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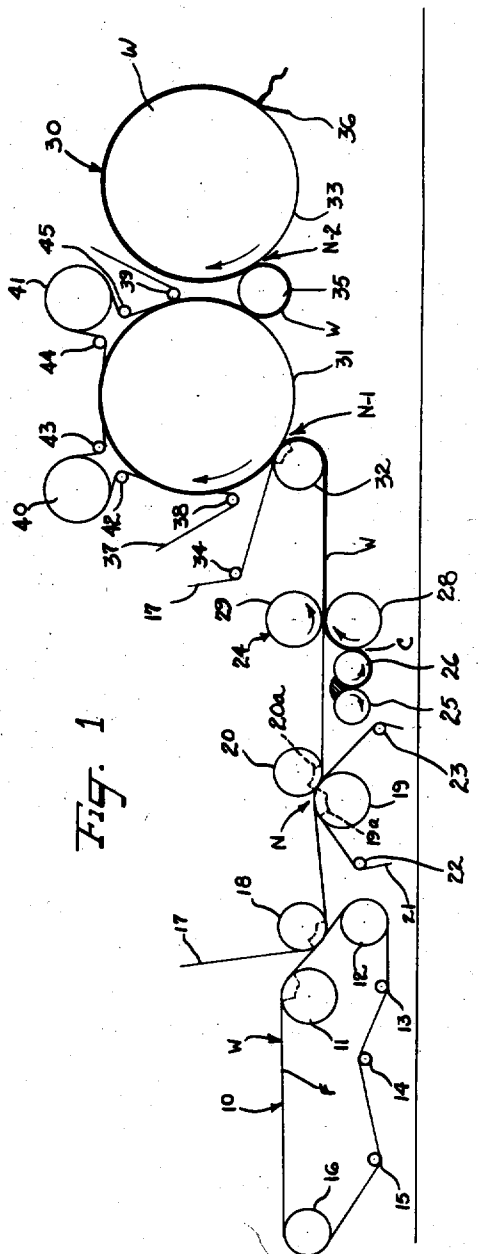
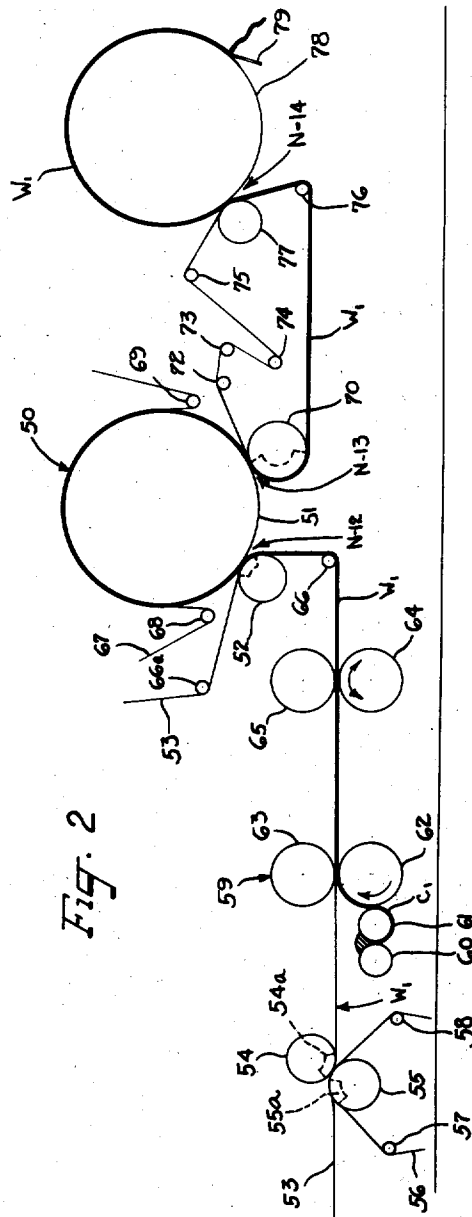
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PAPER MACHINE COATING ARRANGEMENT

Filed Oct. 12, 1955

2 Sheets-Sheet 1



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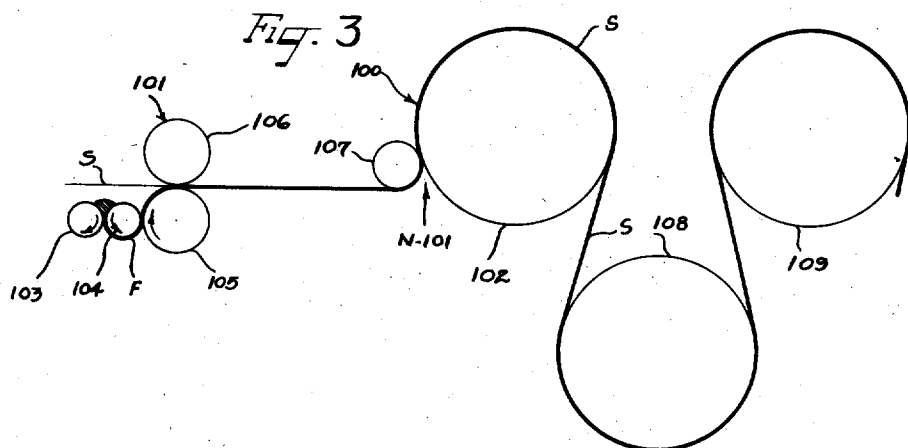
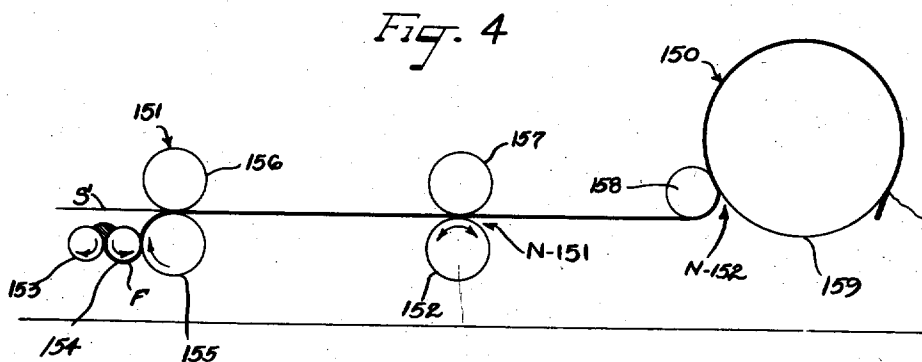
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PAPER MACHINE COATING ARRANGEMENT

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2 Sheets-Sheet 2



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2,920,698

PAPER MACHINE COATING ARRANGEMENT

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8 Claims. (Cl. 162-265)

This invention relates to an improved apparatus and method for the handling of paper webs or similar traveling sheets, and more particularly, to an improved paper making machine comprising a coating device and an improved method of treating a paper web therein.

Although the instant invention may be adapted for use in the coating of a number of traveling flexible sheets (including cloth, etc.) it may be used to particular advantage in the coating of a traveling paper web in a paper machine.

In particular, the instant invention may be used to advantage in a Yankee dryer machine or "Yankee" machine; and such a machine may have a cylinder or Fourdrinier wet end and it may also have a number of presses or auxiliary dryers of the usual type. The characteristic feature of the Yankee machine is the large Yankee dryer drum, having a diameter from nine feet to about fifteen feet, that is made of cast iron or steel and has a very high polish imparted to the outside cylindrical surface. Soft material, such as a paper web with a coating thereon, will develop a fine glazed, smooth surface if it is pressed against the heated finely polished dryer drum surface during the drying of the web.

There are certain limitations or difficulties in connection with the operation of machines of this type for coated paper, however. First of all, it is extremely difficult to apply coating smoothly to a traveling paper web to the degree of uniformity desired, at the time of first application. On the other hand, doctors or similars smoothing or scraping devices afford certain operational difficulties. For example, the usual doctor rolls tend to cause imperfections in the coated paper product, presumably because of a tendency for the rotating roll to pull off small amounts or particles of coating from the surface of the coated web (to give imperfections sometimes referred to in the art as "duck tracking"). Also, if such coating is to be done in a Yankee dryer machine, the coating (and web coated thereby) must be dried completely before it can be removed from the Yankee dryer drum. It will also be appreciated that the coated web cannot have too little moisture when it contacts the dryer drum or it will not glaze, and the coated web cannot have too much moisture when it contacts the dryer drum or the dryer drum will have to be operated at a much slower rate and a lower temperature. In general, the temperature of the dryer drum must be carefully controlled, since it must be cool enough to take the paper from the conveying source at the initial transfer nip and it must be hot enough to dry the paper in about three-quarters of a revolution of the dryer drum. There are, also, certain limitations as to the amount of moisture that can be removed from the web prior to casting onto the dryer drum surface, because a certain definite predetermined amount of moisture may be added at the time the coating is applied and subsequent treatments to attempt to remove the moisture from the web, as by pressing, after the coating has been applied have been unsuccessful.

The instant invention provides a unique answer to the problems hereinbefore involved in the operation of coat-

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ing devices in paper machines generally and in the operation of such devices in Yankee machines. In accordance with one phase of the instant invention, the originally applied coating material is subjected to a doctor formed of a hydrophobe material defining the surface thereof. It has been found that such a material may be used to smooth the coating on the paper without creating imperfections therein. Another phase of the instant invention involves the employment of a plurality of dryer drums, such as the Yankee dryer drums, wherein all but the last of such drums is provided with a hydrophobe layer mounted thereon defining the casting surface thereof. In this manner, partial drying of the coating may be accomplished on each of a plurality of successive Yankee dryer drums mounted in the paper machine; and the hydrophobe layer (which will be described in detail hereinafter) is unique in that it permits separation of the partially dried coated web from the casting surface without damage thereto, so that the machine may be operated at a much faster than usual rate with partial drying on each dryer drum being permitted because of the ability of the hydrophobe surface to release the paper web, even though the web is not yet dry. The last drum in the machine must, however, receive the web in wet enough condition to adhere to the drum or casting surface and effect such casting thereof as is desired.

It is, therefore, an important object of the instant invention to provide an improved paper machine and an improved method of making paper.

It is a further object of the instant invention to provide an improved method of coating paper and drying the coated paper which permits faster paper machine operation and the more uniform application of a coating to the paper.

Still another object of the instant invention is to provide an improved device for coating a traveling sheet comprising coating means on one side of the sheet applying a continuous film of coating material to the sheet, and a doctor roll on the same side of the sheet and behind said coating means in the direction of sheet travel urged against said sheet to smooth the coating thereon, said doctor roll having a hydrophobe surface engaging the sheet.

Other objects, features and advantages of the present invention will become apparent to those skilled in the art from the following detailed disclosure of preferred embodiments thereof and the attached drawings which are made a part hereof.

On the drawings:

Figure 1 is essentially a diagrammatical view of a paper machine showing an embodiment of the instant invention;

Figure 2 is essentially a diagrammatical view of a paper machine showing a second embodiment of the instant invention;

Figure 3 is essentially a diagrammatical view of a paper machine coating and drying section showing a third embodiment of the instant invention; and

Figure 4 is essentially a diagrammatical view of a paper machine coating and drying section showing a fourth embodiment of the instant invention.

As shown on the drawings:

In Figure 1, the paper machine indicated generally by the reference numeral 10 comprises a traveling forming wire F trained over suction couch roll 11, a turning roll 12, guide rolls 13, 14 and 15, and breast roll 16. As is known, the paper web W is formed on the top run of the forming wire F and is picked up therefrom by a first press felt, or suction pickup felt 17 which contains a suction pickup roll 18 within the loop of the belt 17 urging the felt 17 against the forming wire F to pick up the web W therefrom. Next, a pair of press rolls 19

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and 20 define a suction press nip N. The upper roll 20 has a suction box 20a and is positioned within the loop of the first felt 17, and the lower roll 19 has a suction area 19a and is positioned within the loop of another felt 21, mounted on suitable guide rolls 22 and 23. The pair of press rolls 19 and 20 serve to dewater the web passing therethrough on the underside of the press felt 17.

Next, the web W is guided by the felt 17 to and through a coating device, indicated generally at 24, which comprises a pair of doctor rolls 25 and 26 mounting therebetween a generally liquid mass of coating material and rotating in the directions indicated by the arrows so as to "film" a layer of the coating material onto the downrunning side of the roll 26, from which the coating layer C is transferred onto the uprunning side of a "printing" roll, or applicator roll 28. The applicator roll 28 presses the coating film C against the underside of the web W carried on the felt 17 and an upper roll 29 cooperates with the applicator roll 28 to provide pressure at the point of application so that the coating layer may be applied adherently to the bottom side of the web W. The coated web is then carried on the bottom side of the felt 17 to the casting or drying section indicated generally by the reference numeral 30.

In the drying section 30, there are mounted a first Yankee dryer drum 31 which has a hydrophobe surface to engage the coated side of the web, a first press roll 32 defining a first nip N-1 with the underside of the first drum 31, a continuation of the felt 17 running through the first nip N-1 for effecting transfer of the web W thereat onto the first drum, and additional drying means 33 in the form of a second Yankee dryer drum.

In following the travel of the coated web W, it will be noted that the web is passed from the coating device 24 around the first press roll 32 on the felt 17 and through the first press nip N-1. After the first press nip N-1 the felt 17 is separated from the web W, as by a guide roll 34, and the web remains wrapped around the first Yankee dryer drum 31 and travels thereon around to the lower portion of the downrunning side of the drum 31, whereat a second press roll 35 is mounted defining a second nip N-2 with the underside of the second Yankee dryer drum 33. The web W is transferred from the first drum 31 to the second drum 33 by the second press roll 35 (which may assist in removal of the web W from the first dryer drum 31 by a suction area, which is not shown, or it may merely function as a guide roll in guiding the web to the second nip N-2). The drying and casting of the web is then completed on the second dryer drum 33 and the web may be removed from the second dryer drum 33 at the lower portion of the downrunning side thereof by a doctor 36 or by other suitable means.

In the use of the first dryer drum 31 it has also been found preferable to employ an additional felt 37 that is a very fine wool felt that is lapped over the web W on the first drum 31 above the first nip N-1 so as to retain the web on the surface of the first drum 31 on the up-running side and to the extent desired on the down-running side. Suitable guide rolls 38 and 39 apply the felt 37 to the drum 31 and remove the felt 37 therefrom, respectively. The felt 37 also assists in effecting controlled even and slow evaporation of moisture, all of which is absorbed by the felt 37. Because of the moisture absorption of the felt 37 a pair of auxiliary dryer drums 40 and 41 are positioned adjacent the drum 31 and guide rolls 42 and 43 train the felt 37 over the dryer drum 40, and guide rolls 44 and 45 train the felt 37 over the dryer drum 41 in order to accomplish drying of the felt 37 at spaced intervals during its travel along with the web W on the surface of the drum 31.

In Figure 2, which shows another embodiment of the invention indicated generally by the reference numeral

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50, it will be seen that the paper machine 50 comprises a first Yankee dryer drum 51 having the hydrophobe surface hereinbefore mentioned for engaging the web W₁, a first press roll 52 defining a first nip N-12 with the underside of the first drum 51, a first felt 53 running through the first nip N-12 for effecting transfer of the web W thereat onto the first drum 51, and a pair of press rolls 54 and 55 associated with the first felt 53 to dewater the web W₁ thereon. As indicated the upper press roll 54 has a suction area 54a and the lower press roll 55 has a suction area 55a. The first felt 53 covers the suction area 54a of the upper roll 54 and another felt 56 on guide rolls 57 and 58 covers the suction area 55a of the lower roll 55. In this manner the web W is retained on the bottom side of the felt 53 as it passes through the pair of press rolls 54, 55.

Next, positioned between the pair of press rolls 54, 55 and the first nip N-12 is a coating device, indicated generally by the reference numeral 59, and having the same structure as the coating device 24 of Figure 1, with small doctor rolls 60 and 61 carrying therebetween a body of coating material and filming a layer thereof on the downrunning side of the roll 61, from which the layer is transferred onto the uprunning side of the applicator roll 62 which pinches the web and felt in cooperation with an upper roll 63 to apply the layer of coating C₁ to the bottom side of the web W₁ on the felt 53. It will also be appreciated that other coating means may be employed, such as a roll passing through a coating bath at the bottom side thereof for "printing" a coating onto the web in a similar manner.

Next, a doctor roll 64 is positioned between the coating device 59 and the first nip N-12 on the bottom side of the coated web W₁ and urged against the web and felt 53, backed by an upper roll 65, so as to smooth the coating C₁ on the bottom side of the web, and remove excess coating if such is necessary. The doctor roll 64 is also provided with a hydrophobe layer on the engaging surface thereof and this hydrophobe layer prevents the creation of imperfections in the coating on the web, as will be explained hereinafter. As will be appreciated the doctor roll 64 may be rotated in either direction, with or against the traveling web, so as to effect the desired smoothing and leveling function.

Next, the coated web W₁ on the felt 53 passes over a turning roll 66 and through the nip N-12 whereat the web W₁ is transferred onto the surface of the first drum 51 and the felt 53 is guided away from the web W₁, as by a guide roll 66a. Partial drying of the web W₁ is accomplished on the first drum 51, and such drying may be assisted by a fine wool felt 67 applied to the back surface of the web W₁ by guide rolls 68 and 69, in the manner hereinbefore described. The web is cast readily onto the smooth surface provided by the drum 51, but the drum 51 is also provided with a hydrophobe layer defining the casting surface thereof which permits removal of a partially dried web W therefrom at the down-running side, in this case at a nip N-13 defined by the drum 51 and a suction pickup roll 70. The suction pickup roll 70 is within the loop of a felt 71 (carried on guide rolls 72, 73, 74, 75, 76) and the incompletely dried web W₁ is transferred at the nip N-13 by the suction roll 70 onto the felt 71 and carried on the underside of the felt run 71 from adjacent the first drum 51 to another transfer nip N-14 defined by another press roll 77 and a second dryer drum 78, at the underside of the second dryer drum 78, whereat the web W₁ is cast onto the dryer drum 78 and carried over the top of the dryer drum 78 and to the downrunning side thereof, whereat it may be removed by suitable means such as a doctor 79.

The hydrophobe casting surfaces provided on the dryer drum 31 of Figure 1, the doctor roll 64 of Figure 2 and the dryer drum 51 of Figure 2 are preferably in the form of a layer or coating covering the drum or roll surface (or defining the casting or active surface). This material is

made of a hydrophobe (i.e. a material that is not wetted by water). Materials of this type include rubber or other natural or synthetic plastic resins or elastomers; most preferably polytetrafluoroethylene ("Teflon") or similar heat resistant materials are used, because the material must be able to stand up under the operating temperatures of approximately 200° F. in a dryer drum. The doctor roll 64 need not require such a heat resistant plastic material. In the dryer drums, because the heat resistant hydrophobe coatings such as polytetrafluoroethylene are not very good heat conductors, the coatings are applied in as thin a layer as possible.

Referring now to Figure 3, it will be seen that the device indicated generally by the reference numeral 100 shown therein provides for the coating of a traveling sheet S which may be a paper web (but which is not necessarily supported by a felt as indicated in Figures 1 and 2) which comprises coating means indicated generally at 101 applying a continuous film F of coating material to the sheet S and a dryer drum 102 on the same side of the sheet behind the coating means 101 in the direction of sheet travel wrapped by the sheet S, the dryer drum 102 having a hydrophobe surface engaging the sheet S, which is the same type of hydrophobe surface hereinbefore described. In the arrangement 100 of Figure 3, the coating means 101 comprises a pair of coating doctor rolls 103 and 104 retaining a well of coating material therebetween in liquid form and filming off a layer F thereof on the downrunning side of the roll 104 which in turn applies the film F to the uprunning side of a printing roll 105. The printing roll 105 applies the film F to the bottom side of the sheet S by pinching the sheet S and film F between itself and an upper press roll 106, in the manner hereinbefore described. The device 100 is adapted for use wherein a substantial amount of coating material is applied thereto and ordinary dryer drums do not have a sufficient amount of capacity to complete the drying of the coating on the sheet S. As will be appreciated, dryer drums such as the Yankee dryer drum 102 are limited in size and in the load which can be carried thereby, since only so much heat can pass through the heating walls of the dryer drum 102.

In the embodiment 100, the coating material or film F applied is, as in the case throughout the instant disclosure, an aqueous material or material wetted with a volatile solvent such as water which is to be evaporated on the various dryer drums. In the practice of the invention using the arrangement 100, it will be noted that the coated sheet S is first cast onto the casting surface of the first dryer drum at a first nip N-101 defined with a press roll 107 near the uprunning underside of the dryer drum 102 and the wet sheet is then dried as it travels around to the downrunning side of the first Yankee dryer drum 102, at which point the web is dewatered to 50-70% dryness. The semi-dry sheet S is then fed onto a second Yankee dryer drum 108, in this case the dryer drum 108 engages the sheet side rather than the coated side of the sheet S, but further drying may be accomplished. The partially dried coated sheet S may be removed from the first Yankee dryer drum 102, because the first Yankee dryer drum has the smoothly polished hydrophobe surface hereinbefore described which permits this separation of the coated sheet and the dryer drum without causing imperfections in the coated sheet. Additional drying is accomplished by the Yankee dryer drum 108, although no "casting" is accomplished because the coated surface is exposed. The sheet S is next cast onto the third Yankee dryer drum 109, in this case casting the coated side onto the dryer drum 109 and the web is trained over the dryer drum 109 and may be separated therefrom on the downrunning side by suitable means such as a doctor (not shown).

It is important to note that the sheet S must be wet at least to a limited extent when it is applied to the Yankee dryer drum 109 or no casting will effectively take place

and it will not adhere to the dryer drum 109 so as to travel normally therewith to complete the drying thereof. It has been found that the sheet should not be dewatered to more than 50-70% dryness before it is cast for the last time on a drying surface, in this case the Yankee dryer drum 109, from which it will be removed at dryness of 93-95%. Accordingly, the partial drying of the sheet S on the first dryer drum 102 and the second dryer drum 108 should be such that the web is still only 50-70% dry when it is removed from the last dryer drum 108 in the series before the final dryer drum 109.

In the embodiment shown in Figure 4, the arrangement is indicated generally by the reference numeral 150 showing coating means 151 applying coating to a sheet S' (which is preferably a paper web but need not be supported by a felt as indicated in Figures 1 and 2), and a doctor roll 152 on the same side of the sheet that the coating film F' is applied thereto and behind the coating means 150 in the direction of sheet travel. The doctor roll 152 is urged against the sheet S' to smooth the coating F' thereon, and it is important to note that the doctor roll 152 has a hydrophobe surface for engaging the sheet S', which is the same type of hydrophobe surface described hereinbefore. In the embodiment 150, the coating material is maintained in a well between a pair of doctor rolls 153 and 154 and filmed onto the downrunning side of the doctor roll 154 from which it is filmed onto a printing roll 155 which squeezes the sheet S' and the film F' together between itself and a top press roll 156 so as to apply the coating to the sheet S'. Next, the sheet S' passes between a nip N-151 defined by the doctor roll 152 and an upper roll 157, so as to permit the doctor roll to smooth out the film coating, remove excess coating, and possibly remove a portion of the moisture, if enough pressure is applied at the nip N-151. Next, the coated sheet S' passes around a press roll 158 which defines a transfer nip N-152 with a Yankee dryer drum 159 whereat the sheet S' is cast onto the dryer drum surface. In the embodiment shown in Figure 4 there is an advantage in that smoothing of the coating and possible dewatering thereof is accomplished at the doctor roll 152 so that less drying capacity is required and only a single dryer drum 159 may be required to accomplish the desired drying. In such instance, subsequent drying means are not required and it is thus not necessary to employ a hydrophobe surface on the dryer drum 159.

In any cases, however, such as shown in Figures 1, 2 and 3 where the partially dried web must be separated from a first casting surface, such casting surface must be provided by the hydrophobe surface herein described in order to practice the instant invention to advantage. Also, it will be noted that the second casting or the final casting of the paper web onto the last Yankee dryer drum in the series requires that the paper web be dried only to 50-70% dryness, or it will not cast adequately onto the dryer drum.

It will be understood that modifications and variations may be effected without departing from the spirit and scope of the novel concepts of the present invention.

I claim as my invention:

1. In a device for coating a travelling paper web in a paper machine, a first heated Yankee dryer drum, said first drum having a surface of a solid heat resistant hydrophobe material engaging the web, a first press roll defining a first nip with the underside of said first drum, a first felt running through said first nip for effecting transfer of the web thereat onto the first drum, means associated with said first felt ahead of said first nip applying an aqueous coating to the side of the web to be engaged by said first drum, and a heated dryer drum positioned after said first drum in the travel of said web removing the web from said first drum and completing the drying thereof.

2. In a device for coating a travelling paper web in a paper machine, a first heated Yankee dryer drum, said

first drum having a surface of a solid heat resistant hydrophobe material engaging the web, a first press roll defining a first nip with the underside of said first drum, a first felt running through said first nip for effecting transfer of the web thereat onto the first drum, means associated with said first felt ahead of said first nip applying an aqueous coating to the side of the web to be engaged by said first drum, a second heated Yankee dryer drum, a second press roll defining a second nip with the underside of said second drum, and a second felt running from adjacent said first drum through said second nip to receive the web from the first drum and transfer the web to the second drum.

3. In a device for coating a travelling paper web in a paper machine, a first heated Yankee dryer drum, said first drum having a surface of polytetrafluoroethylene engaging the web, a first press roll defining a first nip with the underside of said first drum, a first felt running through said first nip for effecting transfer of the web thereat onto the first drum, means associated with said first felt ahead of said first nip applying an aqueous coating to the side of the web to be engaged by said first drum, a second heated Yankee dryer drum, and a second press roll defining a second nip with the underside of said second drum transferring the web from the first drum to the second drum at said second nip.

4. In a device for coating a travelling paper web in a paper machine, a first heated Yankee dryer drum, said first drum having a surface of a solid heat resistant hydrophobe material engaging the web, a first press roll defining a first nip with the underside of said first drum, a first felt running through said first nip for effecting transfer of the web thereat onto the first drum, a pair of press rolls associated with said first felt to dewater the web thereon, means positioned between said pair of press rolls and said first nip for applying an aqueous coating to the side of the web to be engaged by said first drum, and a heated dryer drum positioned after said first drum in the travel of said web removing the web from said first drum and completing the drying thereof.

5. In a device for coating a travelling paper web in a paper machine, a first heated Yankee dryer drum, said first drum having a surface of a solid heat resistant hydrophobe material engaging the web, a first press roll defining a first nip with the underside of said first drum, a first felt running through said first nip for effecting transfer of the web thereat onto the first drum, a pair of press rolls associated with said first felt to dewater the web thereon, means positioned between said pair of press rolls and said first nip for applying an aqueous coating to the side of the web to be engaged by said first drum, a second heated Yankee dryer drum, a second press roll defining a second nip with the underside of said second drum, and a second felt running from adjacent said first drum through said second nip to receive the web from the first drum and transfer the web to the second drum.

6. In a device for coating a travelling paper web in a paper machine, a first heated Yankee dryer drum, said first drum having a surface of a solid heat resistant hydrophobe material engaging the web, a first press roll defining a first nip with the underside of said first drum, a first

felt running through said first nip for effecting transfer of the web thereat onto the first drum, a pair of press rolls associated with said first felt to dewater the web thereon, means positioned between said pair of press rolls and said first nip for applying an aqueous coating to the side of the web to be engaged by said first drum, a doctor roll positioned between said means and said first nip urged against the side of the web coated by said means, and heated dryer drum after said first drum in the travel of said web removing the web from said first drum and completing the drying thereof.

7. In a device for coating a travelling paper web in a paper machine, a first heated Yankee dryer drum, said first drum having a surface of a solid heat resistant hydrophobe material engaging the web, a first press roll defining a first nip with the underside of said first drum, a first felt running through said first nip for effecting transfer of the web thereat onto the first drum, a pair of press rolls associated with said first felt to dewater the web thereon, means positioned between said pair of press rolls and said first nip applying an aqueous coating to the side of the web to be engaged by said first drum, a doctor roll positioned between said means and said first nip urged against the side of the web coated by said means, a second heated Yankee dryer drum, a second press roll defining a second nip with the underside of said second drum, and a second felt running from adjacent said first drum through said second nip to receive the web from the first drum and transfer the web to the second drum.

8. In a device for coating a travelling paper web in a paper machine, a first heated Yankee dryer drum, a thin layer of solid heat resistant hydrophobe material mounted on the first drum and defining the casting surface thereof engaging the web, a first press roll defining a first nip with the underside of said first drum, a first felt running through said first nip for effecting transfer of the web thereat onto the first drum, means associated with said first felt ahead of said first nip applying an aqueous coating to the side of the web to be engaged by said first drum, and a heated dryer drum positioned after said first drum in the travel of said web removing the web from said first drum and completing the drying thereof.

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