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METHOD FOR COOLING AND SETTING WAX COATINGS ON PAPER

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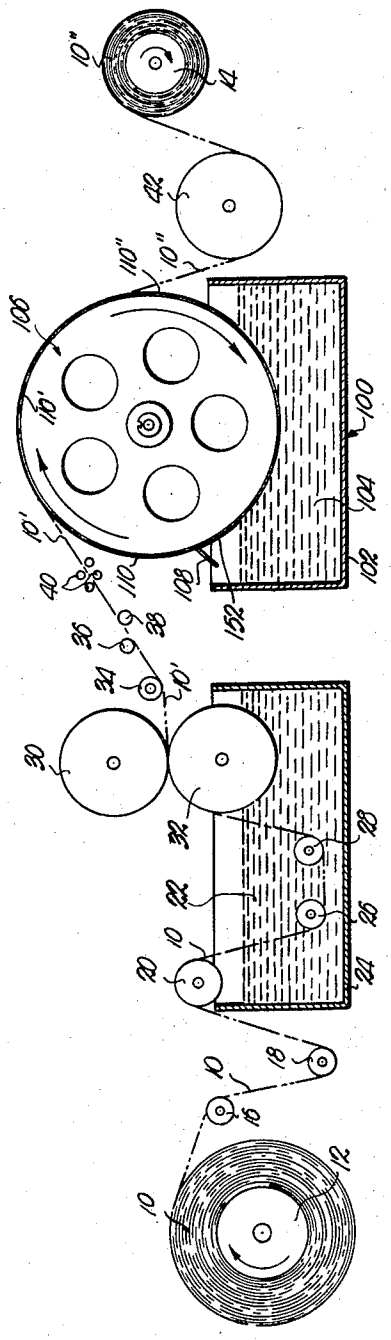

Fig. 1.

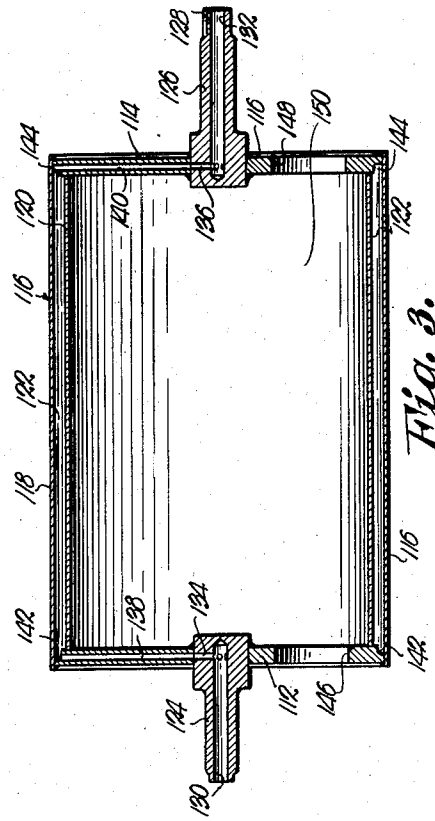

Fig. 3.

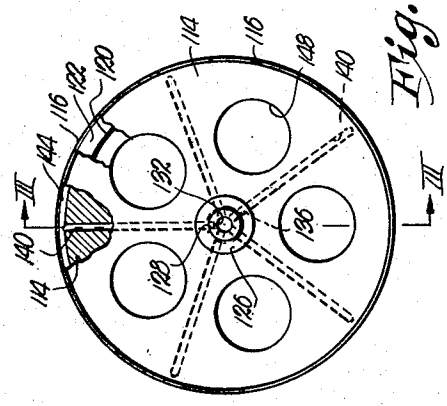

Fig. 2.

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METHOD FOR COOLING AND SETTING WAX COATINGS ON PAPER

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4 Claims. (Cl. 117—103)

This invention relates to the manufacture of wax coated paper and, more particularly, to an improved method for cooling a molten coating of wax material applied to a web of paper to solidify and set such coating thereon.

As is well known to those skilled in the art, the conventional manner of manufacturing wax coated paper broadly involves applying a hot coating of molten wax material to a continuously moving web of paper being unwound from a supply roll, smoothing the coating of molten wax material on the web to give it the desired thickness and degree of uniformity, and then, in some manner, cooling the coating to set the same as the web continues to move toward a finished product roll upon which it is being wound. Obviously, the speed with which such coated paper can be produced is limited by the time required to cool and set the coating, since such operation must be completely finished before winding of the product upon a roll if tacking is to be avoided.

The conventional method of carrying out the cooling operation is to pass the web bearing the molten coating through a cold water bath in which the web and coating are immersed, the wax coating hardening and becoming set virtually immediately after the initial shock of its immersion in the cold water. Although it might seem that such conventional shock method of setting would, because of the speed with which solidification of the wax coating is accomplished, lend itself to optimum speed in performing the overall cooling and setting operation, such is not the case in practice. The initial contact of the molten wax on the moving web with the cold water bath used in the conventional method tends, during the brief instant before setting, to form "crows feet" and other irregularities and flaws in the surface of the coating. As the speed at which the web, and therefore the molten wax, enters the cold water bath is increased, the tendency for irregularities to form, as well as for the paper to wrinkle, likewise increases to a point of intolerability. Accordingly, it has been found in practice that the speed of the whole production line must be slowed to a point where the cooling operation can be accomplished in a manner preventing the formation of irregularities and flaws in excess of limits deemed tolerable for the particular purpose for which the coated paper is to be used.

One of the principal objects of this invention is to provide an improved method for performing the cooling operation involved in the manufacture of wax coated paper in a manner which accomplishes the actual solidification of the molten coating more gradually than in the conventional method but in a way entirely eliminating the danger of formation of the irregularities and flaws above referred to as inevitable in the conventional, cold water immersion method of cooling, whereby the overall cooling operation can in practice be performed substantially more rapidly than in the conventional method, permitting increased production by virtue of faster speeds of web travel through the whole production line.

Another of the most important objects of this invention is to provide such a method adapted for preserving

the inherent moisture vapor resistant qualities of the wax coating, improving the moisture vapor transmission rate characteristics of the waxed paper and obtaining a higher degree of gloss and sheen for the coating, by virtue of the more gradual solidification of the coating, through reduction of the wax crystal size and elimination of the tendencies for irregularities, flaws and the formation of larger size crystals which are inevitable with conventional shock type cooling.

Another important object of this invention is to provide an improved method of setting a coating of molten wax material on a piece of paper by cooling a body below the solidifying temperature of the coating material, providing a thin, heat exchanging film of liquid on the body, and placing the piece of paper adjacent the body with the coating in contact with the heat exhanging, liquid film until the coating has cooled sufficiently to set.

Still other important objects of this invention, including certain operational conditions of the method, will be made clear or become apparent as the following description of the invention progresses, reference also being had to the accompanying drawing, wherein:

Figure 1 is a diagrammatic representation of the various operations and apparatus employed in manufacturing wax coated paper in accordance with a process employing the improved cooling method and apparatus of this invention;

Fig. 2 is an end elevation view of the chill or cooling drum forming a part of the apparatus of this invention; and

Fig. 3 is a cross-sectional view of the cooling drum taken on line III—III of Fig. 2.

The steps of the improved cooling method of this invention will be more clearly understood after a consideration of the overall coating process and the preferred form of apparatus provided by the invention for performing the method. Accordingly, reference is first made to Fig. 1, wherein the numeral **10** designates a web of paper wound upon a rotatable supply roll **12**. Web **10** passes, during the coating process about to be described, through various operations and structures to a rotatable, finished product roll **14** upon which it is ultimately wound, it being understood that suitable driving means (not shown) are provided for rotating rolls **12** and **14** in the directions indicated by the arrows thereon.

As web **10** leaves roll **12** in uncoated, room temperature condition, it conventionally passes over an idler roller **16**, thence around a tension roller **18**, over a preheating roller **20**, into a bath of hot, molten, wax coating material **22** contained in a vat **24**, around guide rollers **26** and **28** within vat **24** and beneath the surface of molten material **22**, and between applicator rollers **30** and **32** of which the former is usually rubber and the latter metallic; then, in moltenly coated, highly heated condition, it conventionally passes around heated smoothing roller **34**, past final smoothing rollers **36** and **38**, and between a plurality of air blowers **40** to the improved cooling apparatus **100** of this invention. From apparatus **100**, web **10** passes in solidifiedly coated, moderately heated condition around cooling roller **42** to finished product roll **14** upon which it is wound. It is to be understood that suitable driving means (not shown) are conventionally provided for various of the above-mentioned rollers.

It may be noted that material **22** may consist of any suitable coating formula conventionally employed for coating paper by the usual process described above, involving application of the material **22** in a molten state and subsequent cooling to set the same. With typical materials **22**, application thereof is carried out at temperatures of about 200 degrees Fahrenheit or more, the exact temperature to be preferred depending upon the

nature of the formula 22 as will be obvious to those skilled in the art.

In Fig. 1, that portion of web 10 which is as yet uncoated is designated simply by the numeral 10, while that portion which bears a molten coating of material 22 is designated 10', and that portion upon which the coating of material 22 has been solidified and set is designated 10".

Apparatus 100 broadly includes, in combination, an open-topped pan or vat 102 containing a quantity of liquid 104, a rotatable, cooled, cylindrical drum 106 disposed above pan 102 with a lowermost portion of drum 106 always within, below the surface of and in contact with liquid 104, and a wiper element 108 disposed in wiping engagement with the surface of drum 106 along a line disposed over pan 102 and on the side of drum 106 which leaves liquid 104 and travels away therefrom when drum 106 is rotating. Under actual operating conditions when drum 106 is operating, the combination also necessarily includes a thin, uniform film 110 of liquid 104 in adhering relationship to the surface of drum 106.

Pan 102 may be provided with any suitable means (not shown) for maintaining the liquid 104 therewithin at a predetermined temperature, although in the preferred form this is unnecessary, as will hereinafter be explained.

Liquid 104 may be any suitable substance having properties adapting it for use as a heat transfer medium when disposed in a thin film as at 110' between cooling drum 106 and moltenly coated web 10', water for example having been found quite satisfactory. However, in the preferred method of this invention, liquid 104 comprises a water solution containing either or both of a minor percentage of a wetting agent to aid the penetration of film 110' into the molten coating on web 10' for increasing the efficiency of the heat transfer from web 10' to drum 106 effected by film 110' and a minor percentage of a waxed paper softener to give added flexibility to the coated web 10". Such wetting agent may be any suitable substance conventionally used for such purpose, such as dioctyl sodium sulfonate, a material available on the market under the name "Aerosol"; similarly, the softener may be any suitable substance conventionally employed for such purpose, it being understood that the exact percentage of such substances included in liquid 104 depends upon the particular materials used.

Cooling drum 106 includes a pair of circular end walls 112 and 114, an outer, cylindrical side wall 116 having a smooth outer surface 118, and an inner, cylindrical side wall 120 of lesser diameter and height than outer wall 116. End walls 112 and 114 are disposed within and in closing relationship to the opposed ends of outer side wall 116, inner side wall 120 extending between end walls 112 and 114 in spaced, coaxial relationship to outer side wall 116, presenting an elongated, closed chamber 122 of annular cross-section extending from end wall 112 to end wall 114 between side walls 116 and 120.

End walls 112 and 114 are respectively provided with outwardly extending, centrally disposed, axially aligned shafts 124 and 126 for rotatably mounting drum 106, shaft 126 having a keyway 128 formed therein for engagement with a key on the drive shaft of any suitable drive means (not shown) for rotating drum 106.

Shafts 124 and 126 are respectively provided with internal, axially disposed bores 130 and 132 in communication with chamber 122 through a number of normal bores 134 and 136 in shafts 124 and 126 respectively, a number of radial bores 138 and 140 in end walls 112 and 114 respectively, and peripheral grooves 142 and 144 formed in end walls 112 and 114 respectively, and extending laterally in one direction from the outermost ends of bores 138 and 140 toward adjacent chamber 122. A number of transverse openings 146 and 148 are preferably provided in end walls 112 and 114 respectively to reduce the inertia of drum 106 and place space 150 enclosed by end walls 112 and 114 and inner side wall 120 in communication with the atmosphere.

It will now be understood that bores 130 and 132, and hence chamber 122, are coupled by means (not shown) for circulating a liquid cooling medium such as cold brine through chamber 122 to maintain drum 106, and particularly surface 118 thereof, at a predetermined reduced temperature. The temperature of surface 118 should be held at a level substantially below the solidification temperature of the particular wax material 22 being used, the exact temperature being dependent upon the characteristics of the material 22 as will be readily understood by those skilled in the art.

In operation, with drum 106 being rotated in the direction indicated by the arrows in Fig. 1 and being maintained in cooled condition at the desired temperature by the circulation of brine or the like through the chamber 122, a quantity 152 of liquid 104 adheres to surface 118 of drum 106 as it leaves the liquid 104 in vat 102, such layer 152 being metered by wiper 108 to present an extremely thin, uniform film 110 of liquid 104 on that portion of surface 118 proceeding toward the point of juncture of moltenly coated web 10' and drum 106. As drum 106 continues to rotate, film 110 passes under web 10' in contacting engagement with both the molten coating on web 10' and surface 118 of drum 106 between which it is sandwiched as at 110'. Film 110' serves as a heat exchanging medium between the hot coating on web 10' and the cooled surface 118 of drum 106, making possible a greatly increased transfer of heat from web 10' to drum 106 than would be possible in the absence of film 110'.

When sufficient heat has been transferred from the molten coating on web 10' through film 110' to drum 106, such coating solidifies or sets. Although such transfer of heat occurs relatively more gradually than with the conventional cold water bath method of shock cooling, it is found in practice that the coating on web 10' sets without difficulty or flaws such as are characteristic of the conventional cooling method, even when drum 106 is rotating and web 10' is advancing at a speed far in excess of those practical in conventional methods of cooling. The web 10" with its coating set thereon leaves surface 118 and is conventionally further cooled by means 42 before winding upon roll 14.

It may be noted that the preferred temperature of film 110, and hence liquid 104 in pan 102, for most efficient heat exchanging operation and avoidance of flaws, is slightly above that of surface 118 of drum 106, although still substantially below the solidification temperature of coating material 22. It is significant, therefore, that a portion 110" of film 110, which has been heated during its contact with web 10' as at 110', is returned to the supply of liquid 104 in pan 102 and will tend to slightly raise the temperature of the latter. Further, it is obvious that the cooled surface 118 of drum 106, passing through the liquid 104 in pan 102 as it does, will exert a considerable cooling influence on such supply of liquid 104. Accordingly, it has been found that by properly choosing the volume of liquid 104 in pan 102, and by properly mounting or adjusting drum 106 to place a predetermined segment thereof within liquid 104 in pan 102, all in view of the temperatures of material 22 on web 10', and of surface 118 of drum 106, as well as the speed of rotation of drum 106 and the general range of ambient temperature encountered, the liquid 104 in pan 102 may be automatically maintained during operation at the desired temperature of a few degrees Fahrenheit above that of surface 118, without the use of external means for accomplishing such end.

The nature of the improved method of this invention should now be clear.

Relative to the method, it may be noted that same,

although ideally suited for use in regular production line processes for the manufacture of wax coated paper by operation upon a continuously moving web, is not necessarily so limited. This will be clear when it is recognized that, most basically, the method involves merely the steps of cooling a body, providing a film of heat exchanging liquid on the body, and placing the molten wax coating on a piece of paper into contacting relationship with the heat exchanging film until the coating has set. That the steps of the preferred or commercial embodiment of the method may be relatively more complex in more refined definitions thereof is, however, equally manifest.

It will be apparent to those skilled in the art that certain minor modifications of the method of this invention may be made without departure from the spirit thereof. Accordingly, it is desired to be limited only by the scope of the appended claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a method of setting a coating of molten wax material upon an elongated piece of paper while the latter is advanced along a predetermined path of travel at high speed, the improved steps of cooling a cylindrical body to and maintaining the same at a predetermined temperature substantially below the solidifying temperature of said molten wax and sufficiently low to normally form minute cracks in the wax as the same soldifies when the coated paper is brought into direct contact with the body; cooling a quantity of liquid to and maintaining the same at a predetermined temperature, said body being partially submerged in said liquid; continuously rotating said body on its axis at substantially the speed of advancement of said paper to cause a uniform film of said liquid to adhere to and be maintained on the exposed peripheral surface of said body as the latter is rotated; and placing said coated piece of paper in proximity to said exposed peripheral surface of the body with said coating in heat transfer, contacting relationship with said film and as the paper is advanced at said speed, the temperature of said liquid being above the temperature of said body but below the solidifying temperature of said molten wax and correlated with the temperature of said body to assure that said film gradually removes heat from the wax as the paper is advanced over the body to thereby prevent cracking of said coating.

2. In a method of setting a coating of molten wax material upon an elongated piece of paper while the latter is advanced along a predetermined path of travel at high speed, the improved steps of cooling a cylindrical body to and maintaining the same at a predetermined temperature substantially below the solidifying temperature of said molten wax and sufficiently low to normally form minute cracks in the wax as the same solidifies when the coated paper is brought into direct contact with the body; cooling a quantity of an aqueous solution containing minor proportions of a wetting agent and a plasticizing agent to and maintaining the same at a predetermined temperature, said body being partially submerged in said solution; continuously rotating said body on its axis at substantially the speed of advancement of said paper to cause a uniform film of said solution to adhere to and be maintained on the exposed peripheral surface of said body as the latter is rotated; and placing said coated piece of paper in proximity to said exposed, peripheral surface of the body with said coating in heat transfer, contacting relationship with said film and as the paper is advanced at said speed, the temperature of said solution being above the temperature of said body but below the solidifying temperature of said molten wax and correlated with the temperature of said body to assure that said film gradually removes heat from the wax as the paper is advanced over the body to thereby prevent cracking of said coating.

3. A method as set forth in claim 1 wherein said quantity of liquid is cooled by contact of a part thereof with said body.

4. A method as set forth in claim 2 wherein the quantity of liquid and the area of said body disposed within said liquid are predetermined so that said liquid is maintained at said predetermined temperature.

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