

[54] COATING APPARATUS

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[58] Field of Search 118/410, 411, 412, 407, 118/324, 325, 603, 610, DIG. 4; 117/34, 105.3; 425/197, 198

[56] References Cited

UNITED STATES PATENTS

2,761,417 9/1956 Russell et al..... 118/412 X
3,716,317 2/1973 Williams et al..... 425/198

FOREIGN PATENTS OR APPLICATIONS

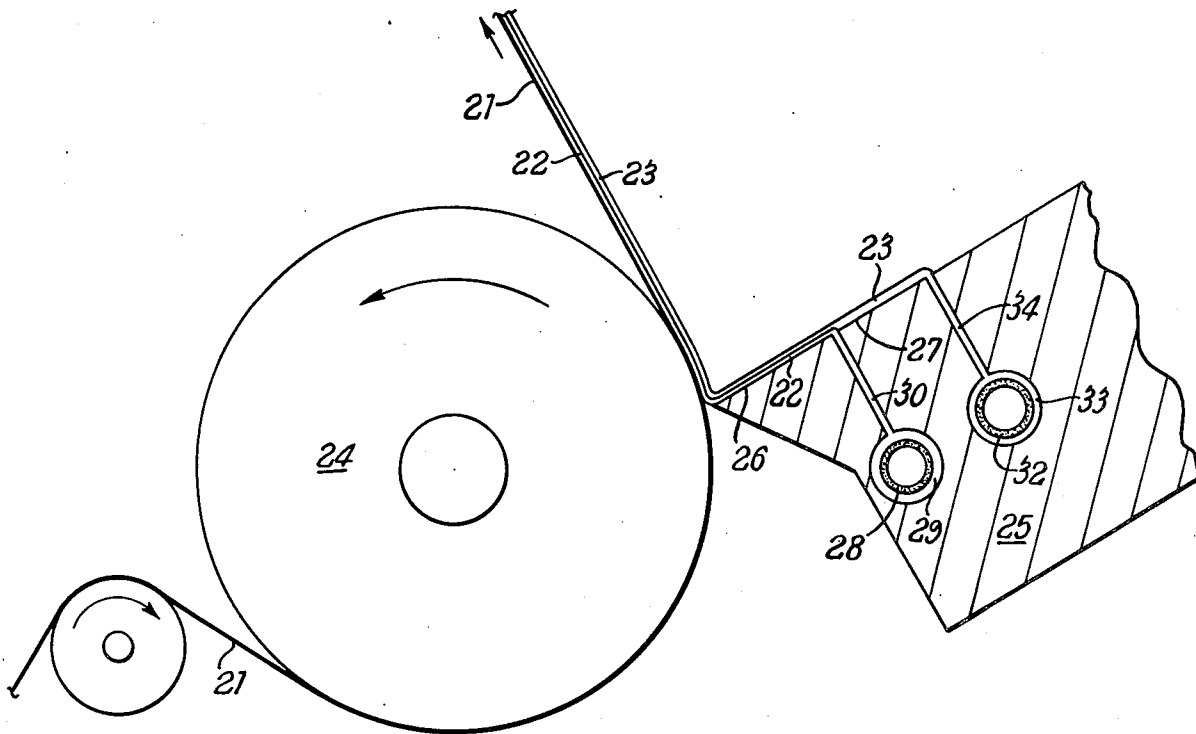
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[57] ABSTRACT

In a coating apparatus for travelling web material which comprises at least one coating liquid distribution slot through which coating liquid is discharged so that it may be carried away by the web material the improvement consists of providing a liquid distribution slot which is relatively broad and providing in the liquid distribution chamber from which the coating liquid is fed to the said distribution slot a permeable tube in to which the coating liquid is fed from a supply source and through which it is forced in to the liquid distribution chamber. The apparatus may be of the curtain-type or of the slide hopper-type. The latter may have one or more downwardly inclined slide surfaces each of which having associated therewith a relatively broad distribution slot and a distribution chamber having therein a permeable tube through which the coating liquid is forced.

4 Claims, 4 Drawing Figures



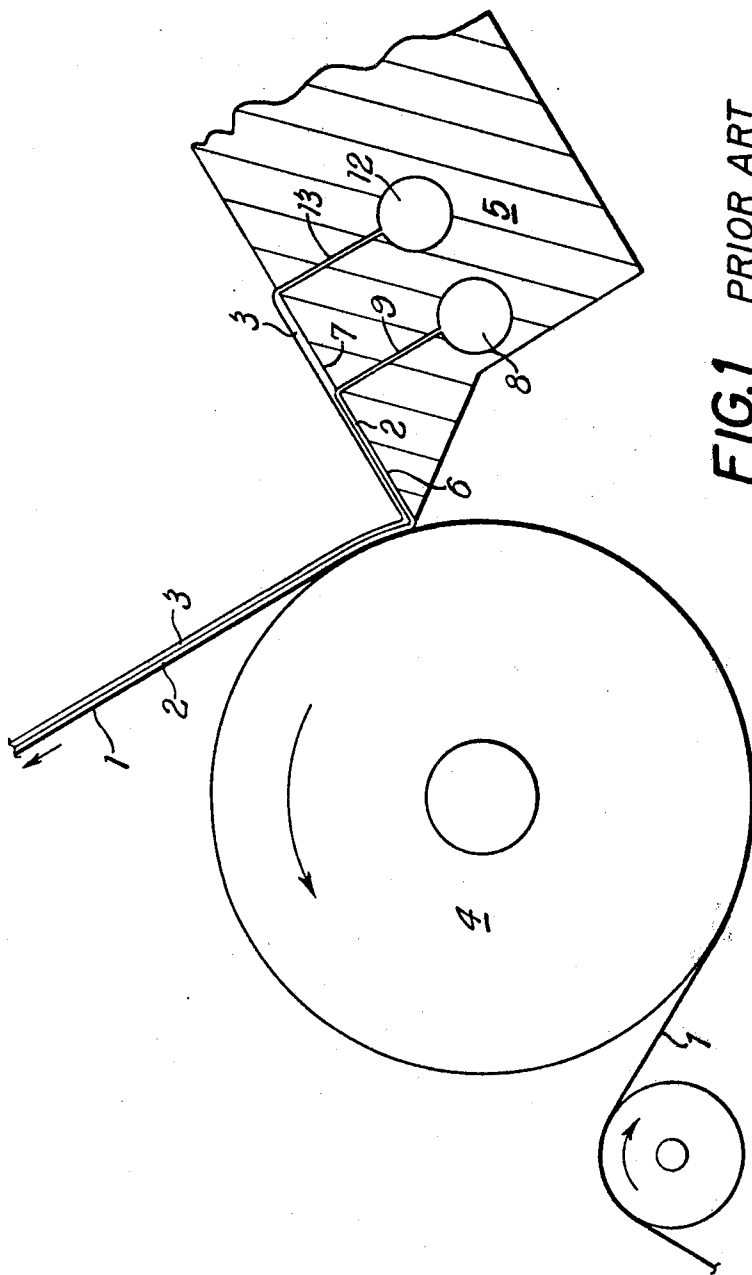


FIG.1 PRIOR ART

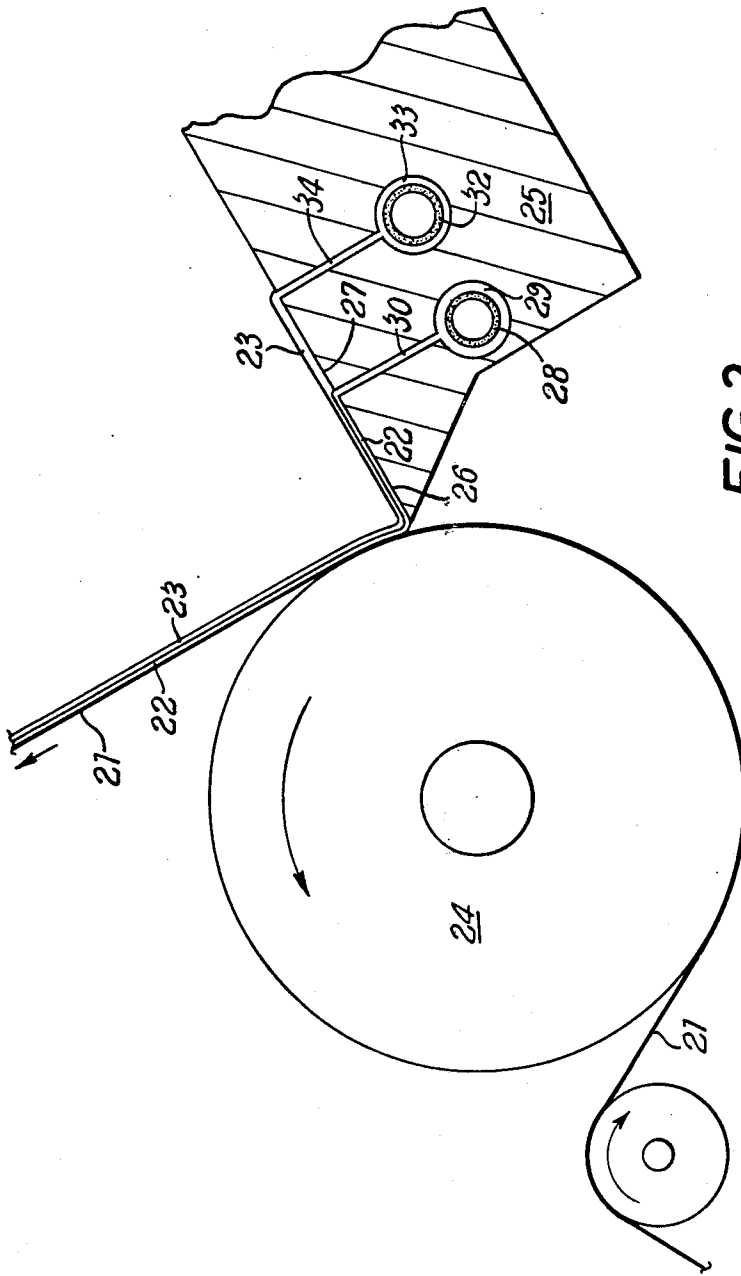
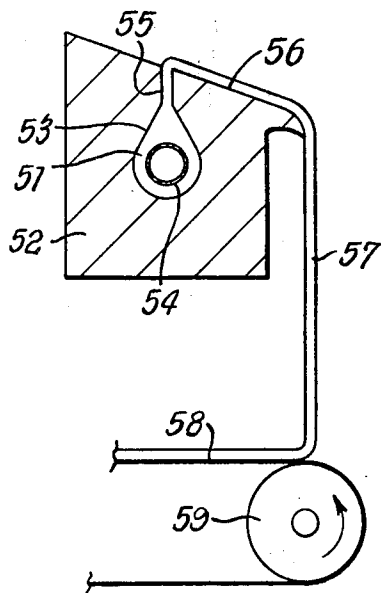
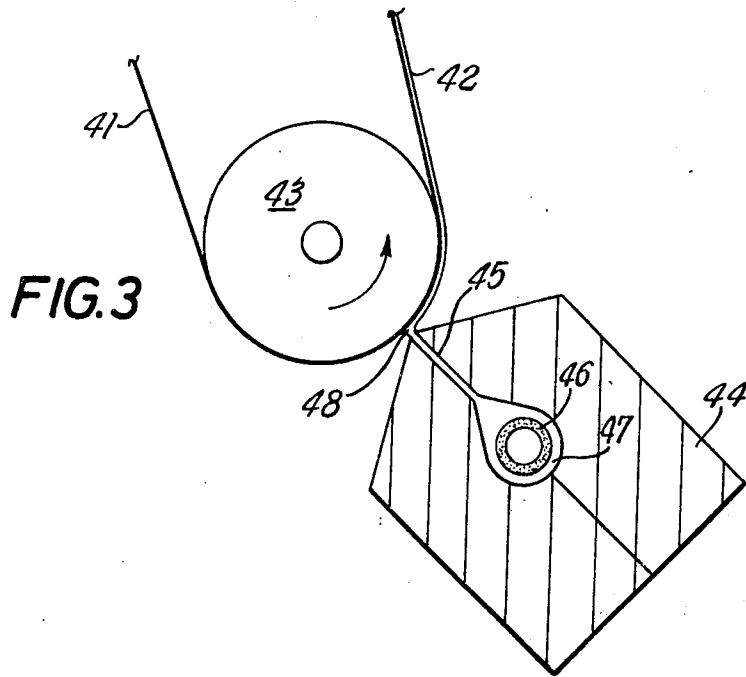


FIG. 2



COATING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to apparatus for coating a liquid layer on to a moving web material.

In a number of such apparatus the coating liquid is discharged through a slot in such a way that a guided moving web material adjacent to the apparatus picks up the liquid and carries it away as a layer. In a number of web coating apparatus there are a plurality of such slots and the web is coated with a like number of layers of coating liquid simultaneously.

In practice it has proved difficult to make uniform narrow distribution slots for coating apparatus since the breadth of the slot (that is to say the width of the slot at right angles to the length of the slot) is usually required to be between 0.2 and 0.5mm and such breadth must be uniform over the length of the slot which is often between 1 metre and 1.5 metres. Since it be required that the thickness of the coating liquid be substantially uniform over the whole width of the coating apparatus it is necessary that the tolerance allowable in the breadth of the distribution slot be no more than ± 0.004 mm, a standard both difficult and costly to achieve.

SUMMARY OF THE INVENTION

It is the object of the present invention to provide a coating apparatus for travelling web material which does not require a narrow highly uniform liquid distribution slot.

According to the present invention, in a coating apparatus for travelling web material which comprises at least one coating liquid distribution slot through which coating liquid is discharged so that it may be carried away by the web material, there is provided the improvement which comprises providing a liquid distribution slot which is relatively broad and providing in the liquid distribution chamber from which the coating liquid is fed to the distribution slot a permeable tube in to which the coating liquid is fed from a supply source and through which it is forced in to the liquid distribution chamber.

It has been found when the coating liquid is forced through a permeable tube into the distribution chamber, that this provides the required resistance to flow necessary to form a uniform layer on the web.

A suitable permeable tube which is commercially available is porous polyethylene tubing.

By relatively broad distribution slot is meant a distribution slot which is typically greater than 0.5mm broad. Thus the breadth of the distribution slot has only a secondary effect on the thickness of the layer of coating liquid present on an associated slide or in a coating bead as the liquid is not required to be forced through this slot since it does not form the main restriction to the flow of the coating liquid.

According to a preferred embodiment of the invention there is provided a slide hopper coating apparatus of the type described which comprises at least one slide surface having associated therewith a relatively broad distribution slot, the coating liquid being fed into the relatively broad distribution slot from a distribution chamber which has therein a permeable tube into which the coating material is pumped from the supply source and through which it is forced into the distribution chamber.

Preferably in the preferred embodiment of the invention the slide hopper comprises a plurality of slide surfaces each of which has associated therewith a relatively broad distribution slot and a distribution chamber having therein a permeable tube through which the coating liquid is forced.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings will illustrate three embodiments of coating apparatus according to the present invention compared with a prior art apparatus.

FIG. 1 is a diagrammatic side elevation of a prior art slide coating apparatus.

FIG. 2 is a diagrammatic side elevation of a slide coating apparatus according to the present invention.

FIG. 3 is a slot coating apparatus according to the present invention.

FIG. 4 is a diagrammatic side elevation of a curtain coating apparatus according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

An apparatus of the type which coats several layers of photographic emulsion on to a moving web of support material through narrow highly uniform distribution slots is illustrated in British Pat. Specification Ser. No. 834,527 in FIGS. 2 and 3 (corresponding to U.S. Pat. No. 2,761,791). Such a coating apparatus is known as a slide hopper coating apparatus. In this apparatus a first liquid is supplied through a distribution slot, it spreads evenly across the width of a downwardly inclined slide surface (the coating face) and flows down this surface on to a moving web which is positioned adjacent to the end of the slide. A second liquid is supplied in a similar manner such that it first flows down the slide surface on its own and then as a layer over the top of the liquid issuing from the first slot. Such an apparatus is shown in FIG. 2 of Specification No. 834,527. A number of layers may be coated thus by providing the requisite number of slots arranged sequentially in an upwardly inclined line. Such an apparatus is shown in FIG. 3 of Specification No. 834,527. Slide hopper coating apparatus of the type described in British Pat. Specification No. 834,527 are hereinafter referred to as slide hopper coating apparatus of the type described.

Slide hopper coating apparatus of the type described have been used successfully for a number of years to coat multiemulsion layer photographic material. In order to achieve uniformity of flow over the full width of the slide surface, the pressure in the distribution chamber must be large compared with pressure differences associated with transverse flow within the distribution chamber. Therefore, to provide the required resistance to flow which is required to distribute a uniform layer of the coating material over the full width at the slide surface, in most of the slide coating hopper apparatus produced hitherto, there are provided narrow slots through which the coating liquids are pumped from a distribution chamber to the slide surface. A slide hopper coating apparatus of this type is shown in FIG. 1 which accompanies this specification.

In this figure a web of film material 1 is being coated with two layers of coating liquid 2 and 3. The web of film material 1 is partially lapped around a coating roller 4 which is rotating in the direction indicated by the arrow thereon. The slide hopper coating apparatus 5 is shown in operative position in relation to the web on

the coating roller. The slide hopper coating apparatus comprises two slide surfaces 6 and 7. The coating liquid 2 is pumped into a distribution chamber 8 through a narrow slot 9 and then it forms a thin layer on the slide 6 and flows down the slide surface on to the moving web. The coating liquid 3 is pumped into a distribution chamber 12 and then through the narrow slot 13 and it then forms a thin film on the slide surface 7 and flows down the slide surface 7 and overlapping the thin film of coating liquid 2 on the slide surface 6 thus two layers of coating liquid are formed on the web as shown on the left of this figure.

In FIG. 2 a film web 21 is being coated. The film web 21 is shown partially lapping a coating roller 24 which is rotating in the direction indicated by the arrow thereon. Coating liquids 22 and 23 are being coated as layers on to the web and layers of these liquids are shown on the web as it leaves the coating roller.

A slide hopper coating apparatus 25 is shown in operative position in relation to the web 21. The slide hopper coating apparatus 25 comprises a slide surface 26 and a slide surface 27. The coating liquid 22 is pumped (from a bulk source not shown) into a permeable polyethylene tube 28 which is located in the distribution chamber 29. After the liquid has been forced through the permeable polyethylene tube 28, out into the chamber 29 it passes upwards through a relatively broad distribution slot 30 and then forms a layer on the slide surface 26.

The coating liquid 23 is pumped into a permeable polyethylene tube 32, which is located in the distribution chamber 33. After it has been forced out of the tube 32 into the distribution chamber 33 it flows upwards through a relatively wide distribution slot 34 and then forms as a layer on the slide surface 27. The liquid 22 flows down the slide surface 26 onto the web 21, the liquid 23 flows down the slide surface 27 and forms a layer over liquid 22 which is flowing over slide surface 26. The two layers of liquid reach the coating point where the end of slide surface 26 is near the web 21 are then carried away as superimposed layers on the travelling web 21.

In one slide hopper coating apparatus as shown in this figure the width of the coating slide was 1.1 metres. The width of the relatively wide coating slots 30 and 34 was 3mm. The greatest diameter of the distribution chambers 29 and 33 was 20mm and each distribution chamber contained a 1.1 metre length of permeable polythene tube which had an external diameter of 16 mm and a wall thickness of 2mm. A gelatin based coating material was coated using this apparatus and two very uniform layers were obtained on the film web being coated, the deviation from the norm being far less than the deviation which is normally obtained using slide hopper coaters.

The required resistance required to produce the uniform coatings was provided by forcing the coating liquids out of the permeable tubes and not by forcing the liquid through the relatively broad distribution slots.

In FIG. 3 a film web 41 is being coated with a layer of coating liquid 42. The film web 41 is shown partially lapping a coating roller 43 which is rotating in the direction indicated by the arrow thereon. The coating liquid 42 is being applied to the film web 41 from a slot coating apparatus 44. The slot apparatus 44 comprises a coating head formed in two halves so as to form a distribution slot 45. The coating liquid 42 is pumped

(from a bulk source not shown) into a permeable polyethylene tube 46 which is located in the distribution chamber 47. After the liquid has been forced through the permeable polyethylene tube 46 into the chamber 47, it passes through the distribution slot 45 which is a relatively broad slot which constitutes only a minor restriction to the flow of the coating liquid. Above the distribution slot 45 the coating liquid forms a coating bead 48 from whence it is removed by the travelling film web 41 as a layer thereon.

A uniformly distributed coating bead 48 along the length of the slot 45 is formed by the liquid being forced out of the permeable tube 46 and not by the liquid being forced out of the distribution slot 45. Since there is a uniform coating bead 48 above the slot coating apparatus 44 a uniform layer of coating liquid is coated on to the travelling web.

In FIG. 4, the apparatus shown is a curtain coating apparatus which comprises an inclined slide. In the figure coating liquid 51 is pumped into a hopper 52 which has therein a liquid distribution chamber 53. In this distribution chamber is located a porous polyethylene tube 54.

The coating liquid 51 is pumped from a liquid supply source (not shown). The liquid then forced through the porous polyethylene tube 54 into the distribution chamber 53 and up a relatively broad slot 55 and forms as a layer on the inclined slide 56. It then falls down as a free-falling vertical curtain 57 on to a travelling web 58 which is supported on a rotating roller 59. The liquid 51 is carried away as a layer on the travelling web 58.

The presence of the porous polyethylene tube 54 means that the channel 55 may be comparatively wide i.e. in the region of 5mm in width.

The required resistance to flow of the coating liquid required to produce a uniform layer of coating liquid on the slide 56 is provided by forcing the liquid through the permeable tube 54.

Permeable polyethylene tubing of a suitable type is comparatively cheap and it is easy to insert such a tube in the distribution chamber or chambers of a coating apparatus which comprises a coating liquid distribution slot or slots and to maintain it there.

What I claim is

1. An apparatus for coating a travelling web with at least one layer of a photographic coating liquid, said apparatus comprising:

a hopper;

means for passing a web relative to said hopper;

said hopper comprising at least one elongated cavity for containing coating liquid and at least one elongated slot communicating with said cavity for discharging the coating liquid from said cavity onto said web; and

said at least one cavity having therein a supply tube for conveying the coating liquid under pressure from a coating liquid source to said cavity, said tube extending over substantially the entire length of said cavity, said tube having a closed inner end and a wall means consisting of a permeable material for forceably delivering the coating liquid from the interior of said tube into said cavity, and said wall means comprising means for providing a flow resistance for the coating liquid greater than the flow resistance provided by the respective slot.

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2. The apparatus of claim 7, wherein said supply tube is a permeable polyethylene tube.

3. The apparatus of claim 1, wherein the breadth of said slot is greater than 0.5 mm.

4. The apparatus of claim 1, wherein said hopper fur-

ther comprises at least one downwardly inclined slide surface onto which said slot opens for conveying the coating liquid from said cavity to said slide surface.

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