

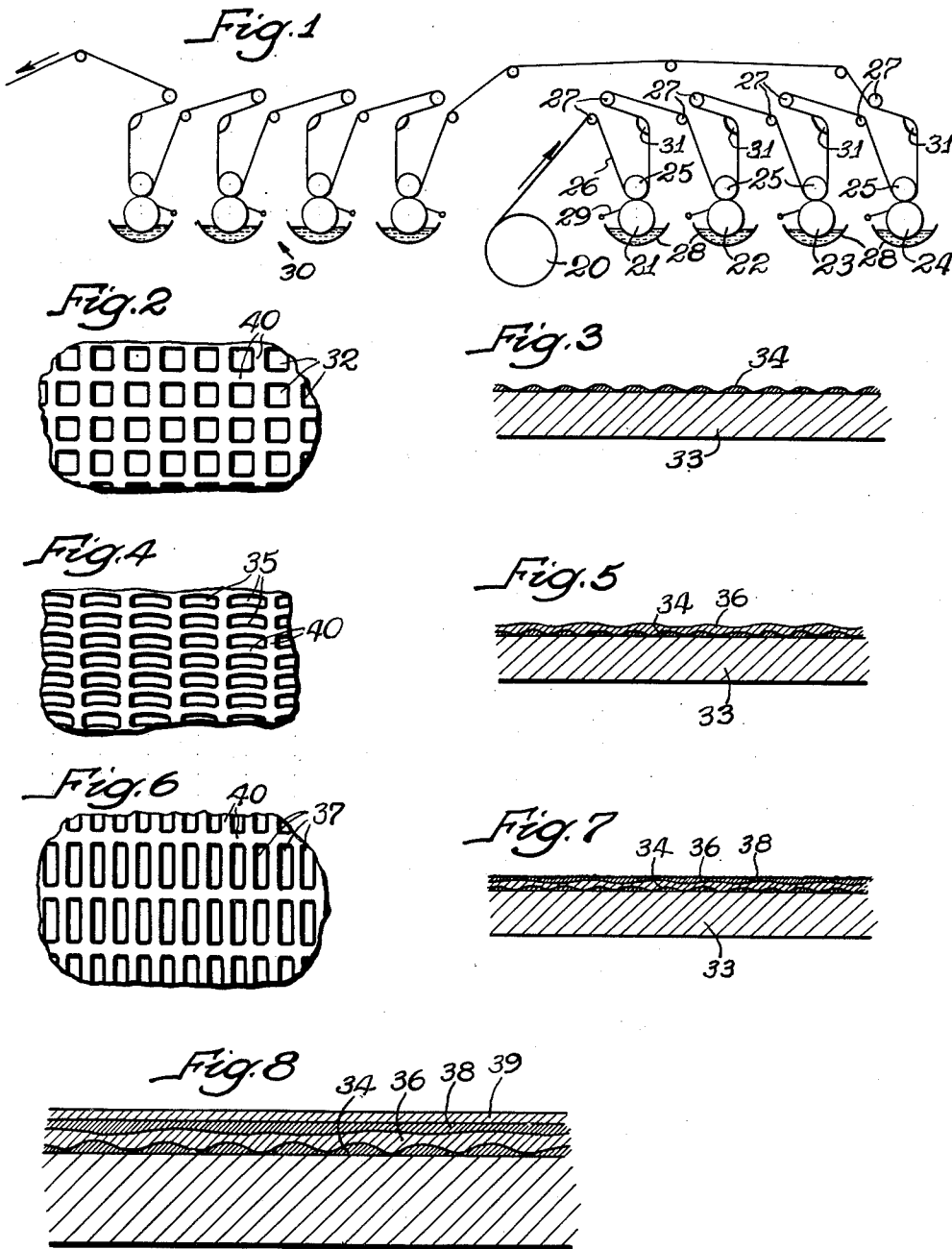
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METHOD OF AND MEANS FOR APPLYING COATINGS

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METHOD OF AND MEANS FOR APPLYING COATINGS

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The invention applies to a method of and means for applying surface coatings to sheets of material and the general aim of the invention is to provide a novel means for and an improved method of applying uniform and evenly distributed coatings to such rough surfaced materials as various types of rough pulp paper stocks.

An object of the invention is to provide a new and improved method of and means for coating rough pulp paper stocks whereby to produce from such stock flexible sheets having coatings thereon selected to impart to the stock a desired property, characteristic, or color.

Another object is to provide a novel method of coating sheet material which includes the step of applying to the surface to be coated, successive layers of coating material, each layer applied being a continuous single tone pattern whereby to insure uniform distribution of the material across the surface in an accurately controlled quantity.

Another object is to provide a novel method in which each layer of the coating is composed of substantially identical non-continuous particles of material which in successive layers may have dissimilar shapes or contours to insure overlapping of the particles of the successive layers.

Another object is to provide a novel coating method of this character in which the successive layers applied to the surface to be coated, may be of the same or dissimilar coating materials so that different properties or characteristics may be given to the stock.

A further object is to provide a novel method of coating rough surface stocks by depositing on the rough surface discontinuous particles in successive layers, each layer of particles being deposited from an intagliated roll whereby the final coated sheet has a calendered finish and appearance.

Another object of the invention is to provide an improved means for applying coating to a sheet of material which embodies a set of coating material applying rolls arranged to apply successively to a surface closely spaced, discontinuous particles of coating material.

In conjunction with the foregoing, another object is to provide a set of such rolls each having the intagliations therein dissimilar on successive rolls.

Other objects and advantages will become apparent in the following description and from the accompanying drawing in which:

Figure 1 illustrates diagrammatically apparatus for carrying out a coating method embodying the features of the invention.

Figs. 2, 4 and 6 each show on a greatly enlarged scale fragmentary surface areas of material applying cylinders.

Figs. 3, 5, 7 and 8 show respectively on greatly enlarged scales the coated stock as the successive steps of the method are performed thereon.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawing and will herein describe in detail, the preferred embodiment, but it is to be understood that I do not thereby intend to limit the invention to the specific form disclosed, but intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

In discussing this invention, reference will be had to uniformity of application of the coating material, to accuracy of control in the amount of coating fluid applied, to irregularities in the surface to be coated, and to the application of thin coatings. It should be understood that wherever these, or similar relative terms appear, they are to be given substantially their extreme significance.

This is for the reason that the present invention aims at the application of coating materials with a high degree of precision and accuracy to surfaces that may be rough and uneven as compared with a smooth finish or calendered surface.

Heretofore, the methods used in coating sheet materials have been quite difficult to control as far as accuracy and uniformity in the amount of coating fluid applied is concerned. This is especially true where sizable areas such as sheets or webs of paper are to be coated either completely or throughout a major portion of the area. The application of coating by a spraying process is obviously not uniform. Where a continuous coating is applied by such means as a coating-carrying roller, precise uniformity of the film of material on the roller is difficult, if not impossible to obtain. A high degree of accuracy is moreover impossible because of the nature of the material to be coated. A sheet or web of paper is not of uniform thickness when the uniformity is measured in ten-thousandths of an inch. Moreover, the fibrous structure of the paper itself, and particularly in such rough pulp paper stocks as news print, kraft, tissue or the like, produces an uneven surface which, in terms of its microscopic appearance, is extremely irregular. Hence, even if the coating material, when applied to such papers, is quite uniform, it will not remain

so on the paper. While I have mentioned paper stocks particularly the invention may also be used in coating cloth, woven fabrics and other materials so that the term paper stock should be considered as embracing such other materials.

A further disadvantage of present coating methods is in the fact that very thin coatings of material cannot be applied. The relatively thick coatings applied by rolls cannot dry substantially instantaneously and a relatively long drying period must elapse or the coated sheet must be specially treated before it can be handled again.

In view of these factors, it has heretofore been difficult, and in some instances impossible, to produce coated papers or the like which are economically and commercially acceptable for such uses as wrapping papers for cigarettes and tobacco, food, meat products, for insulation, and in general for any use requiring a sheet having predetermined properties and characteristics.

I have discovered that the difficulties mentioned above can be eliminated by a method according to the present invention which includes the step or steps of applying to the surface to be coated, successive layers of coating material, each of which layers is composed of regularly and closely spaced minute applications of a selected coating material, the minute applications being of a character which will produce a continuous single-tone pattern. Thus the applied material may be in the form of closely spaced thin lines or closely spaced discontinuous minute particles. The close spacing of the particles is so determined that, although individually deposited on the sheet, they may run or "bleed" together. The exact spacing and the size of the individual particles or width of the lines is dependent upon the material to be deposited and the quantity of material desired in a particular layer. Characteristically, however, they are so small (on the order of .01 inch or less) that they have no appearance of individuality to the naked eye. Application by way of particles is preferred. However, use of this term herein is to be considered as embracing also material application in the form of spaced lines.

Preferably the layers are applied by means of sets of what may be termed single-tone intagliated cylinders or rolls, and while satisfactory results may be obtained by using a set of rolls (the number of rolls is determined by the number of layers to be applied) each having the same form of intagliations therein, I find that substantially improved results are secured where the intagliations differ in form or shape on successive rolls. In either event, the particles of each layer, being closely and evenly spaced, will run or bleed together to produce a layer which is of substantially uniform thickness. The quantity of material per unit area in each layer is controllable with extreme accuracy by properly dimensioning the intagliations. The particles of material deposited in any layer will overlap the margins of the material deposited in a preceding layer, whether the intagliations are similar or dissimilar, as a result of which any minute irregularities in any one layer will be compensated for by the overlap of the particles of a succeeding layer.

In practicing the present process, the minute size of the deposited particles insures that the layers will be relatively thin, usually on the order of a few thousandths of an inch, and each layer will therefore dry rapidly. Accordingly the process is well adapted for coating continuous webs of

material. Moreover, different coating materials may be easily applied in successive layers to introduce certain desired properties, characteristics or color to the coated sheet.

It is possible by my process, to apply any coating material that may be deposited by such means as an intagliated cylinder. For example, such materials as asphaltum, aniline dyes, clay bodies, lacquer, formaldehyde, resinous coatings, various types of inks, casein solutions, various forms of glues, latex base solutions, metallic and non-metallic powders in liquid form (for example lead, copper, aluminum, synthetic resins, and carbon) and synthetic and non-synthetic waxes may be applied by my process. It will, of course, be understood that the size of the intagliations in any roll will depend on the type of coating material to be applied, its viscosity, the amount of pigment, if any, therein, and the coating deposit required. The viscosity of the coating fluid may vary anywhere from the fluidity of water up to a 65 per cent powder solid in solution.

The drawings herein (with the exception of Fig. 1) show diagrammatically, and in a scale greatly exaggerated, the steps of the process and representative shapes of the intagliated cylinders which I may employ in practicing the process. Fig. 1 shows diagrammatically apparatus for practicing the method in the application of a succession of coating layers to both sides of a web of paper. In this figure the numeral 20 designates a roll of paper to be treated. Instead of this arrangement, however, the paper may be taken directly from the paper making machine. A series of intagliated rolls designated 21, 22, 23 and 24 are each arranged for cooperation with an impression roll 25 to act successively on the web of paper 26 which runs over guide rolls 27 and passes between the intagliated and impression rolls. Suitable coating material for each intagliated roll is supplied by a trough or reservoir 28 in which the roll runs partially immersed, a conventional doctor blade 29, or the like, being provided to remove excess fluid. A second series of intagliated rolls and associated elements indicated generally at 30, apply coating material to the reverse side of the web. Should the character of the material applied by any roll require it, a simple heating or drying means, 31, such as a heating roll or pipes or an air dryer, may be located for heating the web after it leaves an intagliated roll.

As has been mentioned, any complete coating will be composed of successively applied layers of discontinuous particles. The quantity of material applied per unit area depends on the number and size of the particles in that area which in turn depends on the number and size of the material-carrying cells or depressions in the same area on the intagliated cylinders. To produce a coating having any desired characteristic, property, color of combination thereof, a set of intagliated cylinders will be used which are so correlated that each will apply a required layer of particles in a predetermined overlapping relation to the particles in a preceding layer or to the inter-particle spaces thereof.

The intagliated rolls or cylinders employed in my coating method, may be produced in several ways. Thus, I may employ cylinders on which the desired intagliations have been produced by photochemical reproduction in which a sensitized carbon tissue which has been exposed to a suitable continuous toned screen is applied to the cylinder and the cylinder then etched. This process is not preferred since it is impossible to eliminate the

join line where the edges of the resist meet. However, an intagliated cylinder produced by this process is nevertheless suitable inasmuch as the overlapping particles of the successive layers will almost entirely eliminate the irregularity of material deposit caused by the join line. Another difficulty with such cylinders is that the size and depth of the depressions or cells is not controllable with the high accuracy that may be required in some instances.

A preferred method of preparing the intagliated cylinders is by the use of knurling tools in the form of cylindrical members of suitable dimensions having on their cylindrical surfaces cutting dies or projections arranged to cut, impress or form complemental cells or depressions in the surface of the cylinder. In forming a cylinder a knurling tool having cutting dies of predetermined form thereon is caused to pass over the surface of the cylinder, thereby forming a continuous single tone pattern of intagliations therein. A wide variety of shapes of the cutting dies or projections on the knurling tool may be employed. For example, the form of the depressions may be squares, rectangles, circles, crescents, or they may be in the form of letters such as the letters "V," "U" or "S." As has been mentioned, the size, shape and depth of the depressions in the intagliated cylinder are determined by the character and quantity of the material to be applied by that cylinder and the selected shape or contour of the depression on any cylinder will, to a considerable extent, be determined by the shape of the depressions on the cylinder for applying a preceding or succeeding layer. Hence the several intagliated cylinders forming a complete set for applying a given coating have a predetermined correlation to afford the best overlapping of the particles of the successive layers.

The knurling tools have their cutting dies or projections formed with microscopic precision by an engraving process or the like. For example, a knurling tool may have cutting dies or projections shaped to produce a square intagliation with a 150 line spacing, which on the basis of a two and one-half screen ratio, would produce a depression or cell .0047 inch square with a spacing between cells of approximately .002 inch and a cell depth of from .0002 inch to .008 inch. Preferably the cells taper inwardly slightly. After the depressions are formed the intagliated cylinder is ground or otherwise polished, and thereafter chrome plated or finished to prevent wear.

I may mention that while I prefer to employ intagliated cylinders prepared by the use of knurling tools because of the greater precision of such cylinders, I may use in any set of cylinders for applying a given coating, some knurled intagliated cylinders and some having photo-etched surfaces.

In Figs. 2, 4, and 6 of the drawing, fragmentary portions of the surfaces of the successive cylinders of an exemplary set are shown on a greatly enlarged scale. The cylinder shown in Fig. 2 has square cells or depressions 32 and the form of the layer applied thereby to the stock 33 is indicated roughly at 34 in Fig. 3. This layer being the one first applied may, as shown, be somewhat irregular because the penetration of the fluid into the stock and the irregularities of the rough stock may prevent the particles from bleeding evenly together. Fig. 4 shows crescent-shaped intagliations 35 which are arranged to

deposit a layer of particles over the first applied layer 34. This second layer is indicated at 36 in Fig. 5 which indicates how the overlapping of the particles and their bleeding together have smoothed out the minute irregularities of the layer 34 first applied. The cylinder shown in Fig. 6 has substantially rectangular depressions 37 producing, as shown in Fig. 7, the third layer 38 which is more even and uniform than either of the preceding layers. If the rectangular depressions are joined at their ends a spaced line formation will be obtained which is discontinuous across one dimension of the sheet. A fourth layer 39 may be applied as shown in Fig. 8 by an intagliated cylinder similar to that shown in Fig. 2. By way of example, the depth of cells or depressions of these various cylinders may be on the order of .002 inch for the square and crescent-shaped intagliations of Figs. 2 and 4, and .001 inch for the rectangular intagliations of Fig. 6.

It will be evident from a consideration of these several forms of intagliations that the margins of the successively applied layers of particles will overlap to insure complete coverage of the stock and that the particles in each layer will run or bleed together to form a uniform, even layer. This is particularly true of the second and succeeding layers and for this reason the layer first applied will, in most instances, be a prime coat capable of penetrating the stock and adapted to provide a strengthening foundation for the other layers by firmly binding the stock fibers together.

An important and unexpected feature of the invention results from the action on the paper stock of the surface portions 40 of the intagliated cylinders which separate the cells or depressions therein. It appears that when a rough fiber paper stock, such as news print, is treated, these surface portions 40 of the cylinder will depress the areas of the fibers engaged thereby while depositing coating material on the intervening fibers. The applied pressure tends to iron or smooth out the fibers and in effect calenders the stock throughout the compressed areas while the bleeding of the applied coating material tends to bind the fibers in that condition. During the application of the successive layers the remaining areas will likewise be pressed down with the result that at the end of the coating operation the coated surface of the stock has the smooth finished appearance of a calendered sheet.

The following example is given as an illustration of the method of coating a thirty-pound news print stock where it is desired to increase its weight to forty-two-pound stock, color it and make it moisture proof. The first layer would be a stock penetrating priming material having moisture proof properties deposited in a quantity which adds six pounds to the weight of the stock. The next layer would be a tinted or pigmented material deposited in a quantity to add four pounds to the stock weight. The final coating would be a moisture proof material increasing the weight of the stock by two pounds. Thus the total weight of the coated stock would be forty-two pounds and the stock would be tinted and moisture proof.

Such a coating will be accurate and uniform in thickness. The coated material will be flexible and the coating thereon will be highly resistant to breaking or cracking due probably to the laminated effect afforded by the successive layers of coating. The invention, of course, may

be used to coat smooth as well as rough finish stock.

I claim as my invention:

1. The method of building up on a web a coating of uniform continuity and accurately controlled weight comprised of superimposed layers of non-uniform continuity but each of accurately controlled weight, which includes, passing the web over a succession of rolls and pressing the web in rolling contact with successive ones thereof, each of said rolls having minute intagliations therein arranged in a pattern of uniform distribution over its surface and with the intagliations in each roll arranged to overlap only partially the area of registry on the web for a corresponding intagliation in the preceding roll, flowing liquid coating material onto each of said intagliated rolls, and doctoring away the excess material from each roll to leave deposits of substantially uniform volume in the intagliations for transfer from the latter to the web as such web is pressed in rolling contact with the rolls.

2. A continuous coating method for webs, which comprises, passing the web continuously through a plurality of successive roll couples in which the web is led in each couple between the bite of a pair of rolls consisting of an intagliated roll and a coacting impression roll, the intagliations in the intagliated roll of each couple all being of the same size and shape as every other intagliation in that same roll and located thereon in a pattern of uniform distribution both circumferentially and longitudinally of the roll, but with the intagliations in the intagliated rolls of each couple or couples following the first couple overlapping although slightly out of registry with the portion of the web presented to the corresponding intagliations on the intagliated roll in the preceding couple, flowing liquid coated material onto each of said intagliated rolls, and doctoring away the excess material from each intagliated roll to leave in the intagliations in the latter deposits of accurately determined volume for application to the web as it passes over the same.

3. The method of coating a web which comprises flowing liquid coating material on a roll in a first roll couple in which such roll has intagliations of uniform size and shape distributed in a pattern thereon which is uniform both circumferentially and longitudinally of the roll; doctoring away the excess coating material from the intagliated roll to leave substantially equal deposits of coating material in the intagliations; transferring to one side of the web, by rolling pressure applied to the web in passing the same through said couple, the deposits from said intagliations in a pattern of minute mounds matching the pattern of the intagliations and with each mound constituted by material from a corresponding intagliation; and depositing further material on the same side of the web by repeating the same steps in a second roll couple also having a cylinder bearing minute intagliations of uniform size and shape and which are, as in the first, distributed in a pattern thereon which is uniform both circumferentially and longitudinally of the cylinder but in which the individual intagliations are slightly out of registry with the mounds deposited on the web in the first couple.

4. The method of coating a web which comprises flowing liquid coating material on a roll in a first roll couple in which such roll has intagliations of uniform size and shape distributed thereover in a pattern of overall coverage which is uniform both circumferentially and longitudi-

nally of the roll; doctoring away the excess material from the intagliated roll to leave substantially equal deposits of coating material in the intagliations; transferring to one side of the web, by rolling pressure applied to the web in passing the same through the couple, deposits from said intagliations in a pattern of minute mounds; and depositing further material on the same side of the web by repeating the same steps in a second roll couple also having a cylinder bearing an overall pattern of uniformly distributed minute intagliations of uniform size and shape but each of which is of a different shape than those on the intagliated roll in the first couple.

5. The method of coating a web which comprises passing the same continuously through a succession of pairs of intagliated and impression rolls with the intagliated roll in each pair bearing a uniformly distributed overall pattern of intagliations, each intagliation in each intagliated roll being of the same size and shape as every other intagliation in that same roll but of a different shape than those in every other intagliated roll in the series, flowing liquid coating material onto each of the intagliated rolls, and doctoring away the excess coating material from each intagliated roll.

6. The method of coating a web which comprises passing the same continuously through a succession of pairs of intagliated and impression rolls with the intagliated roll in each pair bearing a uniformly distributed overall pattern of intagliations, each intagliation in each intagliated roll being of the same size and shape as every other intagliation in that same roll but of a different size than those in every other intagliated roll in the series, flowing liquid coating material onto each of the intagliated rolls, and doctoring away the excess coating material from each intagliated roll.

7. An apparatus for coating a web comprising, in combination, a plurality of roll couples each including an intagliated roll and a coacting impression roll, means for supplying liquid coating material to respective ones of said intagliated rolls and for doctoring away the excess thereon to leave deposits of coating material in the intagliations in such rolls, means for guiding a traveling web through successive ones of said couples with a plurality of said intagliated rolls contacting the same face of the web, and each of said intagliated rolls having the intagliations therein distributed thereover in an overall pattern which is uniform both circumferentially and longitudinally thereof and in which each intagliation in each roll is of the same size and shape as every other intagliation in that same roll but located to be slightly out of registry with the portion of the web face contacted by any intagliation on any other roll in the series which contacts the same face of the web.

8. An apparatus for coating a web comprising, in combination, a plurality of roll couples each including an intagliated roll and a coacting impression roll, means for supplying liquid coating material to respective ones of said intagliated rolls and for doctoring away the excess thereon to leave deposits of coating material in the intagliations in such rolls, means for guiding a traveling web through successive ones of said couples with a plurality of said intagliated rolls contacting the same face of the web, and each of said intagliated rolls having the intagliations therein distributed thereover in an overall pattern which is uniform both circumferentially and

longitudinally thereof and in which each intagliation in each roll is of the same size and shape as every other intagliation in that same roll but of a different shape than the intagliations in every other one of the intagliated rolls contacting the same face of the web.

9. An apparatus for coating a web comprising, in combination, a plurality of roll couples each including an intagliated roll and a coating impression roll, means for supplying liquid coating material to respective ones of said intagliated rolls and for doctoring away the excess thereon to leave deposits of coating material in the intagliations in such rolls, means for guiding a

traveling web through successive ones of said couples with a plurality of said intagliated rolls contacting the same face of the web, and each of said intagliated rolls having the intagliations therein distributed thereover in an overall pattern which is uniform both circumferentially and longitudinally thereof and in which each intagliation in each roll is of the same size and shape as every other intagliation in that same roll but of a different size than the intagliations in every other one of the intagliated rolls contacting the same face of the web.

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