

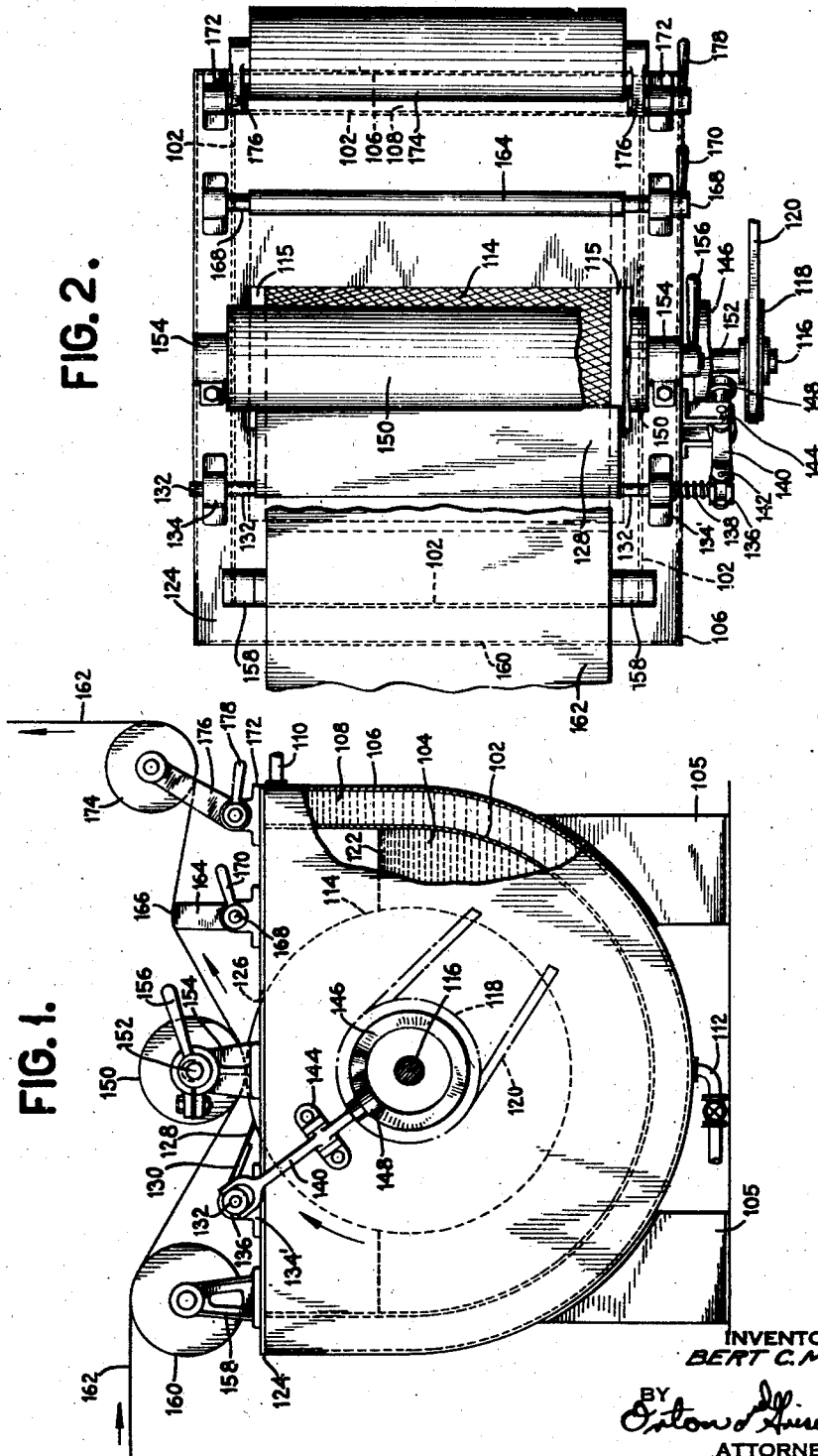
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PROCESS OF COATING WITH THERMOPLASTIC MATERIAL

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PROCESS OF COATING WITH THERMO-
PLASTIC MATERIAL

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1 Claim. (Cl. 117-64)

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This invention relates to a method for the molten application of thermoplastic coating materials to suitable bases for providing coatings thereon.

It has been proposed to apply coating materials in a molten condition to various bases such as paper, cloth, structureless foil and the like as for example, by dipping a sheet or passing a web through a molten bath; dipping a smooth roll into a molten bath and transferring the film from the surface of the roll to a base sheet but such processes have been subject to one or more difficulties. Where the sheet or web is dipped into or passed through a bath of molten material there is usually a great deal of impregnation of the base and it is difficult, if not impossible, to obtain a smooth uniform coating by any subsequent treatment. Where a roll dips into a bath of molten coating material difficulty is experienced in providing a film of uniform thickness and it has been proposed to control the thickness of the film by using nip rolls instead of stationary doctoring means, and by this method more accurate control has been attained. Any roll method of application heretofore known has not produced a uniform or continuous coating on the surface of the base and a subsequent step of smoothing was required.

This invention seeks to provide a method and apparatus for the application of molten thermoplastic materials to provide either a coating as hereinafter defined on a base sheet or a particular form of coating in the form of a substantially continuous film without encountering the difficulties of the prior art procedures as generally set forth above.

It has been found that an accurate control of the amount of coating material applied to the base can be secured by employing a heated roll provided with a surface which is not smooth but which has elevational differences such as a normal surface and depressed portions from the normal surface according to a pattern. The depressed portions may conveniently be made by etching the surface of the roll to form a large number of minute independent pockets the size and shape of which will vary according to the amount of material it is desired to apply to the base. While it is suggested to etch the roll, other means such as mechanical engraving might be employed for providing the independent pockets or providing recesses as hereinafter described. It is also proposed according to this invention to provide recesses from the normal surface of the roll which might be described as of the nature of knurling which comprises a plurality of diagonal intersecting grooves adapted to receive the molten coating material and in which the width, depth and spacing of the grooves determines the amount of material that will be ap-

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plied to the base. With constructions of the type just described, the molten material may be applied to the surface of the roll and this material will fill the recesses or depressed portions and also, to a more or less extent, coat the elevated, or what has been described as the normal, surface of the roll. To secure a control of the amount of material to be applied as determined by the extent of the recesses, the molten material on the normal surface of roll is doctored and thereby removed conveniently by a resilient blade which scrapes the entire width of the roll. The doctor may be stationary but preferably oscillates parallel to the axis of the roll.

Alternatively, it is possible to control the amount of material to be applied by using a relatively smooth roll and doctoring the surface of that smooth roll to form a coating on the surface of the smooth roll which is discontinuous. This may be accomplished by the use of a pair of doctor blades in contact with each other and generally resembling combs which are reversely oscillated. With this arrangement, a substantially continuous film on the surface of the roll passes under the doctor blades having teeth which are in direct contact with the roll and, therefore, remove at least some of the coating from the surface. As the doctor blades reciprocate, the openings between the teeth will coincide and the coating material on the surface of the roll will pass between the teeth but the continued reciprocation of the doctor blades will soon close the opening and cut off the film. The molten coating material on the heated roll behind the doctor blades is in the form of a large number of individual small mounds—substantially the reverse of those on the etched roll. With another form of reciprocation between the doctor blades, the coating material on the surface of the roll behind the blades might be in the form of intersecting continuous lines resembling knurling. By properly adjusting the rate of travel of the surface of the roll, the size and shape of the teeth of the doctor blades and the rate and relative oscillation of these blades, the molten material on the surface of the heated smooth roll will form a discontinuous coating according to a pattern and may generally resemble intersecting ribs or may be individual minute discrete droplets, a single oscillating or non-oscillating comb doctor would give parallel ribs of coating. All such forms hereinbefore described as taken by the material in its application to a web are generically referred to as "mounds."

When a sheet of base material, usually in the form of a web, is brought into contact with the roll, the molten coating material in the recesses on the surface of the roll or patterned above the surface of a smooth roll is transferred from the roll to the base and generally follows the exact

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pattern that was on the roll because clean stripping can be obtained. Where the molten material forms a substantially continuous film on the roll, it is usually not transferred uniformly to the base because of feathering or similar action but where the molten material on the roll is discontinuous, the feathering is substantially reduced, if not entirely obviated, and the base sheet produced has, when proceeding as above described, a generally uniform although not continuous coating. Such a sheet may for some purposes, as in the decorative field, be of utility. The coating does not usually have any particular gloss because of the non-uniformity of reflection and refraction of light from the irregular coating. Some improvement is secured by a rapid hot blast which may smooth the surfaces of individual dots or ribs. In order to provide a uniform glossy surface, the coating on the sheet is fused by bringing it into contact with a heated smoothing element which, by melting and mechanical action, blends the discrete particles or the patterned portions of the coating into a substantially continuous film of high gloss and having characteristics of moisture-proofness and the like consistent with the properties of the coating material.

It will be understood that by controlling the relative size and depth of the recesses or the action of the doctor blades on the smoother roll the weight of the coating applied to the base can be very accurately controlled and the application is very uniform. For example, if a roll is prepared to apply five pounds of coating material per ream this exact amount will always be applied. Similarly, if the roll is so constructed as to apply ten pounds per ream the coating will be uniformly of that weight. The figures above given are not the limits of the amounts which may be applied but merely suggestive. It has been found that coatings of even less weight than five pounds and substantially greater than ten pounds can readily be applied and may be used depending upon the properties desired in the final product.

The coating materials must be of the type identified as thermoplastic and are usually materials which are solid at normal temperatures, except where the coating is used as a laminating adhesive, and preferably has a relatively sharp melting point to produce a complete melt at temperatures not substantially exceeding about 300° F. although materials having higher melting points may under some circumstances and with certain bases be successfully employed. The process and apparatus as herein described is particularly useful for the molten application of essentially resinous materials and may comprise either natural or synthetic resins having the physical properties above described. Other factors influencing the selection of the resins used in the molten coating compositions will be evident to those skilled in the art.

The coating composition for application in molten form is melted before application to the surface of the roll. In some cases it may be desirable to mix the various ingredients in a separate vessel to which heat can be applied or solid materials may, in some instances, be added directly to the molten bath in the apparatus, although it is usually preferable to add the coating material in a molten form to the bath. Means should also be provided for maintaining the bath in a molten condition.

Similarly, the coating roll whether engraved, etched or smooth must be maintained at a temperature sufficient to keep the coating material

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on its surface in a molten condition until it is transferred to the web. A metal roll is used preferably cast iron or steel with a copper electroplate surface for etching or engraving and a final chromium plating. Internal heating means will serve although it is extremely difficult to uniformly heat the roll by internal heating. In one of the preferred forms of this invention internal heating of the roll by extraneous heat sources such as hot oil, electric resistance elements and the like is dispensed with and the roll is heated solely by the bath of molten material. Uneven heating warps the roll making uniform application impossible. To heat the roll by the bath of molten material which provides uniform heating, the apparatus must include means for applying substantial heat to the bath and for keeping the material in motion although the latter is usually accomplished by rotation of the roll. The roll, in order to make up for the heat losses to be web being coated, must be substantially submerged in the molten bath. By substantially submerged it is intended that at least one-half and preferably three-quarters of the roll be submerged when the bath is unagitated. Rotation of the roll will somewhat effect the extent of submersion. With this arrangement in the molten bath, it has been found that the roll is kept at a proper temperature to carry the film of molten coating material and transfer it to the sheet or web.

In the attached drawings there is illustrated an apparatus constructed in accord with certain of the teachings of this invention which is illustrative of the principles of the invention applied to a preferred embodiment.

Figure 1 is a view in side elevation with a part broken away in section showing the coating apparatus; and

Figure 2 is a top plan view of the apparatus shown in Figure 1 with a portion of a roll broken away to show the coating roller.

Referring now to the drawings, reference numeral 102 is a tank for containing the molten coating material 104 which may be supplied through an opening (not shown) either in the side or the top of the tank 102. The tank 102 is jacketed as at 106 to form a compartment substantially surrounding the tank and adapted to receive a heating fluid, as for example, oil, supplied and withdrawn through the conduits 110 and 112. Legs 105 support the apparatus. Mounted within the tank 102 is a roll 114 mounted on a shaft 116 journaled in the sides of the tank and one end of which projects through one side of the tank to receive a keyed pulley 118 driven by a belt 120. The shaft 116 is so positioned within the tank 102 that only a small portion of the entire roll 114 extends out of the top of the tank making it possible to submerge substantially the entire roll where necessary. As illustrated in Figure 1 the upper level 122 of the coating material 104 is above the axis of the roll 114. The top of the tank 102 is substantially closed by a cover plate 124 that also serves as a base on which to mount certain rolls or other apparatus hereinafter described, there being only sufficient opening 126 in the cover 124 to permit the exposure of a small section at the extreme top of the roll 114.

The roll 114 is rotated in a clockwise direction when viewed as in Figure 1 and a section of the surface of the roll 114 after leaving the bath 104 passes under a doctor blade 128 preferably constructed of spring steel and which may have addi-

tional support 130 for mounting on a shaft 132 journaled in bearing brackets 134, 134' for oscillatory reciprocation. The shaft 132 extending through the bearing bracket 134' is provided at its end with a grooved collar 136 or other means to retain a spring 138 between the bearing bracket 134' and the end of the shaft 132 and also for connection to a pivoted lever 140 as by the pin 142. Serving as the pivot for the pivoted lever 140 is a bracket 144 mounted on the side of the jacket 106. The other end of the pivoted lever 140 projects toward the shaft 116 on which is mounted a cam wheel 146 for engagement with a roller 148 on the end of the pivoted lever 140. Rotation of the shaft 116 rotates the cam wheel 146 and the cam surface of the wheel 146 will rock the lever 140 to produce an oscillatory motion in the shaft 132 under the further control of the spring 138 which urges the roller 148 against the cam surface of the cam wheel 146.

The doctor blade 128 is shown as having a straight edge in contact with the surface of the roll 114 and is the type of doctor blade for use with a roller having elevational differences on its surface as above described. The roll 114, rotating in clockwise direction as it leaves the bath 104, has a surface coating which is carried to the doctor blade 128 where all of the coating material on the normal surface is removed leaving only that which is in the depressions. It will be evident that where the roll 114 is provided with a smooth surface, a double toothed doctor blade may be substituted for the single blade 128 as above described. As shown in Figure 2 the roll 114 has depressions in its entire circumferential surface except at the ends 115 which may be smoothed and at the normal surface of the roll. The sheet or web may or may not extend over the end surface 115 but in those cases where it does, no coating will be applied. The roll may be designed for spot application.

Behind the doctor blade and substantially at the top of the roll 114 is a pressure roll 150 mounted on a shaft 152 journaled in bearing brackets 154 and provided with an eccentric handle 156 to adjust the relative position of the pressure roll 150 and the coating roll 114. The pressure roll 150 is preferably relatively small to create a short nip and made of a resilient material at least at its surface to provide resilient uniform pressure across the entire roll 114 as the web passes between these two rolls.

Also mounted on the cover 124, in brackets 158, may be a guide roll 160 to guide a web 162 from a supply roll (not shown) to between the pressure roll 150 and the coating roll 114.

The web, after passing between the said rolls, is drawn over a smoothing bar 164 which at its outer edge is provided with a smooth curved surface ending in a relatively sharp edge at the point where the web 162 leaves the smooth curved surface. The smoothing bar 164 is adjustable for pivoting about its axis 68 under the control of a lever 170. The curved surface 166 of the smoothing bar 164 must be uniformly heated by means not shown in Figures 1 and 2 whereby the discontinuous coating applied to the lower surface of the web 162 is smoothed in passing over the curved surface 166 to form a continuous film. Associated with the smoothing bar 164 and also mounted as by brackets 172 on the cover 124 is an adjustable roll 174. The adjustable roll 174 may be on pivot arms 176 the positions of which are controlled by the lever 178. With the adjustable cooperative relation between the smooth-

ing bar 164 and the adjustable roll 174 it is possible to control the extent of the curved surface 166 in contact with the web and the angle at which the web leaves over the sharp edge of the curved surface 166 in accord with operating requirements for adequate smoothing.

In operation the belt 120, driven by any suitable source of power, drives the pulley 118 fixed to the shaft 116, thereby rotating the coating roll 114 and the cam wheel 146. A web 162 guided by the roll 160 is threaded between pressure roll 150 and coating roll 114, over the smoothing bar 166 under the control of adjustable roll 174 and to a wind-up roll. As the web passes between pressure roll 150 and the coating roll 114 it picks up the coating material on the roll 114 either from the depressions if that type of roll is used or from the surface where the coating material has been applied to the smooth surface to give a generally uniform but discontinuous coating. After cooling (there being no solvent to evaporate) the web can be rewound but where a continuous film is desired, especially one with a high gloss the web passes from the coating roll over the heated smoothing bar 164 where the discontinuous coating is smoothed to form a substantially continuous film. After the coated sheet is cooled it is rewound.

While the invention has been particularly described with reference to the illustrated embodiment, this is to be considered simply as illustrative of the invention because all of the steps or parts shown need not be used in the specific combinations and various substitutes may be used in the combination without departing from the spirit and scope of the invention as will be evident to those skilled in the art.

What is claimed is:

The method of coating sheet material with high melting thermoplastic material having a sharp melting point not substantially exceeding about 300° F., comprising printing a surface of a continuously advancing web of sheet material with said thermoplastic, heated to a liquid state, to form relatively closely spaced but segregated and uniform quantities, and thereafter spreading and smoothing the thus-applied thermoplastic material, in a single step, into a continuous even film solely by the conjoint simultaneous application of heat and spreading pressure to the printed surface of the said continuously advancing web.

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