

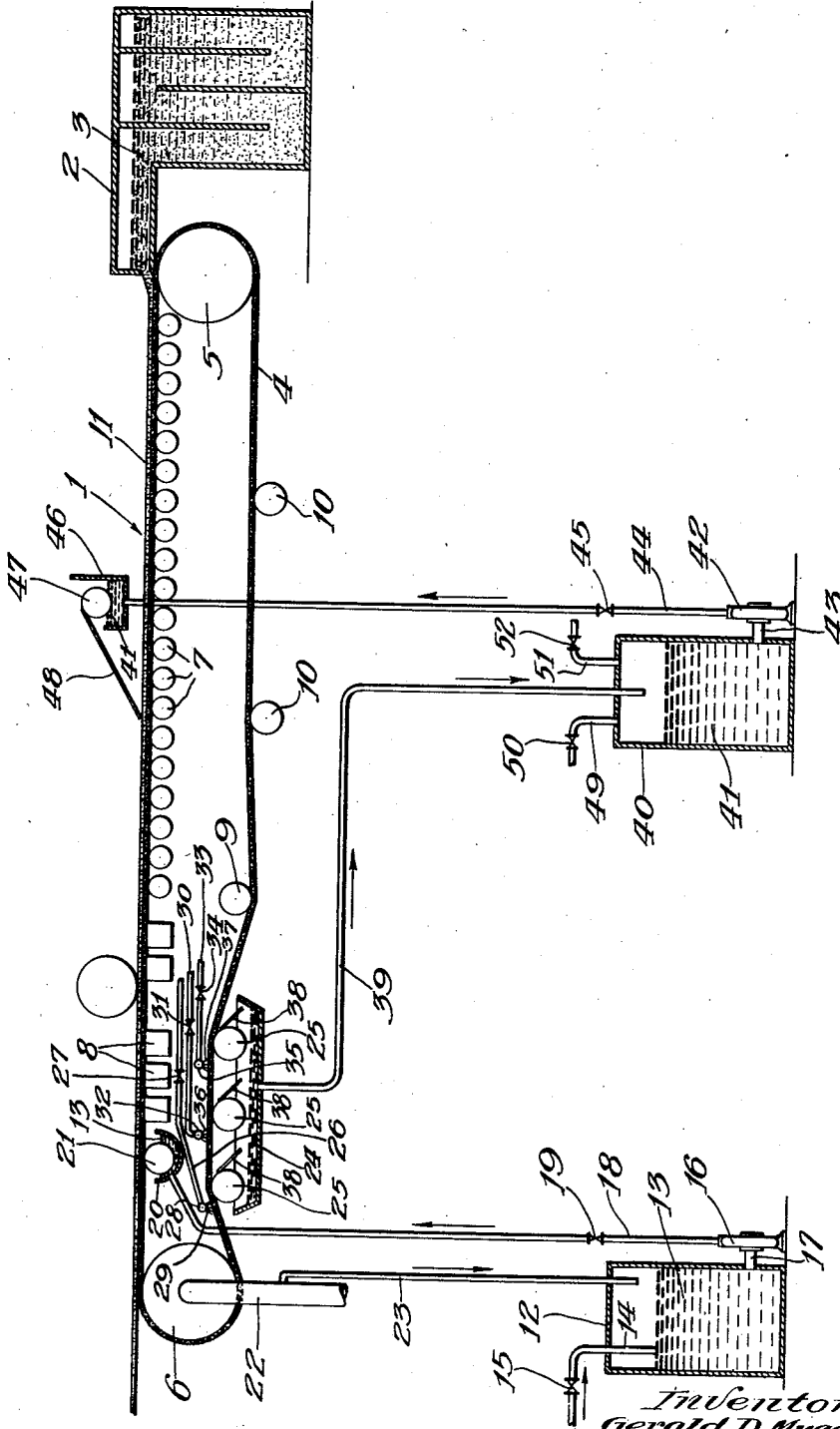
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PROCESS AND APPARATUS FOR COATING PAPER

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PROCESS AND APPARATUS FOR COATING
PAPER

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This invention relates to improvements in a method and means for coating paper, and refers specifically to a continuous method of applying a controllable amount of coating material to opposite surfaces of a newly formed web of paper while the same is on the paper forming wire, and means for carrying out said method.

In making paper upon the conventional Fourdrinier machine, difficulty is encountered in that opposite sides of the paper are not alike in appearance, or in structure, that is, the paper is "two sided." This difficulty is more or less inherent in the paper making operation and is caused in part by the fact that one side of the paper is in contact with the wire during its formation and, consequently, almost invariably has a wire mark. In addition, the paper making operation is in the nature of a filtering action wherein the aqueous carrier of the pulp is filtered through first the wire and then the wire and the fibrous layer upon the wire. As a consequence those fibres having one set of characteristics will settle or be deposited first and will form the lower face or wire side of the web, whereas those which form the upper face may have slightly different characteristics. For instance, the top surface of the web will contain more fine fibres and more filler, where filler is used, than the wire side and will normally be brighter and smoother than the wire side.

Broadly, my method and apparatus is adapted to overcome this "two-sidedness" of the paper by applying a coating material to both faces of the web while it is on the paper forming wire. Specifically, my invention provides a method for closely controlling the continuous application of coating material to both faces of the web whereby, after the desired quality and quantity of coating applied to each face is initially determined, the entire web may be coated with a desired weight and quality on each face without necessitating further adjustments.

As another feature of my invention, a web may be coated continuously as hereinbefore described with the loss of a minimum amount of coating material, since, the coating material which would normally be discarded during the coating of one face of the web, is used as the major bulk of the coating material used upon the opposite face of the web.

Other objects and advantages of my invention will be apparent from the accompanying drawing and following detailed description.

The single drawing is a diagrammatic side sec-

tional view of suitable apparatus for carrying out my invention.

Referring in detail to the drawing, 1 indicates the wet end of a conventional Fourdrinier paper machine in conjunction with which apparatus for carrying out my invention may be employed. The machine 1 comprises the usual head box 2 in which a quantity of pulp 3 is stored and from which said pulp is continuously fed to the upper pass of an endlessly moving paper forming wire 4. The wire 4 travels in endless fashion around breast roll 5, adjacent the head box 2 and at the opposite end of its travel said wire passes around a suction couch roll 6. The wire 4 on its upper pass travels substantially horizontally from the roll 5 to the couch roll 6 and is supported for a predetermined distance from the breast roll 5 by means of table or tube rolls 7. Between the last tube roll 7 and the couch roll 6, the wire passes over a plurality of suction boxes 8. The wire during its lower or rearward pass travels into contact with a wire tightening roll 9 and carrier rolls 10.

The pulp 3 comprises a dilute suspension of fibres in an aqueous carrier and when said pulp is flowed on to the paper forming wire 4, the aqueous carrier together with a portion of the suspended fibres pass through the wire. The paper forming action is in the nature of a filtering operation, the wire tending to retain a quantity of the fibres upon its upper surface until a fibrous mat or web 11 is formed upon said surface. The tube or table rolls 7 contact the lower surface of the wire and tend to assist in the removal of the aqueous carrier. When the wire carrying the web 11 passes over the suction boxes 8, a further quantity of the carrier is removed. At the couch roll 6 the web 11 has been sufficiently dehydrated to form a coherent mat which may be stripped from the couch roll. This mat or web is then carried forwardly through suitable press rolls (not shown) and is eventually dried by passing the same over a plurality of heated drying drums (not shown).

In the forming of the web 11 upon this type of paper machine, difficulty has heretofore been encountered in obtaining opposite surfaces of uniform appearance. As has been hereinbefore described, this difficulty is inherent in the paper making operation and is cured by my invention.

A chamber 12 is positioned adjacent and preferably beneath the couch roll end of the paper machine and is adapted to carry a quantity of coating material 13 which may be introduced into said chamber through pipe 14 controlled by valve

15, the opposite end of said pipe being connected to a suitable source of supply. The coating material 13 may comprise any of the conventional coating suspensions or solutions which have heretofore been used in the coating of paper for printing or opacating purposes.

A pump 16 is connected by means of pipe 17 to a lower portion of the container 12, the pipe 17 comprising the intake of the pump 16. The pump 16 may be driven by any conventional means (not shown). Coating material 13 drawn by the pump 16 is forced upwardly through pipe 18 which is controlled by valve 19, said pipe discharging into fountain 20 positioned immediately beneath the upper pass of the wire 4 between the last suction box 8 and the couch roll 6. A roll 21 is disposed with its surface in contact with the lower surface of the paper forming wire 4, the surface of said roll being adapted to dip in the coating material 13 carried in the fountain 20. By means of this arrangement coating material 13 is carried upon the surface of roll 21 and is applied to the lower surface of the wire 4. A portion of the coating material 12 passes through the interstices of the wire 4 and forms a film or layer of coating material upon the lower surface of the web 11. This coating operation per se has heretofore been employed and comprises no part of my invention except in the combination to be hereinafter more fully described.

As has been hereinbefore described, roll 6 is of the suction couch type, the condition of vacuum within the roll being established by means of a suitable suction pump not shown, connected to the end of pipe 22 which, in turn, connects into the interior of the roll 6. It can readily be seen that a portion of the coating material which is not applied to the lower surface of the web 11, will be drawn into the interior of the suction couch roll 6 and will be removed therefrom through the pipe 22. A pipe 23 connects into pipe 22 and discharges into the storage container 12. A suitable trap (not shown) of conventional construction, may be provided in the pipe 22 and the pipe 23 may connect with said trap whereby the coating material retrieved through pipe 22 is returned to the storage container 12.

In view of the fact that the coating material 13 is in a relatively dense state when applied to the lower surface of the wire 4, the major portion of said coating material which is not applied to the lower surface of the web 11, remains on the wire and is not drawn through the suction couch. However, there will be a portion of said material drawn through the couch roll 6 and returned through the pipe 23 to the storage container 12.

A vat or pan 24 is positioned beneath the lower pass of wire 4 between the wire tightening roll 9 and the couch roll 6. Immediately above vat 24, one or more rolls 25 may be positioned, wire 4 upon leaving couch roll 6 being adapted to pass over said rolls. A pipe 26 controlled by valve 27 carries a shower head 28 at its end, said pipe being connected to a suitable source of water (not shown). The shower head 28 is positioned above wire 4 and slightly in advance of roll 25 and is adapted to direct a spray 29 of water upon the wire 4. A pipe 30 controlled by valve 31 is connected at its end to a suitable source of water and carries at its opposite end a shower head 32 which is positioned above wire 4 and slightly

in advance of the second roll 25. In like manner a pipe 33 is connected to a suitable source of water under pressure and is controlled by valve 34, the opposite end of said pipe carrying a shower head 35 which is positioned above wire 4 and slightly in advance of the third roll 25. Both shower heads 32 and 35 are adapted to direct a spray of water 36 and 37 upon wire 4 as shown in the drawing.

By this arrangement all of the coating material 13 which remains upon the wire 4 after the same leaves the couch roll, will be driven from the wire by the sprays 29, 36 and 37. In addition, each roll 25 will assist in the removal of the coating material and a scraper or doctor blade 38 is positioned in contact with the surface of each of the rolls 25 to remove coating material which may be carried upon the surface of the rolls 25.

It can readily be seen that the coating material thus removed from the wire 4 is retrieved in the vat or pan 24. A pipe 39 connects into the bottom of vat 24 and discharges into a storage container 40 at its opposite end whereby the coating material 41 retrieved is passed to the storage container 40.

A pump 42, driven by any suitable means (not shown), is connected to a lower portion of the storage container 40 by means of pipe 43 which constitutes the intake of the pump 42. The discharge of the pump 42 is connected to pipe 44 controlled by valve 45. The upper end of said pipe connects into the bottom of the fountain 46 which is positioned above the upper pass of wire 4. A roll 47 is disposed in the fountain 46 in such a manner as to have its surface dip into the coating material 41 maintained in the fountain. A member 48 is disposed in contact with the upper portion of roll 47 and forms an inclined surface which leads to the upper surface of web 11 upon wire 4. The member 48 is adapted to remove coating material from the surface of roll 47 and said coating material travels downwardly along the inclined face of the member 48 and is deposited upon the upper surface of the web 11.

It can readily be seen that by the arrangement hereinbefore described both surfaces of the web 11 may be coated before the web leaves the paper-forming wire. However, in view of the fact that the opposite faces of the web are initially different in character, the coating material applied to the respective faces must be closely controlled as to amount and consistency or density so that in the final web both faces are alike. In addition, since the coating material charged to the system comes from the same source, namely, the storage container 12, the system must be susceptible to constant, continuous operation after once adjusted.

For example, to obtain a predetermined finish on each surface of the web, a coating material of a predetermined density or consistency must be initially delivered to the surface of roll 21. Of the total coating material delivered to the under side of wire 4, a percentage, depending on the density or consistency of the coating material, the mesh of the wire, the wire speed, and to a degree the character of the web, will be delivered to the lower surface of the web. The remaining coating material delivered to the wire obviously remains upon the wire. A relatively small percentage of this remainder is drawn through the couch roll and is returned to the storage chamber 12. The major portion of the coating ma-

terial not delivered to the web, however, is removed from the wire by the sprays 28, 36 and 37 and the rolls 25.

It is the material thus removed from the wire which constitutes the charging stock for the coating of the upper face of the web, and inasmuch as this material plus the water from the pipes 26, 30 and 33 is passed directly to the storage chamber 40 from whence it is delivered to the upper surface of the web, the control of the density or consistency of the material 41 is controllable by the proper setting of the valves 27, 31 and 34. Hence, for a predetermined wire speed and a material 13 of predetermined density or consistency, a continuous supply of material 41 of predetermined, constant density or consistency may be obtained.

It can readily be seen that substantially one hundred percent of the coating material charged to the system is eventually carried away on the web, making my process both efficient and economical. As has been hereinbefore mentioned, the broad idea of applying a coating material to the wire side of a web by means of a roll similar to roll 21, is in itself not my invention. However, to merely carry out this operation is a wasteful and uneconomical process since it would be commercially impracticable to retrieve the material carried by the wire, after the wire has left the couch roll, and recycle this material, because to remove the material from the wire, it must be diluted to such an extent that without a subsequent concentration operation it would not be usable, that is, it could not be charged back to the storage container 12. This expensive handling of the unused material, therefore, makes the recovery thereof an uneconomical process. The wastefulness of this process alone can be appreciated when only about 40% of the total charged material can be applied to the web.

I also appreciate that the flowing of coating material to the upper surface of a web while the same is on the paper forming wire may in itself be old. However, by combining both operations, that is, the coating of the lower and upper surfaces of the web, and using the recovered material from the first mentioned operation as the basis of charging stock of the second operation, unlooked for economies are obtained. In addition, the function of the controlled sprays 29, 36 and 37 is unique since they not only serve to clean the wire and assist in the recovery of the coating material from the under coating operation, but serve to proportion and control in a continuous manner the density or consistency of the material charged to the upper surface of the web.

As an example of my process, a paper web is formed having a weight of 45 pounds, on a wire of 80 mesh; the wire traveling at a speed of approximately 600 feet per minute. The coating material 13 has a density or consistency of about 7½ per cent solids. About 40 percent of the material 13 applied to the wire 4 by roll 21 is taken by the lower surface of the web, and neglecting the small amount of coating material retrieved by the suction couch roll (which operated at about 15 inches of water) about 60 percent of the coating material is carried by the wire past the couch roll. The valves 27, 31 and 34 are set to remove all of the coating material from the wire and the resulting material 41 has a consistency of about 2 percent solids. This material is in toto deposited upon the upper surface of the web. It has been found that a web so formed has sides of equal brightness and smoothness.

Of course, the above example is given merely for purposes of illustration and I do not wish to be limited to the specific conditions stated.

It will be noted that in the example stated, 40 percent of the material is applied to one side of the web, whereas 60 percent is applied to the other and yet both sides are of substantially equal brightness. This seemingly unlikely condition is the result of the different initial characters of the upper and lower surfaces and the manner in which the coating material is applied. In the case of the lower surface, the coating material is applied in a more dense state to a surface which is more or less dense. Hence, more of the solids tend to remain on the surface. In the case of the upper surface, the coating material is less dense and is applied to a surface which is more porous and hence a proportion of the solids stray into the body of the web. In effect, however, the process can be controlled so as to balance these factors and obtain opposite surfaces of uniform brightness.

If desired, the manipulation of valves 27, 31 and 34 as a control, can be supplemented by moving the point of application of the coating material to the upper surface. For instance, the member 48 and fountain 46 may be moved closer to, or further away from, head box 2. It can readily be seen that by so moving this coating applicator, the coating material may be deposited upon the web while the upper surface thereof is more or less receptive to the coating and, hence, there will be more or less "straying" of the solids into the body of the web.

If desired, the characteristics of the coating material 41 in the storage chamber 40 may be altered by introducing more liquid carrier through the pipe 49 controlled by valve 50, or by introducing more solid material through pipe 51, controlled by valve 52. However, these controls are extraneous of my broad process and are adapted to be used only as occasion may demand.

One of the important advantages which accrue from the use of my process is as follows: The proportion of the material applied by the roll 21 to the wire 4 and not taken up by the web 11, increases as the density or solids content of the material increases. The weight of coating applied to the web is dependent upon the density or solids content of the coating material. Hence, unless all thoughts of economy are banished, an economic limit is soon reached as to the weight of coating which may be applied by the underwire system operating alone. However, by recovering and using the otherwise wasted coating material as part of a continuous process of coating both sides of the web, an increase in density, even with a decrease in the proportion taken up by the underside of the web merely results in increasing the density of the charging stock applied to the upper side of the web. Hence, it can be seen that these factors are compensating in my process and the upper limits of coating weight which can be obtained are dependent only upon the wire mesh and the character of the web.

I claim as my invention:

1. A process of coating a newly formed web as the same is carried forwardly on an endlessly moving paper forming wire which comprises, depositing coating material upon the upper surface of said web, then carrying said web forwardly and applying a coating material to the lower surface of the wire upon which the web is carried whereby a portion of said coating material is deposited upon the lower surface of the web, washing said

wire to remove the remaining portion of the coating material, retrieving said washing liquid and coating material, and using the same as the charging stock for said first mentioned coating operation.

2. A process of coating a newly formed web as the same is carried forwardly on an endlessly moving paper forming wire which comprises, depositing a relatively dilute coating material upon the upper surface of said web, carrying said web forwardly and applying a relatively concentrated coating material to the lower surface of the wire upon which the web is carried whereby a portion of said coating material is deposited upon the lower surface of the web, washing said wire to remove the remaining portion of the coating material and dilute the same, retrieving said washing liquid and coating material, and using the same as the charging stock for said first mentioned coating operation.

3. A process of coating a newly formed web as the same is carried forwardly on an endlessly moving paper forming wire which comprises, depositing a relatively dilute coating material upon the upper surface of said web, carrying said web forwardly and applying a relatively concentrated coating material to the lower surface of the wire upon which the web is carried whereby a portion of said coating material is deposited upon the lower surface of the web, washing said wire with a controlled quantity of liquid to remove the remaining portion of the coating material and dilute the same, retrieving said washing liquid and coating material, and using the same as the charging stock for said first mentioned coating operation.

4. A process of coating a newly formed web as the same is carried forwardly on an endlessly moving paper forming wire which comprises, depositing coating material upon the upper surface of said web, applying a coating material to the lower surface of the wire upon which the web is carried whereby a portion of said coating material is deposited upon the lower surface of the web, washing said wire to remove the remaining portion of the coating material, retrieving said washing liquid and coating material, and using the same as the charging stock for said first mentioned coating operation.

5. A process of coating a newly formed web as the same is carried forwardly on an endlessly moving paper forming wire which comprises the following successive steps, depositing a coating material having a relatively high proportion of solids to the lower surface of said paper forming wire whereby a portion thereof passes through the mesh of said wire and is deposited upon the lower face of the web, washing said wire to re-

move the remaining portion of said coating material and dilute the same, retrieving said diluted coating material and depositing the same on the upper surface of the web at a predetermined distance from the point of application of the coating material to the lower surface of the web.

6. In combination with a paper machine of the type wherein a web of paper is continuously formed on an endlessly moving paper-forming wire, a coating roll disposed in rolling contact with the lower face of the paper-forming wire during its upper pass, means for applying coating material to the roll surface which in turn is transferred to said wire and the lower face of the web carried thereon, liquid spray means for removing residual coating material from said wire during its lower pass, means for collecting said sprayed liquid and coating material, means for passing said mixture of liquid and coating material above said web upon said paper-forming wire, and means for depositing said materials upon the upper surface of the web to coat said surface.

7. In combination with a paper machine of the type wherein a web of paper is continuously formed on an endlessly moving paper-forming wire, a coating roll disposed in rolling contact with the lower face of the paper-forming wire during its upper pass, means for applying coating material to the roll surface which in turn is transferred to said wire and the lower face of the web carried thereon, liquid spray means for removing residual coating material from said wire during its lower pass, means for controlling said liquid spray, means for collecting said sprayed liquid and coating material, means for passing said mixture of liquid and coating material above said web upon said paper-forming wire, and means for depositing said materials upon the upper surface of the web to coat said surface.

8. In combination with a paper machine of the type wherein a web of paper is continuously formed on an endlessly moving paper-forming wire, a coating roll disposed in rolling contact with the lower face of the paper-forming wire during its upper pass, means for applying coating material to the roll surface which in turn is transferred to said wire and the lower face of the web carried thereon, means for removing the residual coating material from said wire and diluting the same during the lower pass of said wire, means for passing said diluted coating material above said web upon said paper-forming wire, and means for depositing said diluted coating material upon the upper surface of the web to coat said surface.

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