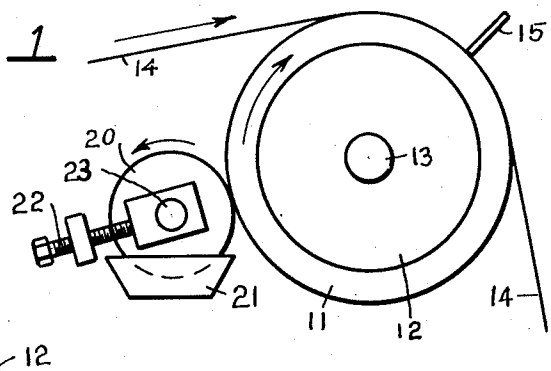
Dec. 19, 1950 W. P. TAYLOR 2,534,321

COATING METHOD AND APPARATUS

Filed May 16, 1946

Fig. 1



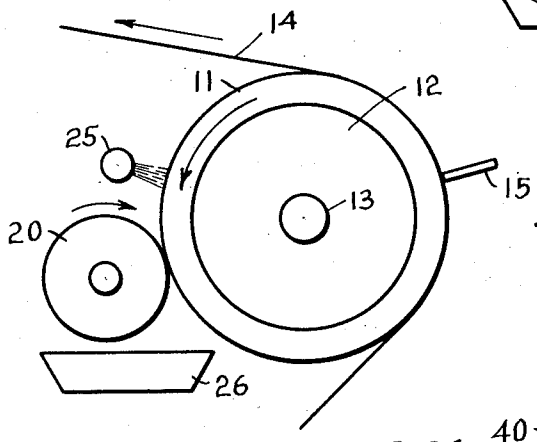
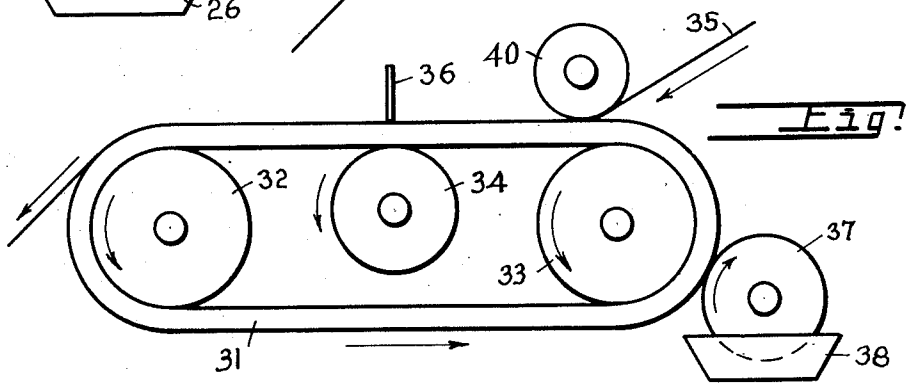




Fig. 2

Fig. 3



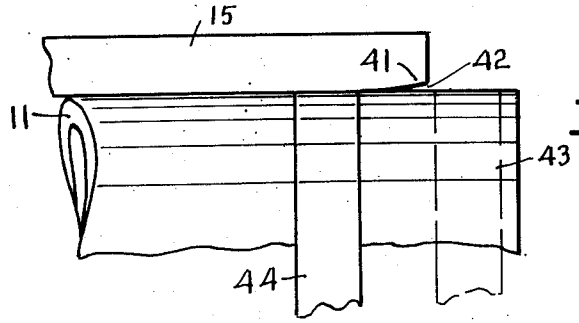




Fig. 4

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Patented Dec. 19, 1950 2,534,321

# UNITED STATES PATENT OFFICE

2,534,321

## COATING METHOD AND APPARATUS

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Application May 16, 1946, Serial No. 670,276

8 Claims. (Cl. 117—111)

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This invention relates to the application of coatings to paper webs and has particular reference to coating processes and apparatus wherein the web is carried on the moving surface of a belt or roller while the coating is spread uniformly thereover by means of a doctor blade or the like.

In the past, coatings of various kinds have been applied to paper and fabric webs by the use of blade or knife spreading and smoothing devices. In a large class of such coaters the web has been supported on a moving carrier surface, sometimes in the form of a roller and at other times in the form of an endless belt. In most of these a definite clearance was provided between the blade and the web carrier, though in some cases pressure was exerted between the blade and the web. Usually the surface of the web carrier was rigid but in some cases rubber, leather, or similar material has been used for the web carriers. In many cases a mass or pool of the coating material was maintained on the web in front of the blade.

With such prior art processes and apparatus, the application of the coating is not always as perfect as desired in the production of high grade coated printing paper. Threading of the paper between the blade and the carrier surface frequently involves considerable difficulty and often necessitates lifting the blade from the carrier surface to provide threading space. In those cases where a pool of coating material is maintained against the blade, such movement of the blade usually involves loss of this coating material and in general requires washing up the blade and carrier surface before re-threading. Further, difficulty is commonly experienced with wrinkling and tearing of the paper under the blade, due frequently to buckles or slack edges in the paper web. These are portions less than the full width of the web, between or at the edges of the web, which are of slightly greater length than other portions of the web. When such a web is carried on a surface of uniform length across its width, and under a fixed doctor blade, the excess length in the buckles and slack edges tends to accumulate in front of the blade until it is drawn through as a wrinkle or fails to pull through and starts a tear which usually breaks down the web and requires washing up and re-threading the machine. The excess length in buckles and slack edges may vary from zero up to proportions so great that the paper will not lie smoothly on a flat surface. The frequency of occurrence of these defects is generally greater as their severity is less, but it has been found that

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defects, of a severity sufficient to cause trouble in coating operations of the type described, occur with sufficient frequency to constitute a serious disadvantage in the use of such coating methods and apparatus.

The primary objects of the present invention are to facilitate and improve the coating operation; to permit threading under doctor blades, even those in pressure contact with a yielding web-carrying surface, without lifting the blade or wasting coating which may be held in front of the blade; to carry through buckles and slack edges which may be present in the paper; to prevent wrinkling and tearing of the web under the blade in coating devices of the type described; and to provide apparatus for accomplishing these purposes. Other and more detailed objects and advantages of the invention will become apparent from the following description.

I have now discovered that these objects can be accomplished if the carrier surface is made of rubber or similar yielding resilient material, the doctor blade is so held as to indent the surface slightly as it passes thereunder, and the paper web is caused to adhere to said surface where it is carried past the doctor blade. The degree of adhesion required is such that the paper will strongly resist any forces tending to cause it to slide along the surface but will readily part from the surface when pulled along a path which diverses therefrom.

Adhesion of this degree can, I find, be secured by dampening the carrier surface prior to the contact of the paper therewith. The surface is advantageously dampened with clear water, though the water may contain small percentages of adhesive, usually the adhesive used in the coating composition, since the surface is not ordinarily allowed to become dry during the time the device is in operation. The degree of dampness required can, I find, be obtained by thoroughly wetting the surface and squeezing off the excess by means of a roll pressed thereagainst. The paper web is then laid smoothly on the moist carrier surface either by tension or by pressure.

The adhesion thus secured between the paper web and the carrier surface serves to carry through the portions of excess length whether in the form of buckles or slack edges, and to improve the smoothness and uniformity of the coating operation. The reasons for these improvements are not understood but they are thought to be at least partially based on the fact that where the coated paper web is carried under the

doctor blade the yielding resilient carrier surface is slightly indented and consequently lengthened to a small extent. Because of the adhesion of the paper web to the carrier, this lengthening of the carrier surface places the paper thereon under increased longitudinal tension, stretching it slightly, and increasing the speed of its travel to a corresponding degree. This stretching is, at any instant, confined to that part of the moving web which is under and immediately adjacent the blade at that instant, and is believed to equalize the length of that short section of the web, across its entire width, thus eliminating buckles and slack edges where the actual leveling of the coating is taking place. This increased tension in, and consequent stretching of, the paper at the blade is also believed to bring about the observed equalization in the smoothing action of the blade on the coating.

The moisture applied to the carrier surface also acts as a lubricant between the blade and those parts of the surface not covered by the paper web so that they readily slide under the blade in spite of the pressure which may exist between the blade and the surface. It also prevents any coating material which may spread over the carrier surface, where not covered by the web, from being carried under the blade and building up to form an objectionable deposit or causing other difficulties.

I have also found that the adhesion which I have provided between the paper and the carrier surface greatly facilitates threading, and makes it possible to thread a paper web through the device without lifting the blade from the carrier surface or releasing a pool of coating, if such is maintained on the surface in front of the blade. This is accomplished, as hereinafter more fully described, by threading a "tail" over the carrier surface and then widening the "tail" to the full width of the web as is done in threading papermaking machines.

The invention will be further explained with reference to the accompanying drawing wherein:

Fig. 1 is a diagrammatic illustration showing the application of the present invention to one type of blade coater.

Fig. 2 is a diagrammatic illustration showing the application of the present invention, by slightly modified mechanism, to another type of blade coater.

Fig. 3 is a diagrammatic illustration showing the application of the present invention to a blade coater which uses a web carrier in the form of an endless belt instead of in the form of a roll.

Fig. 4 is a fragmentary view of one end of a web carrier roll and doctor blade showing the method of threading paper under the blade.

Referring to Fig. 1 of the drawing, the covering 11, of rubber or similar yielding resilient material, on the roll 12 which is mounted for rotation on journal bearings 13, carries the paper web 14, with the coating thereon, under the doctor blade 15 which smooths the coating in a manner which forms no part of the present invention and will not be further described. In order to cause the paper web to adhere to the surface of the rubber covering 11 on roll 12, this surface is slightly moistened by contact with a roll 20 which dips into a pan 21 containing water which is carried up by the roll 20 and transferred to the rubber roll covering 11. In order to regulate the degree of moistening of this surface, the moistening roll 20 is held against the surface 11 with the desired degree of pressure which is adjusted by conventional means such as screws 22 acting on journal bearings 23.



In the modification illustrated in Fig. 2, the rubber covering 11, roll 12, journal bearings 13, paper web 14, and doctor blade 15 remain as described except for the direction of rotation of the roll and consequent direction of travel of the paper web. The degree of moistening is controlled as before by pressure of roll 20 against the rubber covering 11 of roll 12. The application of water is made in this case by a shower 25 directed onto the surface 11 as shown, onto roll 20, or into the nip between the two. The pan 26 is here provided merely for the purpose of catching any overflow or drip.

Fig. 3 shows the application of the invention to a coater in which the web carrier is in the form of an endless belt 31 having a surface of the character described. This belt travels around pulleys 32 and 33 (and an additional supporting roll 34 if desired), and carries the paper web 35 under the doctor blade 36 in a manner analogous to that described. The moistening of the surface of belt 31 is accomplished by roll 37 which dips into water in pan 38 in the manner described in connection with Fig. 1. In this case, however, the paper web 35 is contacted smoothly with the surface of belt 31 by means of roll 40 instead of depending, as shown in Figs. 1 and 2, solely on the tension in the web to insure smooth contact.

Reference to Fig. 4 will make it clear how the paper may be threaded under the blade 15 while it is in contact with and is continuously indenting the moving carrier surface 11. The working edge of blade 15 is, for this purpose, rounded upward slightly at the end as shown at 41, leaving a tapered entry-way 42 between the blade and the carrier surface. With the carrier surface 11 in motion, the moistening devices in operation, and the moist surface sliding freely under, and being continuously indented by, the blade, as described, a narrow strip or "tail" of the paper to be threaded through the machine is passed around the protruding end of the carrier roll or belt 11 as indicated by the broken lines at 43. This "tail" travelling with the carrier surface 11 is then guided sideways under the end of the blade to the position illustrated at 44. The "tail" is then widened out in the manner familiar to papermakers until it becomes the full width of the web. I have found that, in spite of the continuous indentation of the carrier surface as it passes under the blade, this moistening of the surface makes it possible to thread the web under both the blade and a pool of coating material, if one is maintained on the carrier surface in front of the blade, without draining the coating material from the pool, lifting the blade, or even releasing the deforming pressure between the blade and the carrier surface.

In all of these and other embodiments of the present invention, the moistening of the carrier surface is so regulated that the surface of the roll is damp but does not carry water to an extent that it will flow on the sunrface. Under these conditions the paper web adheres to the surface to a degree which strongly resists sliding along the surface but permits the sheet to part readily from the surface where its path diverges therefrom. Also, the carrier surface is so yielding and resilient and the machine is so adjusted that the carrier surface is indented and elongated slightly where it carries the paper web under the blade.

The term "rubber" as used herein is to be understood as referring to natural rubber or synthetic or other rubber-like compositions which are similarly yielding and resilient.

The term "doctoring" as used in the present specification and claims refers to a scraping or wiping action such as is accomplished by known types of doctor blades and is to be distinguished from the action of press rolls, squeeze rolls, and the like.

Alternatively it is possible, though in general less desirable, to secure the desired adhesion by wetting the surface of the paper web instead of the carrier surface before the paper is applied to the carrier surface. Also, methods other than water-wetting may be used for securing the required degree of adhesion in special cases where circumstances render such methods desirable.

The described degree of adhesion to the carrier surface, combined with the indentation of the surface by the blade, I have found enables the device to successfully coat paper webs having buckles, slack edges or the like, without the wrinkling and tearing formerly encountered in coating paper webs having such defects on coaters of the type described. It makes it possible, when desired, to thread the paper through the coater without releasing or lifting the blade or draining the pool of coating, when such is maintained in front of the blade. It has also been found to result in better and more uniform coating than is secured by the same device when the paper is not caused to adhere to the surface.

What is claimed is:

1. In a paper coating device wherein a paper web, at the location where freshly applied coating material is smoothed thereon by a doctor blade, is supported on the surface of a moving web-carrier at least the outer layer of which is formed of yielding resilient material: the combination with said web-carrier of means for continuously applying a thin film of water to the surface thereof prior to the application of the paper thereto; means for holding said doctor blade in a position to indent the surface of said web-carrier; and means for firmly supporting the yielding material of said web-carrier against the pressure of said doctor blade; whereby the surface of said web carrier is slightly elongated under and in the immediate vicinity of said doctor blade.

2. The device of claim 1 wherein means is provided for regulating the thickness of the water film applied to the web-carrying surface.

3. The device of claim 1 wherein a roll with means for pressing it with adjustable pressure against the surface of said web-carrier, is provided for regulating the thickness of the water film applied to the resilient surface.

4. In a paper coating device wherein the paper is carried on a moving surface at the location where freshly applied coating material is smoothed thereon by a doctor blade: the combination of a yielding resilient surface layer on the web-carrier; means for causing the web to adhere to the surface of said carrier at said location; a lateral extension of the web-carrier beyond one extremity of the web-contacting surface of the blade; and a tapering end for said blade, overhanging said lateral extension of the web-carrier and gradually tapering to said web-contacting edge.

5. In a paper-coating device of the type wherein moist coating material on a moving paper web is smoothed by a doctor blade at a location where the web is carried on the correspondingly moving surface of a yielding resilient carrier: means for continuously pressing said doctor blade against the coated surface of the paper on said carrier; means for positively supporting said yielding carrier against bodily displacement by pressure exerted thereon by said doctor blade; and means for continuously moistening the surface of said carrier in advance of the application of the paper web thereto.

6. In a paper coating operation wherein a freshly coated paper web is carried on the surface of a moving, yielding, and resilient carrier of the nature of rubber, past a location where it is subjected to a doctoring operation in which pressure of a doctor member against the supported web deforms and locally elongates the supporting carrier surface to some degree, the method of preventing wrinkling and tearing of the paper at said location, which comprises moistening the moving surface of said carrier in advance of the position where the paper is carried thereon and thereby causing the paper to adhere to said surface where it is carried thereon.

7. In a paper coating process wherein a freshly coated paper web is carried on the surface of a moving, yielding, and resilient carrier of the nature of rubber, past a location where it is subjected to a doctoring operation in which pressure of a doctor member against the supported web deforms and locally elongates the supporting carrier surface to a slight degree, the method of preventing wrinkling and tearing of the paper at said location, which comprises moistening the moving surface of said carrier in advance of the position where the paper is carried thereon, and applying the paper smoothly to the moist surface, thereby causing the paper to adhere to said carrier surface and each portion of the length of the paper web successively to be slightly, locally, and temporarily elongated, by the said elongation of the part of the carrier surface to which it is adhering, as it passes the location of said doctoring operation.

8. In a paper coating device: a rubber-covered rotatable roll for carrying a freshly coated paper web, a doctor blade for smoothing freshly applied coating on the surface of a paper web carried on the surface of said roll; means for pressing said doctor blade against the coated surface of a paper web carried on the surface of said roll, whereby the surface of the rubber covering of said roll will be indented and slightly elongated in the immediate vicinity of said doctor blade; and means for continuously moistening the surface of said rubber covering in advance of the position where said roll is adapted to be contacted by the paper web.

WILLIAM PALMER TAYLOR.

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