Jan. 24, 1956 D. L. CREE 2,732,319

METHOD FOR COATING PAPER WITH THERMOPLASTIC MATERIAL AND COOLING

Filed May 7, 1951 2 Sheets-Sheet 1

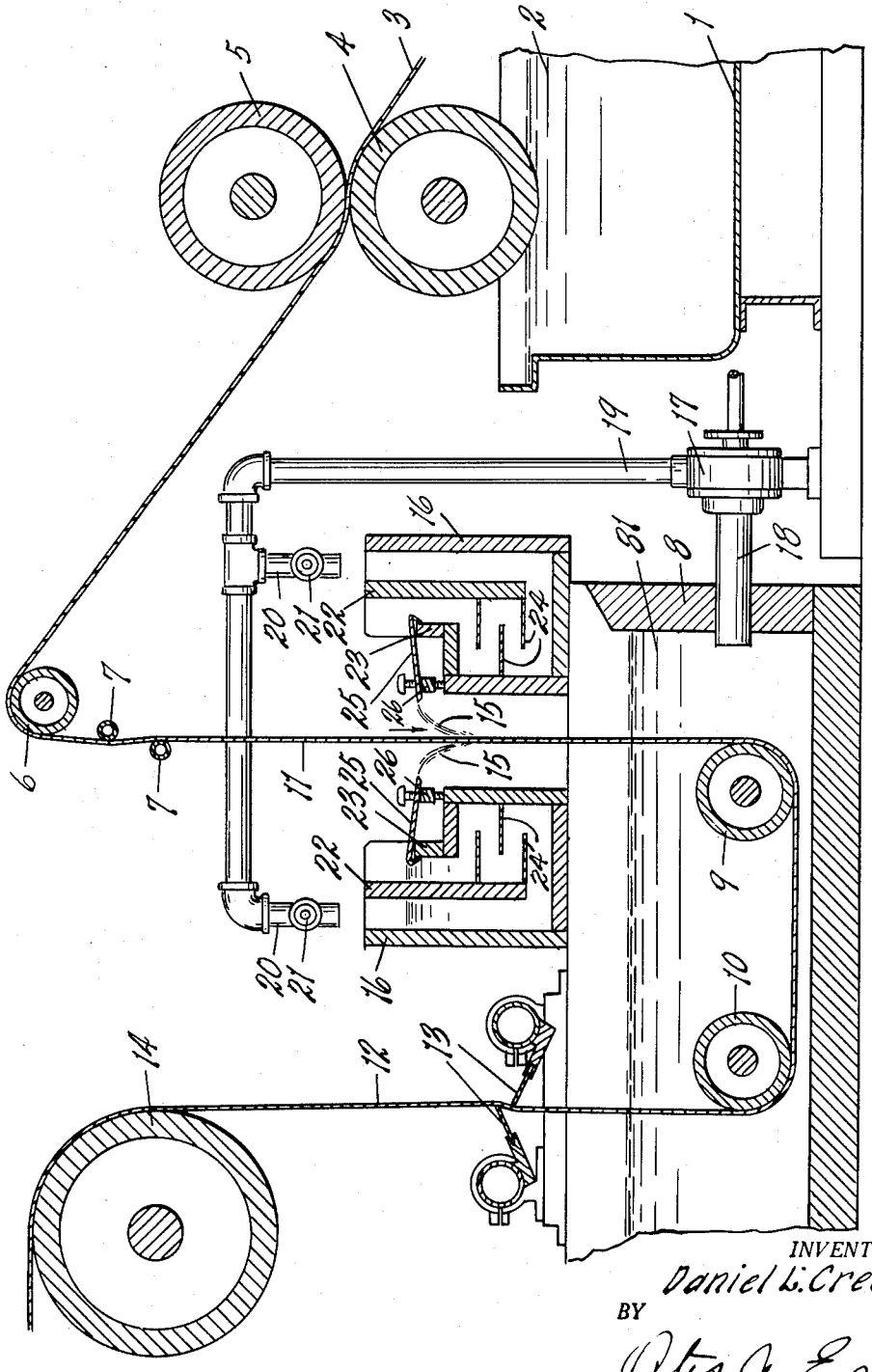

FIG. 1

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METHOD FOR COATING PAPER WITH THERMOPLASTIC MATERIAL AND COOLING

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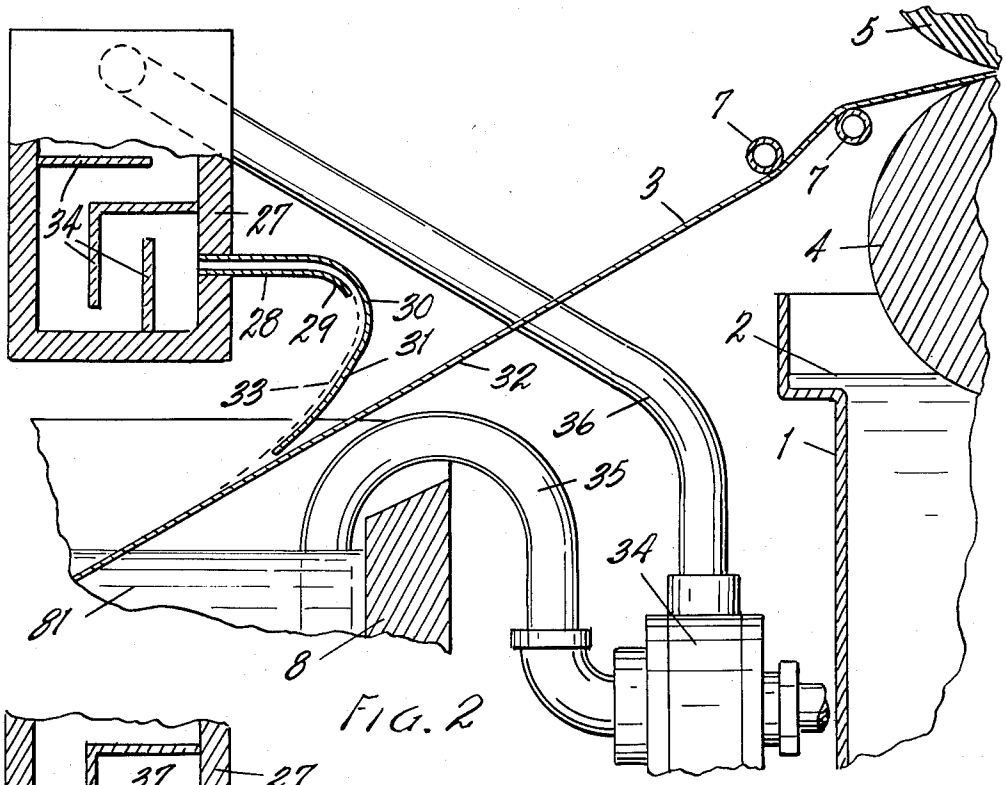

FIG. 2

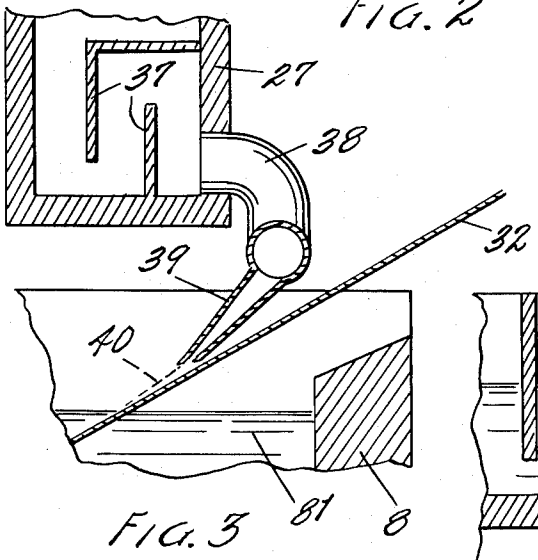

FIG. 3

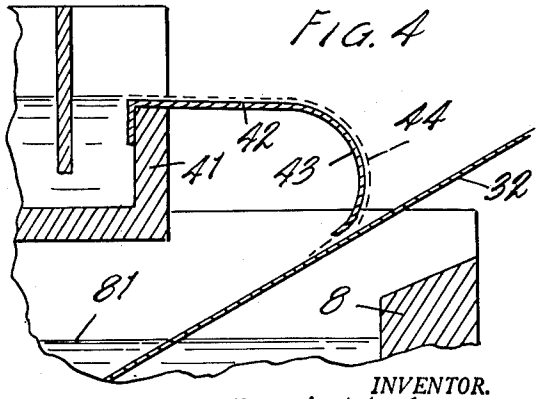

FIG. 4

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2,732,319

METHOD FOR COATING PAPER WITH THERMOPLASTIC MATERIAL AND COOLING

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9 Claims. (Cl. 117—103)

This invention relates to improvements in methods for coating paper with thermostatic material and cooling.

The main objects of this invention are:

First, to provide a method of coating paper with thermoplastic coating materials, including so-called high gloss and "hot melt" coating materials, which results in minimizing so-called "crow tracks" in the coating.

Second, to provide a method of coating paper with melted coating materials which result in increasing the gloss of the product as compared to commonly practiced methods.

Third, to provide a method of coating paper which enables a very substantial increase in the speed of the web and at the same time produces a high gloss coating.

Fourth, to provide an apparatus for practicing the method of my invention which is simple and compact and easily operated and may be installed for use or embodied for use in types of coating and chilling apparatus now in use.

Objects relating to details and economies of the invention will appear from the description to follow. The invention is pointed out in the claims.

A preferred embodiment of the invention is illustrated in the accompanying drawings, in which:

Fig. 1 is a view mainly in vertical section of an apparatus embodying my invention and adapted for use in the practice of my method, parts being shown mainly in conventional form.

Fig. 2 is a fragmentary view partially in vertical section of a modified form or embodiment of my invention and an apparatus that may be used in the practice of the method.

Fig. 3 is a fragmentary view partially in vertical section of still another modification or adaptation of my invention and one that may be employed in the practicing of the method.

Fig. 4 is a fragmentary view in vertical section showing still another apparatus embodying my invention and one which may be employed in the practicing of the method.

In the accompanying drawing various parts are shown mainly in conventional form and without regard to their relative proportions.

Referring to Fig. 1, the apparatus illustrated therein, and which may be used for the practice of the method of my invention, comprises a tank 1 for the coating material indicated at 2. The tank is provided with suitable heating means, not illustrated. The coating material preferably employed is a thermoplastic coating material and is desirably of a character resulting in a high gloss surface when applied to the paper, a web of paper being shown at 3. The roller 4 is a coating applying roller and the roller 5 a press roll coacting therewith, the web being passed between these rollers. It should be understood, however, that the coating may be applied to one or to both sides of the web and as means for accomplishing this is known in the art, I have not illustrated the same herein. From the coating rolls the web of paper

is passed over the guide roll 6 and between smoothing bars 7.

The chilling tank 8 is adapted to contain water 81 desirably maintained in the range of 34° to 46° F. The guide rollers 9 and 10 are arranged in the chilling tank so that the web of paper with the coating thereon is guided through the water of the chilling tank. The guide rolls 6 and 9 are arranged so that the web passes into the water in the tank 8 in substantially a vertical plane, that is, the reach 11 of the web between the rolls 6 and 9 is substantially vertical. Above the tank 8, the outgoing reach 12 of the web of paper is subjected to the water removing doctors or blades 13. The web may, if desired, be subjected to further moisture removing means after passing the roller 14.

It is highly important commercially to run the web at as high a speed as possible but when the speed is increased beyond certain rates, an objectionable amount of "crow tracks" result in the coating and there is a loss of gloss. The applicant attributes that, at least in part, to the impact and turbulence resulting as the web passes into or enters the water in the chilling tank and applicant believes that this results in the frictional moving of portions of the coating relative to other portions before the coating has chilled or become set upon the paper sufficiently to withstand such conditions. To overcome this condition or result the applicant discharges a sheet or film of water indicated at 15 upon one or both sides of the web of paper in advance of the point or zone of the contacting of the coating on the web with the water in the tank. The sheet or film of water is discharged upon the surface of the web desirably in the form of a waterfall as illustrated in Fig. 1 with the streams or sheets of water traveling in the direction of travel of the web and at substantial speeds but less than the speed of travel of the web.

In the embodiment illustrated in Fig. 1, the sheet of water is discharged upon both sides of the web by providing head boxes 16 supplied from the pump 17 having its intake 18 opening to the water 81 in the chilling tank 8. The discharge pipe 19 of the pump is provided with branches 20 having control valves 21 and delivering to the head boxes at the outer side or in advance of the vertical partition 22 which terminates in spaced relation to the bottom of the head box. The head box is provided with an overflow weir 23 and a horizontally arranged series of baffles 24 are disposed in advance of the weir, the purpose being to minimize turbulence in the head box. The delivery chute 25 for the sheet or stream 15 is associated with the head box to receive the overflow from the weir and to direct the sheet of water upon the reach 11 of the web of paper. The outer end of the chute is adjustably supported by the bar 26. The sheet or film of water discharged upon the coated web is so related to the surface of the chilling bath that it remains on the coated surface in the form of a sheet or film as the web enters the bath. There is substantial cooling of the plastic coating resulting from the application thereto of the sheets of water. This film of water remains on the web and travels therewith as it enters the chilling bath and appears to reduce turbulence in the chilling bath and applicant believes it reduces the wiping action of the water of the chilling bath resulting from the coated web passing into the water of the bath. Applicant also believes that this sheet of water on the web sets up a current in the chilling bath water in the direction of travel of the web, that is, particularly adjacent to the surface of the water in the bath.

In taking the water supply of the head boxes from the tank, the water temperature in the head boxes is approximately that of the water in the tank and the temperature

in the tank and head boxes is uniform and more easily controlled.

In the modifications shown in Fig. 2, the coating material tank **1** is provided with a supply liquid coating material **2** which is applied to the web **3** by the roller **4** and coacting press roll **5**. In this apparatus the web is conducted into the chilling bath at an angle of approximately 45°. The head box **27** corresponding to one of the head boxes **16** is provided with a discharge chute **28** with a discharge chute **29** and an overhanging member **30** terminating in an apron **31** curved downwardly above the reach **32** of the web, the water being discharged by the chute **29** on the inner side of the guiding apron **31** into a sheet-like stream or film **33** which is directed onto the web in the direction of its travel.

The pump **34** has an intake **35** depending into the chilling tank and a discharge **36** opening to the head box. The head box is provided with baffles **37** between the inlet and discharge of the head box and designed to minimize turbulence.

In the embodiment shown in Fig. 3, the head box **27** is provided with a discharge pipe **38** having a discharge nozzle **39** directed to discharge the sheet of water **40** against the web closely adjacent to but in advance of the surface of the water **81** in the chilling bath.

In the embodiment shown in Fig. 4, the head box **41** is provided with a discharge chute **42** having a curved apron portion **43** delivering the sheet of water **44** upon the surface of the web in the direction if its travel and in advance of the point or zone of the entrance of the webs into the water within the chilling tank or bath.

The applicant's method and apparatus is particularly designed for "hot melt" coating mixtures requiring higher temperatures than necessary for coating paper with paraffin wax, for example, in which temperatures of application range from 150° to 175° F. The thermoplastic coating mixtures for which the applicant's method and apparatus is particularly designed permits operation temperatures of between 225° and 250° F. or above. As stated, the cooling temperatures in the water bath are desirably maintained approximately in the range of 34° to 46° F. and in order to avoid the so-called "crow tracks" condition in the coating and loss of gloss, it has been found necessary to limit the speed of the web to 300 feet per minute or less. It is desirable that the rate of the flow of the sheet of water at the point of its impingement with the web shall be at least ⅓ of the rate of travel of the web. For example, when the speed of a web is approximately 300′ per minute the speed of the water at the point of its impingement with the coated side of the web may desirably be 100′ per minute. However, it is desired to point out that this is by way of example; much higher speeds are practical with the applicant's method and in commercial practice the rate of speed of the web and the water is very substantially increased.

In the applicant's method and apparatus much higher speeds are permitted without objectionable "crow tracks" and with satisfactory high gloss. The speed at which the web may travel appears to depend somewhat on the speed at which the water sheet is traveling when it is discharged upon the web. In this connection it is desired to point out that even where the web is coated only on one side, the discharge of the cascade or waterfall of water upon both sides of the web so that they impact the web in substantially opposed relation is a desirable feature.

I have illustrated different forms of apparatus for the practicing of my method which I have demonstrated to be practical. I have not attempted to illustrate or describe other apparatus for the practicing of my method as it is believed that this disclosure will enable those skilled in the art to practice my invention as may be desired.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of coating paper comprising the steps of applying a coating of melted thermoplastic coating material at a temperature between 180° and 250° F. to at least one side of a traveling web of paper, passing the traveling web with the coating thereon into a coating chilling water bath with the web traveling downwardly in a substantially vertical plane as it enters the water of the bath, the temperature of the water of the bath being of the order of 32° to 46° F., and impinging downwardly directed sheets of water of a temperature approximately that of the water bath upon the opposite sides of the web in advance of but adjacent the point of entrance of the web into the water, the sheets of water when impinging the web having a speed in the direction of travel of the web less than but at least approximately one-third the speed of travel of the web, the water so discharged upon the web remaining thereon in the form of films at the point of the web's entrance into the water of the chilling bath.

2. The method of coating paper comprising the steps of applying a coating of melted thermoplastic coating material at a temperature between 225° and 250° F. to a traveling web of paper, passing the traveling web with the coating thereon into a coating chilling water bath with the web traveling in a downward direction as it enters the water of the bath, the temperature of the water of the bath being of the order of 32° to 46° F., and impingingly discharging a downwardly directed sheet of water of a temperature approximately that of the water bath upon the coated side of the web in advance of but adjacent the point of entrance of the web into the bath, the sheet of water when impinging the web having a speed in the direction of travel of the web less than but at least approximately one-third the speed of travel of the web, the water so discharged upon the web forming a film on the coated surface of the web at its point of entrance into the water of the chilling bath.

3. The method of coating paper comprising the steps of applying a film of melted thermoplastic coating material at a temperature in excess of 180° F. to a traveling web of paper, passing the traveling web of paper with the unset coating thereon into a water bath of coating setting temperature between 32° and 46° F. for setting the coating, and discharging a thin and unconfined sheet of water of a temperature approximately that of the bath upon and extending transversely across the coating on the web in advance of but adjacent to the point of entrance of the coated web into the coating setting bath to form a film of water on the coated side of the web as the web enters the coating setting bath, the sheet of water being discharged upon the web in the direction of travel of the web and at a rate of travel at least one-third but not in excess of the rate of travel of the web.

4. The method of coating paper comprising the steps of applying a coating of melted thermoplastic coating material at a temperature in excess of 180° F. to a traveling web of paper, passing the traveling web with the coating thereon into a coating setting water bath of a temperature of the order of 32° to 46° F., and impingingly discharging a sheet of water of a coating setting temperature of the order of 32° to 46° F. upon the coated side of the web in advance of the point of entrance of the web into the water bath, the sheet of water when impinging the web having a speed in the direction of travel of the web of not less than one-third the speed of travel of the web, the water so discharged upon the web forming a film on the coated surface of the web at its point of entrance into the water of the bath.

5. The method of coating paper comprising the steps of applying melted thermoplastic coating material to a traveling web of paper, and passing the coated web before the coating has set with the web traveling in a downward direction into a bath of water of a temperature of the order of 32° to 46° F. for setting the coating material on the web, and discharging a sheet of water at a temperature of the order of 32° to 46° F. upon the coated surface of the web in advance of the submergence of the

web in the bath, the sheet of water being discharged upon the coated surface of the web in the direction of travel of the web at a speed of not less than one-third of the rate of travel of the web, the point of impingement of the sheet of water being spaced from the surface of the bath so that the water forms a film on the coated surface of the web as the web enters the chilling bath.

6. The method of coating paper comprising the steps of applying melted thermoplastic coated material to a traveling web of paper before a coating has set, passing the traveling coated web into a water bath of the temperature of the order of 40° F. for setting the coating material on the web, and discharging a sheet of water at a temperature approximately that of the bath temperature upon the coated surface of the web in advance of the submergence of the web in the bath, the sheet of water being discharged upon the coated surface of the web in the direction of travel of the web and at a speed of not less than one-third of the rate of travel of the web and spaced from the surface of the bath so that the water forms a film on the coated surface as the web enters the bath.

7. A method of finishing the coated surface of a web coated with a heat-softenable material, which comprises carrying forwardly a web having the surfaces thereof coated with a heat-softened flowable coating, said coating being capable of hardening to a substantially non-flowing state at a predetermined temperature lower than its temperature at said heat-softened state, applying a sheet of water at a temperature below said hardening temperature of the coating to the surface of one of said heat-softened coating layers to reduce the temperature of said coating layer a sufficient amount to render it substantially non-flowing, said sheet of water being applied to said surface in a plane at a relatively small angle with respect to the plane of the web while both the web and the sheet of water are moving generally in the same direction and at velocities to minimize relative movement of the sheet of water with respect to the movement of the web.

8. The method of finishing the coated surface of a web coated on at least one side thereof with a heat-softenable material which comprises carrying forwardly a web having at least one surface thereof coated with a heat-softened flowable coating, said coating being capable of hardening to a substantially non-flowing state at a predetermined temperature lower than its temperature at said heat-softened state, applying a sheet of water at a temperature below said hardening temperature of the coating to the surface of said heat-softened coating layer to reduce the temperature of said coating layer a sufficient amount to render it substantially non-flowing, said sheet of water being applied to the surface in a plane at a relatively small angle in respect to the plane of the web and while both the web and sheet of water are moving generally in the same direction and at a velocity to minimize relative movement of the sheet of water with respect to the movement of the web.

9. The method of finishing the coated surface of a web coated on at least one side with a heat-softenable material which comprises carrying forwardly a web having at least one surface thereof coated with a heat-softened flowable coating, said coating being capable of hardening to a substantially non-flowing state at a predetermined temperature lower than the temperature at said heat-softened state, applying a sheet of water at a temperature below said hardening temperature to the surface of said heat-softened coating layer to reduce the temperature of the coating layer a sufficient amount to render it substantially non-flowing, said sheet of water being impingingly applied to said surface by the force of gravity only and in a plane at a relatively small angle with respect to the plane of the web while both the web and the sheet of water are moving generally in the same direction, the velocity of the sheet of water being not less than one-third that of the velocity of the web.

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