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[54] **PROCESS FOR COATING SUBSTRATES IN STRIP-FORM WITH PHOTOGRAPHIC EMULSION**

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[51] **Int. Cl.** **B44d 1/12,** B05c 3/12, G03c 1/74
[58] **Field of Search** 117/34, 119, 61; 118/50, 63, 118/410

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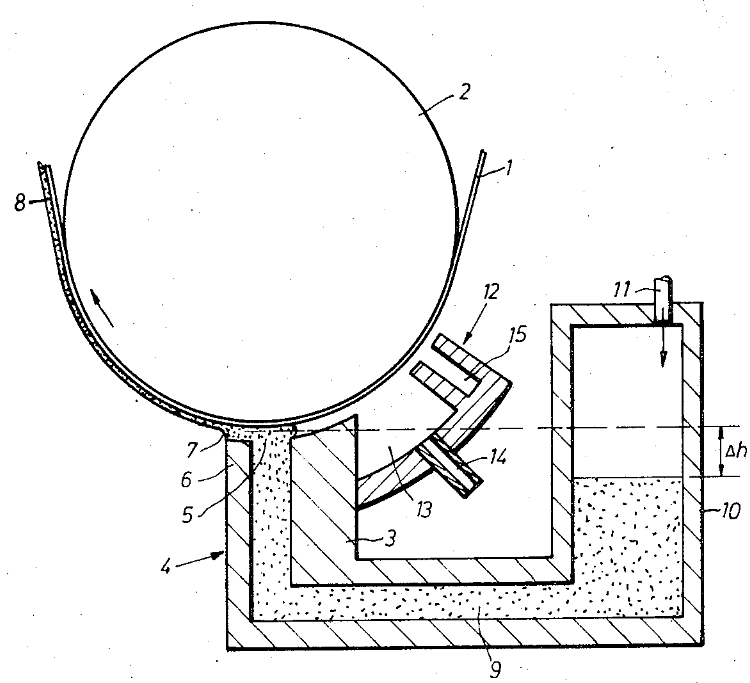
[57] **ABSTRACT**

A process for coating a viscous solution by a wetting process on a movable substrate. The coating solution is formed by a narrow gap between coating apparatus and the movable substrate so that the narrow gap is part of a coating chamber of the coating apparatus. The coating chamber is connected to a vacuum means at the side of the coating apparatus from which the substrate is introduced.

2 Claims, 2 Drawing Figures



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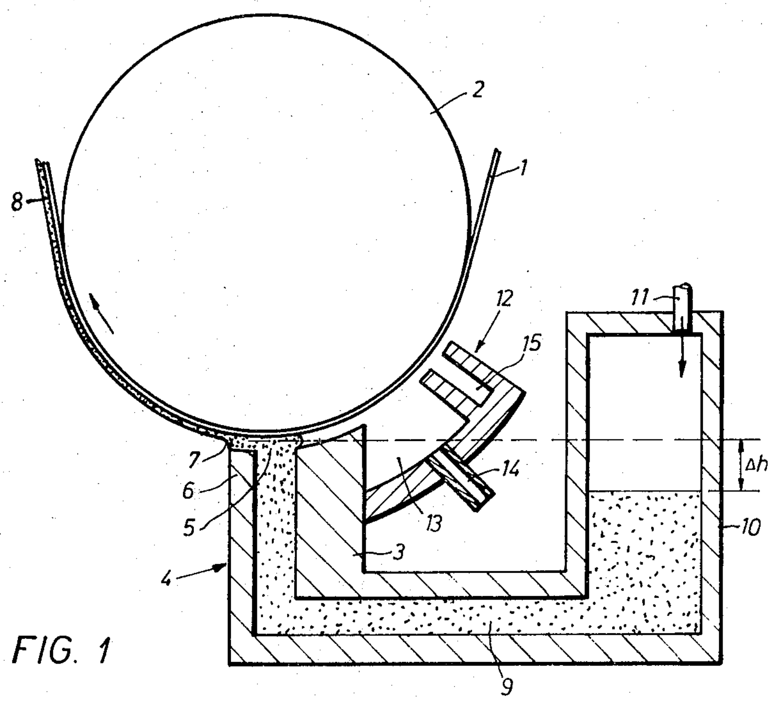

FIG. 1

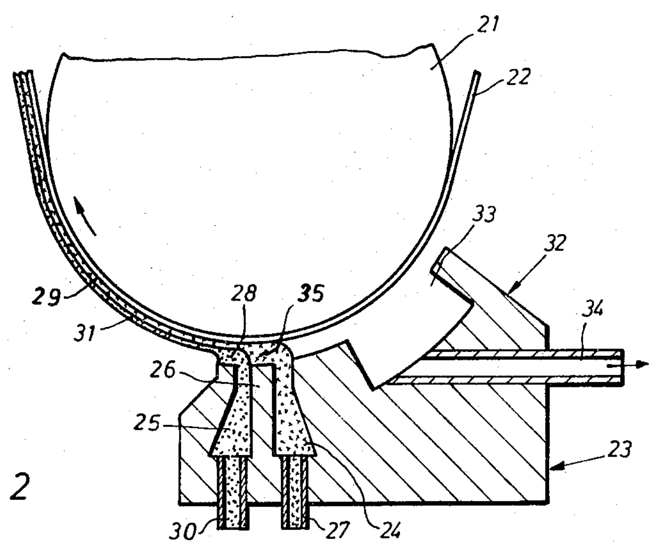

FIG. 2

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PROCESS FOR COATING SUBSTRATES IN STRIP-FORM WITH PHOTOGRAPHIC EMULSION

Reference is made to U.S. application Ser. No. 798,118 filed Feb. 10, 1969; Ser. No. 797,809 filed Feb. 10, 1969 and Ser. No. 797,800 filed Feb. 10, 1969.

This invention relates to a process for coating substrates in strip form with viscous solutions, preferably with photographic emulsions, in which the substrate is wetted in a sealed coating chamber whose end at the point where the emulsion emerges is formed by a narrow gap several times wider than the wet finished layer is thick, and in which to counteract the forward movement of the moved substrate, layer formation takes place under a adjustable static pressure differential between the inlet end and the outlet end of the gap, the lower pressure prevailing at the inlet end.

It is known that the negative pressure can be generated by evacuating the interior of the supply vessel, for example by means of a pump. The level of the coating solution in the supply vessel is kept constant by a level meter or gauge which acts on a pump dispensing the coating solution.

One disadvantage of this embodiment is that the vacuum created by the pump is subject to fluctuations, in addition to which air can leak at one place or another. Separating of vortices increase fluctuations of pressure. Accordingly this conventional coating process is not always reliable in operation. The method of coating in strip-form can be carried out in techniques such as described in copending applications, U.S. application Ser. No. 798,118 entitled "A Process for Coating Substrates in Strip-Form" and U.S. application Ser. No. 797,800 entitled "A Process for Coating Strip-Form Substrates," both filed Feb. 10, 1969.

The object of the invention is to provide a coating process guaranteeing an exact, consistently uniform application of the coating solution to the substrate in a layer thickness with extremely narrow tolerances. In this case the whole solution which is supplied is applied to the strip without return motion. The smallest distance between the coating device and the strip to be coated should be larger than two times the thickness of the coating layer.

According to the invention, this object is achieved by adjusting the required negative pressure through dropping the level of the contents of the supply vessel in relation to the position of the coating gap. In this way it is very easy to adjust layer thickness.

The fall in the level of the content of the supply vessel, i.e., the level of the coating solution, is most readily obtained through consumption. In another embodiment, which enables the level to be adjusted more quickly, a corresponding quantity of coating solution is run off from the supply vessel or otherwise removed. Alternatively, the entire supply vessel together with its contents is vertically adjustable relative to the coating gap.

Coating processes which do not provide a volumetrical control of the thickness of the layer, show the following disadvantage: A stable relation of mechanical data of coating to the static vacuum and to the thickness of the layer resulting therefrom exists only, if the flow properties of the coating solution are always constant. This condition cannot be fulfilled when using different solutions. Even when using the same solution, a change of the flow properties during periods of nonoperation of the device cannot always be avoided. The production of a coating layer of constant thickness therefore requires the level of solution in the vessel to be raised or lowered proportionally to the alterations of the flow properties of the solution; thus, it is necessary, either to measure the alterations of the thickness of the layer and prevent such alterations by controlling the level, or to determine the alterations of the flow properties of the solution and, proportionally thereto, to control the level in the vessel so as to garantuee the desired thickness all over the operating time by the experimentally determined relation between the flow properties, height of level in the vessel and the resulting thickness of layer. Both methods require a large expenditure of measuring and controlling equipment. The second method nevertheless does not garantuee a result of sufficient exactness.

The disadvantage associated with the prior art method is overcome by the invention by volumetrically feeding to the supply vessel per unit of time as much coating liquid as is applied to the surface of the substrate to be coated passing through the coating gap in the same unit of time, the level of coating liquid in the supply vessel being freely and automatically adjusted in dependence upon any changes in the flow properties of the coating liquid and the rate of travel of the substrate to be coated.

In this way, the static pressure differential and hence the level of liquid in the supply vessel are automatically adjusted in dependence upon the flow properties of the coating solution in such a way that exactly the same amount of coating solution is applied to the substrate as is dispensed per unit of time. Any difference between the quantity of coating solution applied and the quantity applied produces a change in level in the supply vessel which affects the quantity applied in such a way that the aforementioned difference is eliminated. The arrangement is self-regulating. The level of coating solution in the supply vessel remains freely adjustable. It is of advantage to keep the cross section of the supply vessel small. For example the supply vessel may consist solely of a standpipe.

If subsequently there is a change in the flow properties, the level in the supply level will in fact change, although the resulting layer thickness will remain unchanged, as required because the rate of application remains equal to the rate at which coating solution is dispensed. In addition, it is readily possible to ensure that the thickness of the coating applied remains constant in the event of any change, in the rate at which the substrate to be coated travels forward.

To this end, the quantity of coating solution dispensed is altered proportionally to the rate of travel. According to the invention, this is preferably done by designing the dispensing or metering device in the form of a pump whose throughput is proportional to its rate of revolutions and whose drive is coupled at a fixed rotational speed ration with the drive of the substrate.

The process of the invention as described before, has proved to be efficient in practice.

However, when starting the process or restarting after an interruption of coating, the coatings obtained have a higher thickness than desired during the time the level in the vessel needs for lowering. On account of the high speed of coating and the long adaptation time of the level of the solution, which takes about one minute, a larger portion of the strip is coated in a thickness of layer beyond the tolerance limits. These portions of the strips are rejected.

According to a preferred embodiment of the process, the portions of the strip which are not useful because the coating thereon is relatively thick, can be decreased in length to a few inches by supplying the volumetrically fed coating liquid to the coating chamber through a completely sealed pipe system which is equipped with an air cushion, preferably enclosed in the vessel.

In a further development of the process according to the invention for applying coatings in several superimposed layers, the strip-form substrate is coated from separate coating chambers in a common coating block, wherein the sealed coating chambers with the corresponding coating gaps are arranged without interspace one after another being separated from one another by a common sealing wall.

In addition, the invention provides in known manner for the application of a vacuum at the inlet end of the coater so that the negative pressure in the coater can be maintained. A blocking vacuum is preferably applied at the end of the coating gap, too.

Two embodiments of the process according to the invention and the associated apparatus are described by way of example in the following with reference to the accompanying drawings, wherein:

FIG. 1 is a cross section through a one-layer coater,

FIG. 2 is a cross section through a multilayer coater.

As shown in FIG. 1, a strip 1 is guided over a roller 2 and passes a rear wall 3 of a coating block 4. In a coating chamber

5, the strip 1 is wetted with coating solution. A front coating wall 6 in conjunction with the roller 2 and the strip 1 forms the actual coating gap 7 which is responsible for determining the thickness of a layer 8 on the strip 1. The coating chamber 5 communicates through a pipe 9 with a supply vessel 10. After commencement of the process the level of the coating solution in the supply vessel 10 is adjusted relative to the level of the coating gap 7 by lowering it the required extent Δh, generating a corresponding negative pressure. The vessel 10 is enclosed so as to provide the air cushion mentioned above. The reference 11 denotes the device for dispensing the coating solution. The rear wall 3 of the coater is adjoined by a vacuum trap 12 in a direction opposite to that in which the strip travels. A chamber 13 of the vacuum lock 12 is connected by means of a suction socket 14 to a suction fan (not shown). The chamber 13 is preceded by another chamber 15 in order to form a kind of labyrinth.

In FIG. 2, the multilayer coater consists of a guide roller 21 for a strip 22. A coating block 23 is provided with two coating chambers 24 and 25 separated from one another by an intermediate wall 26. A first emulsion coating solution is fed through a connecting socket 27 to the coating chamber 24, being applied to the strip 22 in the form of a layer 29 through a coating gap 35. Another coating solution is fed to the second coating chamber 25 through a connecting socket 30, being applied to the first emulsion layer 29 in the form of a layer 31 through the coating gap 28. Arranged at the inlet end of the coating block 23 there is a vacuum lock 32 whose vacuum chamber is connected to a suction fan (not shown) through a vacuum pipe 34.

We claim:

1. In a process of applying a coating of photographic emulsion of uniform and controllable thickness to a moving foil, the foil being wetted in a body of photographic emulsion coating solution, the body being subjected to a hydrostatic pressure difference, which is formed by the moving foil itself by picking up the coating solution from the body of the solution at the lower pressure prevailing where the foil is first wetted by the body, the improvement which comprises confining the body of photographic emulsion coating solution to a gap, which is several times wider than the thickness of the coating on the foil, feeding the coating solution from a coating solution supply, which is in a completely sealed self-communicating pipe system, to a gap between the moving foil and an adjacent surface of a chamber of the system, removing the coating solution from the gap onto the moving foil, lowering the level of the coating solution in said supply by said removal of the coating solution and creating a pressure differential within said gap between the side closest to the chamber and the side where the moving foil departs from the gap, metering the adding of coating solution into said supply under an air cushion above the level of the solution in the sealed system at a rate variably proportional to the rate of travel of the moving foil so that the rate of volumetric addition is increased with an increase in the rate of travel, per unit of time, and thereby automatically adjusting the level of the coating solution in the supply and adjusting the static pressure differential between said sides of the gap.

2. A process for coating several layers according to claim 1, wherein the different layers are applied successively via a plurality of self-communicating pipe systems, each system having its free adjustable coating solution level in a different supply vessel, the supply vessels being provided with an air cushion, and metering each coating solution to each supply vessel.

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