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T. A. RUSSELL

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MULTIPLE COATING APPARATUS

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2 Sheets-Sheet 2

Fig. 5

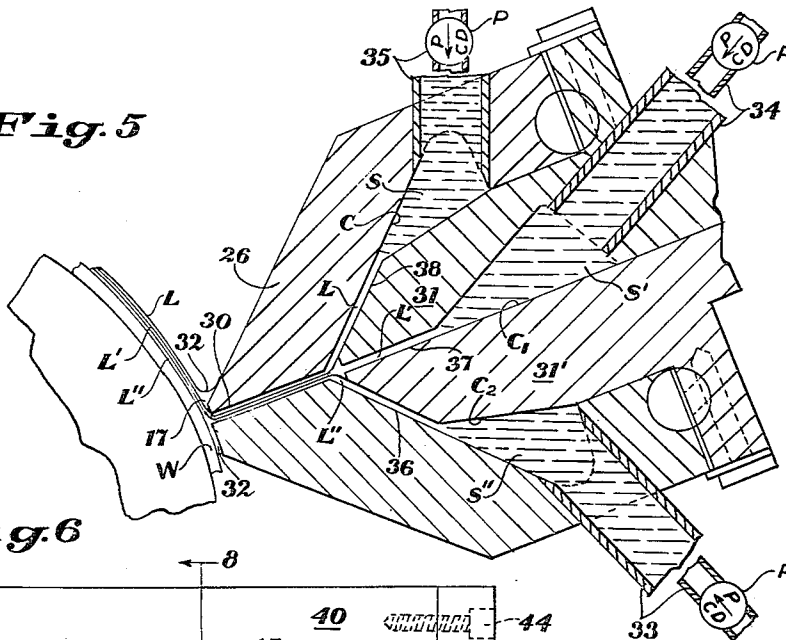


Fig. 6

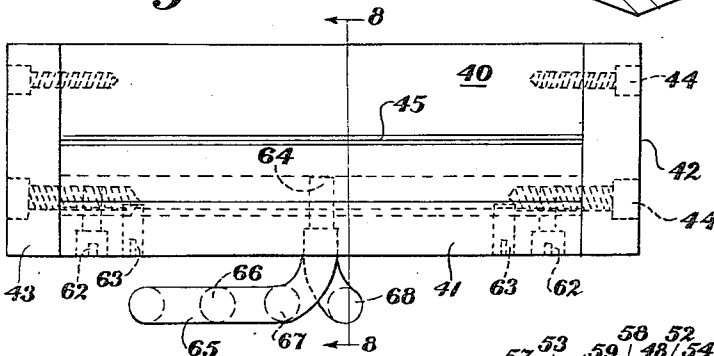


Fig. 7

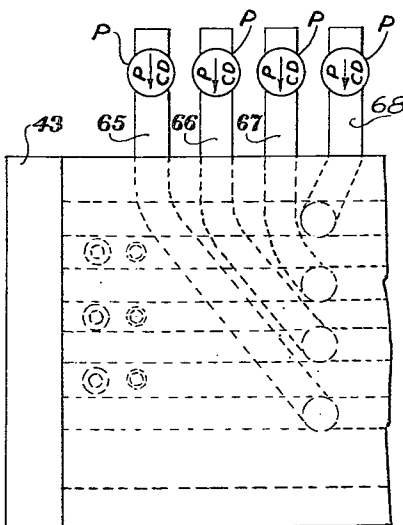


Fig. 8

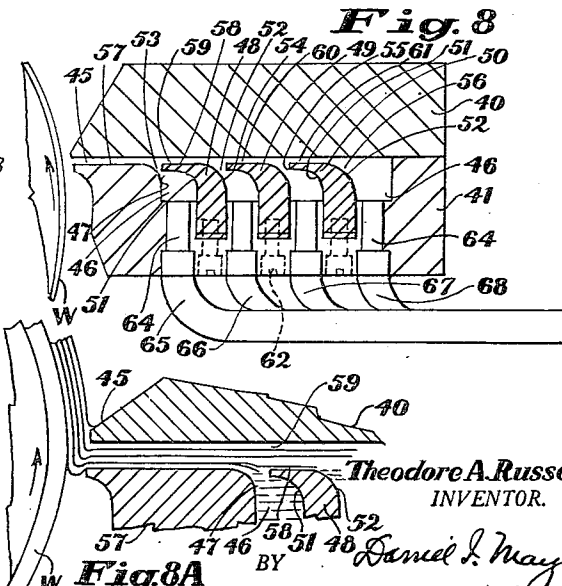


Fig. 8A

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2,761,418

MULTIPLE COATING APPARATUS

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6 Claims. (Cl. 118—410)

The present invention relates to a new coating apparatus for applying multiple coatings to the surface of a web, and particularly to a coating apparatus useful in carrying out the method of multiple coating a web described in my U. S. application Serial No. 489,863, filed on even date herewith.

In my above-identified patent application there is disclosed a method of applying a plurality of separate coatings to the surface of a moving web which allows all of the layers of the separate coating materials to be applied to the web simultaneously while still maintaining a distinct layer relationship between the coatings after deposition. Essentially, it involves continuously forming each fluid composition into a ribbon or layer of given thickness, bringing these layers into surface contact prior to the time they are applied to the surface of the web and then directing them in combined relation to a point of application where they are simultaneously applied to the web in the desired orientation and with no noticeable mixing or contamination at the interface of the layers.

The primary object of the present invention is to provide an apparatus by means of which this method of multiple coating can be carried out.

A further object is to provide a multiple hopper which forms each of several fluid coating compositions into individual layers and then brings said layers into surface contact with one another, after which they are extruded in this combined layer relationship to a point of deposition where they are picked up on the surface of a moving web while the distinct layer relationship is maintained.

Another object is to provide a coating apparatus for simultaneously feeding a plurality of fluid coating compositions in superposed and distinct layer relationship to a common point of deposition where they are simultaneously deposited on the surface of a web in such layer relationship. It comprises a multiple hopper adapted to continuously form each of the coating compositions into a separate layer, bring the separate layers into surface contact and then extrude them in such combined relationship into a bead maintained between the lips of the hopper and the surface of the web to be coated and across and in contact with which bead the web is continuously moved.

And still another object is to provide an apparatus by the use of which the plurality of coatings required on a photographic film or paper can be applied to the support simultaneously and set and then dried simultaneously while maintaining a distinct relationship between the layers, which is as good as when the coatings are successively applied to the support with a complete drying between successive coating applications, as in conventional coating procedures.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its methods of operation, together with additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawing, in which:

Fig. 1 is a schematic side elevational showing, partly in section, of a form of apparatus including a dual hopper which may be used to simultaneously apply two layers of coating material to a web in accordance with the present invention;

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Fig. 2 is an enlarged sectional view of just the dual hopper used in connection with the apparatus of Fig. 1;

Fig. 3 is a greatly enlarged fragmentary section of the dual hopper shown in Fig. 2 and illustrating how two layers of coating material are simultaneously applied to the surface of a web;

Fig. 4 is a fragmentary section showing a color photographic film coated with four different layers of material and using a dual hopper;

Fig. 5 is an enlarged fragmentary section of a triple hopper by the use of which three layers of coating material may be applied to a surface of a web in accordance with the present invention;

Fig. 6 is a front elevational view of a multiple hopper which can be used to simultaneously apply four coatings to the surface of a web in accordance with the present invention;

Fig. 7 is a partial top plan view of the multiple hopper shown in Fig. 6;

Fig. 8 is a sectional view taken substantially on line 8—8 of Fig. 6; and

Fig. 8A is an enlarged sectional detail of the form of hopper shown in Fig. 8 and showing how the four layers of separate coating compositions are fed through the extrusion slot in combined relation and into a coating bead from which they are picked up by a web moving across and in contact with said bead.

In the manufacture of supports or continuous webs which require the application of two or more separate coatings in superposed layer relationship on one surface thereof, it has been the customary procedure to place each of the coatings on the support in succession and to set and/or dry each coating before the application of the next. Such a procedure has been deemed necessary in order to maintain a distinct relationship between the separate layers and to prevent mixing of the coatings or contamination of one by the other at the interface of the layers. It will be appreciated that such a procedure of applying a plurality of coatings to the surface of a support has been very time consuming and has involved the use of duplicate equipment for each coating. These two factors alone have added greatly to the expense of making such multiply coated supports.

In my above-mentioned application there is disclosed a method of coating which permits the simultaneous application of a plurality of separate coating compositions onto the surface of a web whereby the time and duplication of equipment involved in conventional coating procedures is reduced or eliminated, as the case may be. This novel method of coating is not dependent upon the use of any particular form of coating apparatus so long as it permits the formation of each of the coating compositions into layers of a given thickness and permits these layers to be brought into surface contact in the desired orientation prior to the time these layers are fed to the surface of the support in such combined relationship for simultaneous application to the surface. Experiments have shown that multiple coatings applied to the surface of a web in accordance with this method exhibit just as good results, both physically and chemically, so far as distinct layer relationship is concerned as multiple coatings applied by the conventional technique of successively applying the coatings with a complete curing or drying of each one before application of the next.

The present invention relates to a particular type of apparatus adapted for carrying out this new method of multiple coating. Generally speaking, this apparatus comprises a multiple feed hopper into which each of the fluid coating compositions is continuously fed at a given rate commensurate with the thickness desired in the final layer of that particular composition after application to the web. This hopper is then adapted to form a

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thin ribbon or layer of each of these compositions and to bring them into surface contact prior to extruding them in combined relation through a single discharge slot into a coating bead maintained between the discharge lips of the hopper and the web to be coated, and across and in contact with which bead the web is continuously moved to pick up the plurality of layers simultaneously and in the desired orientation.

Referring now to Figs. 1-3, there is shown an apparatus constructed in accordance with one embodiment of the present invention and which has been successfully used to apply two separate coatings to a support in the manufacture of photographic film. Here there is shown a dual feed coating hopper 10 having an exit or discharge slot 11, the lips 12 of which are slightly spaced from the surface of a web W backed up by a roll 13 which may serve to continuously move the web past the hopper slot. One fluid coating composition S is fed into an upper inlet 14 by a suitable metering pump P, whereas the second fluid coating composition S' is fed into the lower inlet 15 by a separate metering pump P'. An adjustable baffle 16 divides the interior of the hopper into two separate cavities and serves to direct the two compositions in the form of thin ribbons or layers L and L' toward the discharge slot 11. Just before the two layers L and L' enter the discharge slot 11, or immediately after they enter the discharge slot, they are brought together in surface contact and pass through and from the discharge slot in this combined relation. When the hopper was made of a transparent plastic material and differently colored coating compositions were used, so that the behavior of the coating compositions were used, so that the behavior of the coating compositions could be watched, it was obvious that the layer L of composition S coming into the upper inlet was on top of the layer L' of composition S' coming into the lower inlet throughout the entire length of the discharge slot 11.

The combined layers L and L' upon being extruded from the discharge slot, instead of being applied directly to the web W, are fed into a bead 17 formed between the web surface and the hopper lips across and in contact with which the surface of the web is continuously moved. This bead technique of coating is well known in the art and is characterized by the formation of a "puddle" or "bead" between the coating hopper and the surface to be coated which tends to pile up, or "puddle," on that side of the coating device from which the web leaves. This pile up or bead extends completely across the width of the web being coated and is generally referred to in the art as a coating bead or a bead of coating. An enlarged cross-section of the form of coating bead believed to exist with the present dual coating device is shown at 17 in Fig. 2. It can thus be seen that with this bead coating technique the coating material is not in fact deposited directly onto the web surface from the hopper but that the hopper merely maintains the coating bead and the web is coated therefrom. With the bead technique of coating the actual thickness of the coating laid down on a web moved thereacross will be determined by the action of the bead and will vary with the speed of the web movement, the efficiency of the hopper, etc., and will not necessarily be equal to, or directly dependent upon, the width of the discharge slot of the coating hopper. When the two combined layers L and L' reach the coating bead 17, this distinct layer relationship must be maintained in the bead, despite deformation of the bead, since an enlarged cross-section of the coated web after being dried showed that the two layers were distinct, extremely free of contamination or mixing at their interface, and possessed a relative thickness commensurate with the rate at which each composition was pumped into the hopper.

The hopper 10 may be provided with any suitable form of adjustable mount so that the position of its exit slot 11 relative to the web W being coated may be adjusted

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for the best coating results. To this end the hopper 10 may be carried by a frame 18 provided with bearings 9 rotatably mounted on the axle of the roll 13 to swing concentrically of the roll 13 so that the position of the hopper as a whole may be shifted around the periphery of said roll. The frame 18 is adapted to be locked in any adjusted position by a clamping screw 7 engaging an arcuate slot 6 in a fixed support 19. The hopper per se is pivoted to the frame 18 at point 20 so that the angle of the exit slot 11 may be critically adjusted relative to the surface of the web to be coated by adjusting screw 5. To permit adjustment of the hopper to and from the web W, and thereby vary the distance between the web surface and the hopper lips, the hopper is slidably mounted on the frame 18 and connected with an adjusting screw 21 for effecting this adjustment.

After the web has been coated, it may be necessary to set and/or dry the coatings applied thereon. In the manufacture of photographic films and papers the coatings applied may be of the type which are set by cooling prior to drying in order to limit the amount of relative flow between the layers themselves and between the layer adjacent the support and the support. In such a case the web W after being coated can be passed through a chill chamber 22 and then through a drying chamber 23. If the coatings applied are of the type which do not require chilling before drying, then chilling chamber 22 may be omitted or bypassed. The web, after being completely dried, is fed away from the drying chamber by means of roll 4.

Referring to Fig. 2, it will be seen that the coating composition entering upper inlet 14 is formed into a thin ribbon or layer upon passing between the end of the baffle 16 and the upper inclined wall 24 of the hopper. Likewise, the coating composition S' entering the lower inlet 15 is formed into a thin layer or ribbon of given thickness upon passing between the end of the baffle 16 and the lower inclined wall 25 of the hopper. These two ribbons or layers are directed toward the exit slot 11 and are brought into surface contact just prior to or upon entering said exit slot. They are then directed by the exit slot in this combined relation into the coating bead 17 wherein they maintain the desired distinct relationship, as indicated in Fig. 2, and from which bead they are coated in the desired layer relationship onto the surface of the web W. It is pointed out that the width of the exit slot is not equal to the combined thickness of the layers of the two coating compositions directed thereto, or to the combined widths of the slots forming said layers, but is preferably equal to the thickness of one of the layers or may even be less than this. This means that the velocity of the combined layers L and L' passing through the exit slot must be greater than that of the individual layers as they approach the slot, i. e. double, if the two layers approaching the exit slot are of equal thickness and the compositions of which the layers are formed are being pumped into the hopper at the same rate. It should be pointed out that it is not the width of the exit slot 11, or the width of the slots forming the individual layers, which determine the final thickness of the layers as applied to the web. This final thickness (wet) will be determined by the bead action and will vary with the velocity of the web, etc. The relative widths of the exit slot 11 and the slots forming the individual layers of the separate coating compositions must be sufficiently great to permit the proper amounts of the different compositions to be fed to the bead as determined by the bead laydown, and the rates at which the different compositions are pumped will be determined by the relative thicknesses of the two layers desired on the web. For example, if the layer of coating composition S applied is to be twice as thick as the layer of coating composition S', then the slot widths are not varied, but coating S is pumped into the hopper at a rate twice that of coating S'.

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Experiments have shown that the types of coating compositions which can be applied by this apparatus as well as the relative thickness of coatings, the speeds of coatings, the viscosities of the coating compositions are apparently without limit in a practical sense of the word. In one test of this disclosed dual feed hopper, a coarse grain silver bromide emulsion was pumped into the lower inlet 15 and a nondiffusing colored gelatin solution was pumped into the upper inlet 14. The emulsion was pumped into the hopper with a metering pump from a belt at 5.35 pounds per silver mole for a coverage of approximately 170 square feet per silver mole. The colored gelatin was pumped by a metering pump into the hopper from a solution containing about seven percent dry gelatin. Both pumps were driven simultaneously with a commercial metering unit. Two coatings were made on a cellulose acetate support, one at twelve feet per minute and the other at eighteen feet per minute, and the two layers were set and dried simultaneously by conventional equipment. Cross-sections of the dried films showed excellent separation of the gelatin and light-sensitive emulsion layers, and indicated that the relative thickness of the two coatings was directly proportional to the rate at which the different solutions were pumped into the hopper. Although this speed of coating in one instance was 50 per cent greater than in the other, there was no indication that the speed of coating had any adverse effect on the distinct layer characteristics of the coatings.

In another experiment the colored gelatin of the above experiment was replaced with a seven percent clear gelatin solution and pumped with a smaller pump. Here again cross-sections of the dried films showed excellent separation of the gelatin and emulsion layers.

In order to determine whether this coating apparatus might also be satisfactory for the application of light-sensitive emulsions used in the manufacture of color print material, the following coatings were made on a cellulose acetate support using this dual feed hopper and producing a coated product shown in Fig. 4. As shown in Fig. 4, this coated product comprises a support or web W of cellulose acetate having successive layers of a blue-sensitized silver chlorobromide emulsion B, a red-sensitized silver chlorobromide emulsion R, a green-sensitized silver chlorobromide emulsion G and a clear gel layer C in that order. Since only a dual feed hopper was used, the first two emulsions R and B were applied simultaneously and then the third emulsion and the clear gelatin layers G and C, respectively, were applied simultaneously atop the first two layers after they were completely dried.

In making this color print coating the blue-sensitized emulsion contained 5.6 percent gelatin and a yellow coupler and was coated at the rate of 16.72 pounds per silver mole and 1.78 pounds per 100 square feet giving a coverage of 940 square feet per silver mole. The red-sensitized emulsion contained 5.6 percent gelatin and a cyan coupler and was coated at the rate of 21.30 pounds per silver mole and 1.78 pounds per hundred square feet giving a coverage of 1200 square feet per silver mole. The green-sensitized emulsion containing 5.6 percent gelatin and a magenta coupler and was coated at the rate of 17.1 pounds per silver mole giving a coverage of 965 square feet per mole. And the clear gelatin which contained seven percent gelatin was coated at the rate of .89 pounds of solution per hundred square feet.

Visual inspection of cross-section studies of these coatings showed no greater contamination between layers than for layers of the same materials applied one layer at a time as in conventional practice.

With a triple feed hopper constructed according to Fig. 5, three separate coating compositions were simultaneously applied to the surface of a web in distinct layer relationship. This hopper 26 has an exit slot 30, the lips 32 of which are slightly spaced from the surface of a

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web W backed by a roll 13 which may serve to continuously move the web past the hopper slot as before. It is also to be understood that this hopper 26 can be carried by a mount like hopper 10 of Fig. 1 so that the hopper can be properly adjusted relative to the web surface to obtain the best coating results. The interior of the hopper is divided by partitions 31 and 31' into three separate cavities C, C₁ and C₂ placed in communication with the exit slot 30 by ribbon or layer forming slots 38, 37 and 36, respectively. One fluid coating composition S'' which is to be in the bottom layer L'' is pumped into cavity C₂ through the lower inlet 33, the coating composition S' which is to be the center layer L' is pumped into cavity C₁ through inlet 34, and the coating composition S which is to be the top layer L is pumped into cavity C through the top inlet 35. Each of these compositions is fed into the hopper by a separate pump P of the metering or constant discharge type. The three coating compositions are then directed toward the exit slot 30 in the form of ribbons or layers by slots 36, 37 and 38, and these ribbons, after being combined in surface relationship prior to, or immediately upon entering the exit slot, flow through said exit slot 30 in the proper striated relationship. In this case the width of the intermediate layer L' will be less than that of the outer layers because the average velocity of the intermediate layer is higher than the average velocity at the edges due to the friction between the outer layers and the faces of the exit slot. The striated relationship of the different coating compositions is retained in the coating bead 17 so that the three different coatings are deposited simultaneously onto the web in the proper layer relationship as the web moves across and in contact with the bead.

In an effort to determine the exact form of the coating bead 17 and just what sort of path the three separate layers of coating composition assume in passing through the bead, several different techniques were used, including photography, direct visual inspection with a 5X magnifier, etc. without too much success. While it was possible to ascertain the general outside shape of the bead, it was practically impossible to obtain an accurate determination of the path taken by the individual layers, even when differently colored solutions were used, because at the edge of the bead the uppermost layers tended to flow down over the others and obscure a view of the separation of the layers. Accordingly, while it is impossible to accurately depict the relationship of the different layers of solution while passing through the bead, I have shown in Fig. 5 what is believed to occur in this connection. It is believed that the uppermost layer of coating solution piles up on the outside face of the upper lip, the middle layer of solution passes through the bead with little, if any, deformation, and the lower layer of solution backs into and fills the space between the end of the lower lip 32 and the web W. It is known that the form of the bead and probably the path of the individual layers will vary with the speed of coating and the viscosity of the coating solution used. Notwithstanding the fact that this conception of the bead form, and the form of the individual layers passing therethrough, may not be correct, it has been unquestionably proven by the inspection of magnified cross-sections of material coated with this apparatus that the individual layers of the different solutions pass through the bead in a regulated manner without mixing and that a multilayer material coated according to this technique shows no more mixing or contamination between the layers than would be experienced by the customary coating techniques where each material is laid down in succession with complete drying between laydowns.

In Figs. 6-8A, I have shown a four-tube, multifeed hopper by means of which a layer of four separate coating compositions have successfully been applied simultaneously to a web surface and still maintain a distinct layer relationship. This hopper is composed of a top

section 40 and a bottom section 41 which are held in assembled relation by two end plates 42 and 43 fastened to the top and bottom sections by bolts 44. The forward edges of each of the top and bottom sections are spaced from one another to provide an exit or discharge slot 45 which extends across the width of the hopper and whose width is defined by end plates 42 and 43. The bottom section 41 is provided with a recess or chamber 46 communicating with the exit slot of the hopper by a curved convex surface 47. This chamber is divided into four sections by three dams 48, 49 and 50 which extend entirely across the width of the hopper chamber 46. Each of these dams includes a concave curved surface 51 and a convex curved surface 52 which cooperate with one another in opposite pairs to form gradually restricted flow passages 53, 54, 55 and 56 which cause coating solutions pumped into the enlarged portions thereof to spread out across the hopper and to be forced in thin streams or layers toward the hopper discharge slot 45. The convex surfaces 52 and the front wall 47 of the hopper chamber 46 each terminate in a substantially flat surface 57 or 58 which is spaced from the lower face of the upper hopper section 40 to form discharge slots 59, 60 and 61 for forming the separate coating compositions into layers of regulated thickness and which layers are directed to the discharge slot 45. In order to facilitate assembly and to regulate the thickness of the individual layers of the different coating compositions in the hopper, each of the dams 48, 49 and 50 is made adjustable by means of a pair of adjusting screws 62 and set screws 63. By adjustment of screws 62 the width of each of the discharge slots 59, 60 and 61 can be regulated to the desired extent, and after the desired adjustment has been made, the set screws 63 are adjusted to lock the dams in such positions. Each of the four flow passages has connected thereto a nipple 64 onto the end of which one of four feed tubes 65, 66, 67 or 68 may be slipped. Each of the four feed tubes is connected to a supply of a different coating solution and from which supply the coating solution can be pumped into the hopper by separate metering pumps P at rates commensurate with the thickness of the particular coating layers desired in the final lay-down.

I have found that if four different coating solutions are fed into the hopper through feed tubes 65, 66, 67 and 68 that they will be formed into four layers which will pass through the exit slot 45 of the hopper in distinct layer relationship and will be so deposited on a web W providing the web is fed across and in contact with a bead of the solutions into which the combined layers issuing from the lips of the discharge slot are constantly fed. If the web is moved in a counterclockwise direction, looking at Fig. 8, then the layer of coating solution entering feed tube 65 will be deposited directly on the web surface, that entering feed tube 66 will lie upon the layer of coating solution from tube 65, that entering feed tube 67 will be next and finally that entering feed tube 68 will be the outermost layer. No attempt has been made to show in Fig. 8 the flow of the four separate layers of different coating compositions onto the web because of the small scale of that figure. However, in the enlarged detail section of Fig. 8A, the manner in which the four separate layers of coating solution pass through the extrusion slot of this four-tube hopper and into the bead for subsequent pickup by the web is illustrated to the best of applicant's knowledge. If the direction of the feed of the web W across the bead is reversed, then the relationship of the layers of coating solution will be reversed on the web. As pointed out above, the relative thicknesses of the individual layers of the different coating solutions deposited on the web W will depend not upon the width of the discharge slot formed by the several dams and the upper section of the hopper but will depend upon the rate at which the respective coating compositions are pumped into the hopper. I have found that the above-mentioned

orientation of the different layers of coating solution will not be affected by the order in which the pumping of the different solutions into the hopper is started.

This four-tube multifeed hopper was tested and proved by making a multiple coating of black and clear gelatin on a web of photographic support in the following manner. For this test the black gelatin was prepared by dispersing 2450 grams of a 3.7 percent black gelatin containing a metallic silver dispersion in 5500 grams of ten percent photographic gelatin plus 1070 cc. of distilled water. The clear gelatin coatings were made from a solution of 6810 grams of ten percent photographic gelatin plus 2850 cc. of distilled water. Twenty cc. per liter of a 7½ percent saponin solution were added to each coating solution to act as a coating aid.

The coatings were made by applying the black gelatin in the first and third layers and the clear gelatin in the second and fourth layers. With the hopper shown in Figs. 6-8, this meant feeding the black gelatin into feed tubes 65 and 67 and the clear gelatin into feed tubes 66 and 68 and running the web W in a counterclockwise direction as indicated. After these coatings were set and dried, a photomicrograph of a cross-section of the multiple coating showed that all of the coats applied satisfactorily and that each layer was oriented in the proper relation. Furthermore, there appeared to be no mixing or contamination of the individual layers.

I am unable to explain why two or more layers of coating composition when simultaneously coated onto a web in accordance with the present invention do not mix but maintain a layer relationship as distinct and as free of mixing and contamination at the interface of the layers as when the same compositions are coated successively with a complete drying of each coating before the next one is applied thereto. It is not based on the fact that the different coating compositions are physically or chemically non-compatible because, as the examples show, the same results are obtained if all of the coating compositions are identical both physically and chemically, except that a dye or carbon dispersion was incorporated in one to give visible proof of this phenomenon.

In attempting to explain the reason why the different layers of coating composition do not mix when coated according to the present invention, the question of whether it was because a form of viscous liquid motion known as "laminar flow" was involved as distinguished from a form of motion known as "turbulent flow" has been considered. According to the Reynolds theory of fluid motion (R. C. Binder, "Fluid Mechanics," Prentice-Hall, 1943, p. 71), when two separate streams of water are passed through a pipe, they will stay separated due to a condition of viscous flow so long as the critical velocity is not reached and after the critical velocity is reached, the flow becomes turbulent and the streams will mix. Reynolds showed that the critical velocity depended on the diameter of the pipe, the velocity of the fluids passing through the pipe, its density, and its viscosity, and that if these four factors were combined in one way, and one way only, a function known as the Reynolds number would be obtained giving the critical velocity for the flow of a fluid through a pipe. While this theory might be applied to explain the reason why the separate layers do not mix in passing in combined relation through the exit slot in one of the disclosed extrusion type hoppers, on the basis that the flow is laminar because the Reynolds number is not high enough to reach the critical velocity, it does not explain the maintained separation of the layers through the coating bead and after deposition on the web until they are dried, because the layers are not moving through a pipe nor are they totally confined in any way. The one explanation for this phenomenon which might be advanced is that normally it takes an appreciable time for two solutions to mix even if they are brought together in such a way as to provoke turbulence, and with applicant's method of coating, the different layers are not

in combined layer relationship long enough, before being deposited on the web, to allow noticeable mixing to take place even if the conditions of flow are such as to be conducive to such a mixing. As to why the layers of coating maintain their separate relationship between the time they are deposited on the web and they are completely dried is inexplicable except in the case of those coating compositions which are capable of being set by chilling, heating, or by chemical action immediately after deposition on the web surface and prior to drying. Here again the element of time might be the critical factor since the time elapsing between the deposition of the layers on the web and the time the coating is dried is relatively short and perhaps less than the time required for the coatings, or the materials dispersed therein, to diffuse into one another.

While I have shown and described certain specific embodiments of my invention, I am aware that many modifications thereof are possible. My invention, therefore, is not to be limited to the precise details shown and described but is intended to cover all modifications coming within the scope of the appended claims.

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

1. An apparatus for simultaneously feeding a plurality of fluid coating compositions in superposed and distinct layer relationship to a point of deposition where they are simultaneously deposited onto the surface of a web in such layer relationship and comprising a hopper provided with a discharge slot, a plurality of closed chambers within said hopper, one for each coating composition, an elongated duct connecting each chamber with the hopper discharge slot adapted to form a layer of the coating composition extruded therethrough, each of said ducts directed toward the end of said discharge slot and arranged to bring the layers of coating composition extruded therethrough together in superposed strata relationship prior to extrusion of the combined layers from said discharge slot, and means for continuously feeding a different one of said coating compositions into each of said chambers at a given rate commensurate with the thickness desired for each of said layers after coating.

2. In an apparatus for simultaneously applying a plurality of fluid coating compositions onto the surface of a web in superposed layer relationship, the combination with a web guiding surface, means for continuously moving a web to be coated over said guiding surface, of a multiple feed hopper comprising a chamber provided with a discharge slot directed toward and spaced from said guided portion of the web, partition means within said hopper chamber dividing the same into a plurality of separate chambers, one of each of said coating compositions and each of said separate chambers provided with a layer forming slot directed toward said discharge slot, said layer forming slots arranged so that all of the layers of coating compositions extruded therethrough are brought into superposed strata relationship prior to extrusion of the combined layers through said discharge slot in the desired layer relationship, and means for continuously feeding one of said coating compositions into each of said separate chambers at a given rate commensurate with the thickness desired in each of said respective layers.

3. A multiple feed hopper for simultaneously feeding a plurality of fluid coating compositions in distinct layer relationship toward a point where they are deposited onto a web in such layer relationship and comprising a closed chamber provided with a discharge slot, partition means within said chamber dividing the same into a plurality of separate chambers and each provided with a layer forming slot directed toward and communicating with said discharge slot and arranged so that all of the layers of coating composition extruded through said layer forming slots are brought together in strata relationship prior to extrusion of the combined layers through said discharge

slot in the desired layer relationship, and means for continuously feeding one of said coating compositions into each of said separate chambers at a given rate commensurate with the thickness desired in each of said respective layers when extruded from said discharge slot.

4. A multiple feed hopper for simultaneously feeding two fluid coating compositions in superposed and distinct layer relationship toward a point where they are deposited onto a web in such layer relationship and comprising a closed chamber provided with a discharge slot, a partition dividing said closed chamber into two separate chambers and spaced from and cooperating with two walls of said closed chamber to provide two layer forming slots, each directed toward said discharge slot and placing opposite ones of said separate chambers in communication with the end of said discharge slot whereby the layers formed by extrusion of coating composition therethrough are brought together in superposed strata relationship prior to extrusion of the combined layers through said discharge slot, and means for continuously feeding one of said coating compositions into each of said separate chambers at a given rate commensurate with the thickness desired in each of said respective layers when extruded from said discharge slot.

5. A multiple feed hopper for simultaneously feeding three fluid coating compositions in distinct layer relationship toward a point where they are deposited onto a web in such layer relationship and comprising a closed chamber provided with a discharge slot, partition means dividing said closed chamber into three separate chambers, one for each coating composition, a layer forming slot placing each of said separate chambers in communication with the end of said discharge slot whereby layers formed by extrusion of coating composition therethrough are brought together in superposed strata relationship prior to extrusion of the combined layers through discharge slot, and means for continuously feeding one of said coating compositions into each of said separate chambers at a given rate commensurate with the thickness desired in each of said respective layers upon extrusion from said discharge slot.

6. A multiple feed hopper for simultaneously feeding a plurality of coating compositions in superposed and distinct layer relationship toward a point where they are to be deposited onto a web in such layer relationship and comprising a recessed bottom section, a top section fixed to said bottom section and having a straight wall facing said recess to provide a closed chamber, an elongated discharge slot formed in one side of said chamber by a continuation of the straight wall of said top section and the top edge of one wall of said bottom section which is provided with a notch equal in length and width to corresponding dimensions of said slot, a plurality of dams spaced from one another in tandem in said recess to divide the chamber into a plurality of separate chambers, one for each coating composition, the top of each dam spaced from said straight wall and cooperating therewith to form a duct through which layers of the respective solutions are adapted to be extruded, said ducts being in tandem and in alignment with one another and with said discharge slot whereby as the layers of the individual coating compositions are formed they are brought into superposed strata relationship in succession and the combined layers are extruded from said discharge slot, and means for continuously feeding one of said coating compositions into each of said separate chambers at a given rate commensurate with the thickness desired in each of said respective layers upon extrusion from said discharge slot.

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