hinder uniform rotation of said roll when driven at slow speeds.

The novel features that we consider characteristic of our invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings in which,

Fig. 1 is a plan view of an open-mouth hopper and applicator roll rotatably mounted therein, and showing said hopper equipped with shields constructed and mounted in the hopper in accordance with a preferred embodiment of the present invention, and

Fig. 2 is a sectional view taken substantially on line 2-2 of Fig. 1, and showing the hopper and applicator roll associated with a web guiding roll as customary in the bead method of application.

Fig. 3 is a sectional view corresponding to Fig. 2, and showing the hopper equipped with a shield constructed and mounted in the hopper in accordance with another embodiment of the present invention.

Like reference characters refer to corresponding parts throughout the drawings.

Referring now to the drawings, the hopper, indicated generally at 10, may be of a well-known type and comprise an elongated trough having a bottom wall 11, side walls 12, top walls 13, and a substantially semi-circular wall 14 connecting said top walls as shown. The hopper may be cast from metal with all of said walls being contiguous, as shown, so as to form a hollow chamber, or chambers, 15 completely surrounding the semi-circular wall 14, and through which a heating medium, such as, hot water or steam, can be circulated by means of an inlet type 16, pipe 17 connecting the two chambers, and outlet pipe 18, for the purpose of maintaining the coating solution in the hopper at a given temperature as, and for the purpose, well known in the art. The reservoir 20, formed by the semi-circular wall 14, will be open at the top of the hopper for the reception of the customary applicator roll 21, and the width of the open mouth of the reservoir will be substantially greater than the diameter of the roll 21 to permit its insertion and removal therefrom. Due to this difference in size the opening between the edges of the mouth of the reservoir and the periphery of the roll, when the latter is in its operating position, will be quite large, and will permit air, necessarily circulated over the mouth of the hopper, to contact the roll rather freely at any point above its point of submersion in the coating solution.

The coating solution may be introduced into the reservoir in any suitable manner so that a given level can be maintained, and for the purpose of illustration I have shown the reservoir provided with an inlet pipe 22 which may be connected to a suitable supply of coating solution, and the flow through which may be controlled in proportion to the solution coated so as to maintain a substantially constant level in the reservoir. The applicator roll 21 may be rotatably mounted in the hopper by having opposite ends of the shaft 23 connected thereto rotatably mounted in suitable bearings 24 passing through the end walls 25 of the hopper. The applicator roll is preferably mounted with only the lower portion of its periphery submerged in the coating solution, and with the upper portion of its periphery extending through the mouth of the hopper to the outside thereof and adjacent to a web guiding roll 26, in the case of the bead method of application, over which a web W to be coated is guided. The applicator roll 21 may be rotated in one direction by any suitable means, not shown, and in a counter direction to the rotation of the guiding roll 26, as indicated by the arrows, so as to feed a quantity of coating solution to, and for the purpose of maintaining, the bead 27 of solution through which the web W is moved, as is well known in the art.

The hopper and applicator roll combination heretofore described is well known and forms no part of the present invention except insofar as it cooperates with the hereinafter described shields to produce the beneficial results hereinafter fully set forth. Referring to the drawings it will be noted that with an arrangement of the type described there is a relatively large opening at the

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mouth of the hopper on each side of the applicator roll, and extending down into the hopper to the level of the coating solution, into which air circulated over the mouth of the hopper can pass and evaporate solvents from the thin coating of solution on the roll between the bead and the level of the coating solution. In addition, in order to avoid packing the bearings of the applicator roll shaft it is necessary that the level of solution in the reservoir be kept below said bearings. However, as pointed out above, lowering of the solution level in the hopper would increase the amount of thin coating of solution on the roll exposed to the air circulating around the mouth of the hopper and would increase the run back tendencies of the solution on the roll, both undesirable features.

The present invention which cuts down the undesirable exposure of the applicator roll to air circulating about the mouth of the hopper, and permits the use of a lower level of coating solution than heretofore found practical, will now be described. An arcuate shield 30 is suspended in the hopper 10 on both sides of the applicator roll 21 in concentric relation with, and spaced from, the periphery of the roll. Each of these shields is slightly longer than the roll so that it overlaps said roll on either end, and each shield preferably extends from a point below the normal level L of the coating solution in the hopper, to a point outside of the mouth of the hopper, see Fig. 2. These shields, as will be noted, effectively prevent the air circulating about the mouth of the hopper from entering the hopper and contacting that portion of the roll encircled by the shields, so that evaporation of solvents from the coating solution is greatly reduced. While these shields could be extended to a point closer to the bead 27 than has been illustrated, and thereby protect more of the periphery of the roll against exposure to the circulating air, we have found that the time of exposure of that portion of the roll beyond the end of the shield and the bead, as shown, is not sufficient to effect an appreciable evaporation of the solvents contained in the solution. Further, since the air circulating about the mouth of the hopper is generally moving tangentially of the applicator roll 21, there is no great tendency for the same to circulate into the space between the roll and the shields, particularly in a counter direction to the rotation of the roll.

It will be appreciated that to act merely as a shield against the exposure of the roll to the air circulating about the mouth of the hopper the shield need extend only to, or adjacent to, the level L of the coating solution in the hopper. However, we have found that by extending said shield below the level L of the solution the same serves to effectively raise the level in the hopper, in addition to protecting the roll against exposure to the circulating air. Referring to Fig. 2, it will be noticed that a rather limited space is provided between the lower portion of the shield 30 and the periphery of the roll. When the roll 21 is rotated in the direction of the arrow the coating solution rises, or is pumped, up into the space between the shield and the roll in the direction of rotation of the roll to the level L' which is somewhat higher than the normal level L of the solution. Since it is the solution at this new level with which the roll engages prior to moving to the coating point, or bead 27, the effective level, or that submerging that portion of the periphery of the roll leaving the hopper,

is raised only adjacent the periphery of the roll and in a manner not affecting the bearings of the applicator roll shaft whereby it is not necessary that said bearings be packed. In addition, this rise in the effective level of the coating solution reduces the arc of the periphery of the roll exposed with a thin coating of solution prior to reaching the coating point, thereby reducing the opportunity for evaporation of solvents from the solution, and at the same time the tendency of the solution to run back on the roll prior to reaching the coating point is reduced.

By referring to Fig. 2 it will be observed that the shield 30 on the side of the applicator roll entering the coating solution acts just the opposite than does the other shield in that the level of the coating solution adjacent the roll at this point is lowered by virtue of rotation of the roll instead of being raised. Consequently, this shield need only extend to the normal level L of the coating solution to act in the sole capacity of protecting the periphery of the roll against exposure to the air circulating around the mouth of the hopper. However, by submerging both shields in the coating solution the apparatus is ready for use regardless of which direction the applicator roll 21 is rotated in. The shield on the side of the roll entering the coating solution is really necessary only when the bead method of application is being used, since in this instance all of the coating on the roll is not left in the bead but a part of it is carried back to the hopper. However, where the roll 21 directly applies the coating solution to the web to be coated, and carries no appreciable amount of the coating solution back to the hopper after passing the coating point, the prevention of evaporation on that portion of the roll between the coating point and the hopper in the direction of rotation of the roll is not so important, and only the one shield on the side of the roll approaching the coating point may be necessary.

It will be appreciated that the rise in the effective level of the coating solution will depend upon the proximity of the shield to the periphery of the roll and the viscosity of the coating solution. If a relatively thin coating solution pumps up to a certain effective level L' with a given spacing between the shield and the roll, a more viscous solution used with the same spacing would be pumped to a higher effective level for a given speed of rotation of the roll 21. For this reason it is desirable to be able to adjust the spacing of the shield 30 relative to the roll, and the following means has been shown as one way of accomplishing this. Since both shields have the same type of mounting the description of one will suffice for both.

Located on each of the top walls 13 of the hopper 10 are one or more guide tubes 35, the number and spacing of the same depending upon the length of the shield 30 to be supported. A threaded supporting pin 40 extends freely through each guide tube 35 and has one end engaging a threaded block 36 attached to one end of the shield 30 and pinned to said block. A manually adjustable knob 37, in threaded engagement with the other end of said pin, has a shoulder 38 provided with a peripheral groove 39 with which a yoke member 41 bolted to the guide tube 35 engages to prevent axial movement of the knob when turned. Thus when the knob is turned, since it cannot move axially, the threaded supporting pin 40 and the shield carried

thereby is moved to and from the roll 21 depending upon the direction of rotation of the knob.

Instead of having the roll protected by two shields 30 as described, it will be appreciated, that there is no reason, other than for the ease of assembly of the parts, why the two shields could not be connected at their lower ends and thereby constitute a single shield of tubular form. As clearly shown in Fig. 3 such a shield could be made from a single tube 50 by cutting a slot 51 the length thereof through which the applicator roll 21 extends at the coating point. This shield should be shorter than the distance between the end walls of the hopper so that the coating solution in the hopper can enter the ends of the tube to fill the space between the same and the roll. A shield of this type can be slid over the roll prior to its being inserted into the hopper and could be suspended from the top walls 13 of the hopper by the means shown. However, it will be appreciated that a single tubular shield could not be adjusted to and from the periphery of the roll, as described in connection with the two shields, so that the supporting means for such a single shield would not have to be adjustable as that one particularly described in connection with the two separate shields. As shown in Fig. 3, the tubular shield could be suspended from the top wall 13 of the hopper by having the ends of adjustable attaching bolts 52, passing through guide tubes 51' on the top walls of the hopper, adapted to threadedly engage threaded blocks 53 attached to the wall of the tube adjacent the slot therein.

From the above description it will be readily understood how the present invention provides a simple, cheap, and effective means, adaptable to any form of coating apparatus of the type described, for protecting the coating solution on the applicator roll from exposure to air circulating about the mouth of a hopper, and thereby eliminate, or greatly reduce, the evaporation of solvents which might be contained in the coating solution due to such exposure. The shields in addition to serving the above-mentioned results by cutting down exposure of the roll to circulating air, also serve the added advantage of raising the effective level of the coating solution in the hopper. By so raising the effective level of use of a level of solution in the hopper below the bearings for the applicator roll whereby unpacked tunity for separation of the solvents from the coating solution and the run back of the solution on the roll.

Although we have shown and described certain specific embodiments of our invention, we are fully aware that many modifications thereof are possible. Our invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

Having thus described our invention, what we claim is new and desire to secure by Letters Patent of the United States is:

1. In a coating apparatus the combination with an open-mouth hopper adapted to contain a supply of coating solution, an applicator roll rotatably mounted in said hopper with a portion of its periphery dipping into said solution and another portion extending out of the mouth of said hopper, means for rotating said roll in one direction, of means for protecting that portion

of the periphery of said roll between the solution and the coating point, in the direction of rotation of the wheel, from exposure to air circulating around the mouth of said hopper, said means comprising an arcuate shield suspended from said hopper in concentric relation with said roll and spaced therefrom, said shield encircling that portion of the periphery of the roll between the point where it leaves the solution and a point outside of said hopper within 30° of the coating point.

2. In a coating apparatus the combination with an open-mouth hopper adapted to contain a supply of coating solution, an applicator roll rotatably mounted in said hopper with a portion of its periphery dipping into said solution and another portion extending out of the mouth of said hopper, of means for protecting the greater part of that portion of the roll between the coating point and the solution from exposure to air circulating around the mouth of said hopper, said means comprising a pair of arcuate shields each of which is suspended from said hopper in concentric relation with said roll but spaced therefrom, one of said shields encircling that portion of the roll between the point where it leaves the solution and a point adjacent the coating point, and the other of said shields encircling that portion of the roll between a point adjacent the coating point and the point where it enters said solution.

3. In a coating apparatus the combination with an open-mouth hopper adapted to contain a supply of coating solution, an applicator roll rotatably mounted in said hopper with a portion of its periphery dipping into said solution and another portion extending out of the mouth of said hopper, of means for protecting the greater part of that portion of the roll between the coating point and the solution from exposure to air circulating around the mouth of said hopper, said means comprising a tubular shield of slightly greater diameter than the roll and provided with an elongated slot extending lengthwise thereof, said shield suspended from said hopper in concentric relation with said roll with the slot therein located at the coating point on said roll.

4. In a coating apparatus the combination with an open-mouth hopper adapted to contain a supply of coating solution, an applicator roll rotatably mounted in said hopper with a portion of its periphery dipping into said solution and another portion extending out of the mouth of said hopper, means for rotating said roll in one direction, of means for protecting the greater part of that portion of the periphery of said roll between the solution and the coating point, in the direction of rotation of the wheel, from exposure to air circulating around the mouth of said hopper and for raising the effective level of the solution in said hopper, said means comprising an arcuate shield suspended from said hopper in concentric relation with said roll but spaced therefrom, said shield adapted to extend from a point below the level of the solution in said hopper to a point outside of said hopper, and means for adjusting the shield to and from the periphery of said roll in accordance with the viscosity of the coating solution being used and the speed of rotation of the roll.

5. In a coating apparatus the combination with an open-mouth hopper adapted to contain a supply of coating solution, an applicator rotatably mounted in said hopper with a portion of its

periphery dipping into said solution and another portion extending out of the mouth of said hopper, of means for protecting the major part of the unsubmerged portion of the periphery of said roll from exposure to air circulating around the mouth of said hopper and for raising the effective level of the solution in said hopper, said means comprising a pair of arcuate shields suspended from the hopper on opposite sides of said roll, and spaced therefrom, each of said shields adapted to extend from a point below the level of the solution in said hopper to a point outside of said hopper, and means for adjusting each of the shields to and from the periphery of said roll.

6. In a coating apparatus the combination with an open-mouth hopper adapted to contain a supply of coating solution, an applicator roll rotatably mounted in said hopper with a portion of its periphery dipping into said solution and another portion extending out of the mouth of said hopper, means for rotating said roll in one direction, of means for protecting the greater part of

that portion of the periphery of said roll between the solution and the coating point, in the direction of rotation of the wheel, from exposure to air circulating around the mouth of said hopper and for raising the effective level of the solution in said hopper, said means comprising a supporting member movably mounted on the hopper at one side of the mouth thereof and extending horizontally transversely of said mouth, an arcuate shield connected to said supporting member and adapted to be in concentric relation with said roll but spaced therefrom, said shield adapted to extend from a point below the level of solution in said hopper to a point outside of said hopper, and manually adjustable means for moving said supporting member transversely of said hopper mouth for moving said shield to and from the periphery of said roll in accordance with the viscosity of the coating solution being used.

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