

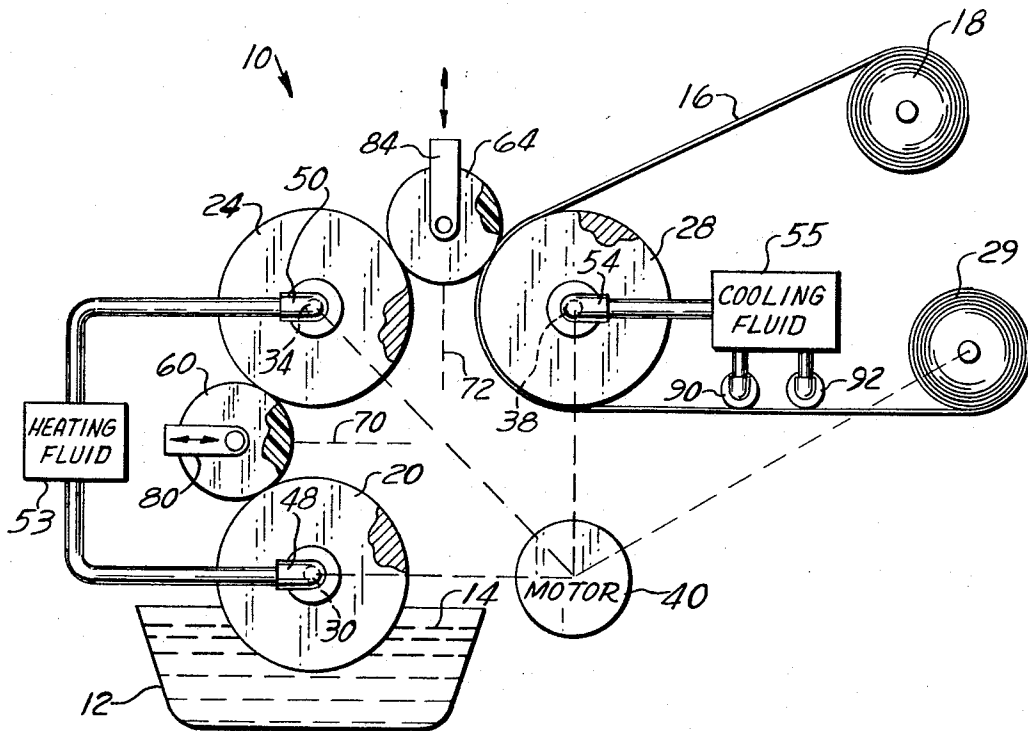
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COATING APPARATUS WITH COOLING BACK-UP ROLL

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COATING APPARATUS WITH COOLING BACK-UP ROLL

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My invention relates to the coating art and, particularly, to improved apparatus for applying decorative, protective, and useful coatings on a substrate.

The apparatus of the present invention has wide utility and may be used to form decorative coatings, for example, such as those used on wallpaper or the like; protective coatings such as coatings of synthetic resinous material or the like, for example, for waterproofing or for other purposes; and useful coatings such as, for example, transfer coatings of the type used in carbon paper. These coatings may be formed on many different types of substrates or webs. A web is a continuous sheet of material generally of single thickness.

The prior art is replete with different types of coating apparatus. However, in general, such coating apparatus cannot successfully and easily coat many different types, grades, and qualities of webs, such as paper, including vary porous papers, with a coating of controllable density and thickness and with little or no readjustment of the coating apparatus required for each type of paper coated. In addition, known apparatus cannot be operated to provide easy control of the amount of material which is coated and the depth of penetration of the coating material into a web, particularly a very porous web.

The speed of operation of most prior art coating apparatus is also subject to criticism. In general, speeds of the order of 80 feet per minute are typical in the prior art, and such speeds are undesirably low. Furthermore, specifically considering coated articles such as carbon paper produced by prior art apparatus, probably the most common criticism of such articles is that they are unpleasant to use because the coated material is never completely set and is readily transferred to the hands of the user.

In addition, there is no relatively simple coating apparatus available in the prior art for applying a material which must be maintained at a relatively high temperature to a sheet or web which is itself sensitive to such temperature or carries a coating which is temperature-sensitive. Furthermore, generally, in prior art apparatus, tension is applied to the web as it is being coated. As a result, many webs, for example, a web of unsupported polyethylene, would react adversely to the tension and could not be coated. An unsupported film of any material is a film which does not have, but generally requires, a supporting substrate.

These problems in the prior art have been solved, for the most part, by the apparatus described and claimed in my copending application Serial No. 127,057 filed July 26, 1961. However, the apparatus of my present invention provides other improvements due, in part, to the fact that the present invention is somewhat simpler in construction and, thus, is easier to set up, adjust, and operate. The improvements in construction provide many advantages which are discussed in detail below.

Accordingly, the objects of the invention are directed to the provision of improved apparatus for coating a web.

Briefly, the apparatus of the invention comprises a first roll which is positioned partly submerged in a tank of coating material and which is known as a fountain roll. A second similar roll is positioned adjacent to, but spaced from, the first roll and serves to transfer coating material to a third roll which is positioned adjacent to, but

spaced from, the second roll and supports the web to be coated during the coating operation. The first, second, and third rolls are all hard-surface rolls which are fixed in position and are positively driven. These rolls are also spaced apart from each other.

The apparatus of the invention also includes means for transferring coating material from the supply tank to the web to be coated by way of the above-mentioned rolls. This means includes a first free-floating roll positioned between the first and second fixed rolls and adapted to be set in frictional contact therewith whereby coating material can be transferred from the fountain roll to the second roll. This means also includes a second free-floating roll positioned between the second and third fixed rolls and adapted to be brought into frictional contact with the second roll and the web carried by the third roll whereby coating material may be transferred from the second roll to the web as a fine uniform coating. The first and second free-floating rolls have a surface of a soft, resilient material.

Means are also provided for regulating the temperature of the various rolls, the arrangement being such that the supply tank of coating materials, the first fountain roll, and the second fixed roll are operated at a relatively elevated temperature to maintain the coating material in a desirably fluid state. The temperature of the third web-supporting roll is adjusted to control the depth of penetration of the coating material into the web being coated. In general, the lower the temperature of the web-supporting roll and the web itself, the less the penetration of the coating material. One or more chill rolls may also be provided following the third web-supporting roll in the coating cycle in order to set the coated material on the web and thus provide a dry, clean coating when the web leaves the coating machine.

In operation of the coating machine of the invention, initially, the first and second free-floating rolls are moved into contact with the fixed rolls with which they are associated and the temperatures of the various rolls are adjusted as required. The first fixed fountain roll picks up a layer of coating material on its surface from the supply tank, and some of the coating material is transferred by the first free floating roll to the second fixed roll. The first free-floating roll provides a metering action in this transfer operation and forms a smooth layer of coating material on the surface of the second roll. Some of this coating material is now transferred, by the second free-floating roll, directly to the surface of the web carried by the third fixed web-supporting roll. A second metering action is preformed in this transfer operation and a thin, smooth coating is formed on the web by the second free-floating roll.

The single figure of the drawing is a side elevational view, partly in section, of coating apparatus embodying the invention.

Coating apparatus 10 embodying the invention may be used for applying a coating of a transfer material, such as an ink, to a paper web, and the following description of the invention is directed toward this use of the apparatus. However, as indicated above, it will be clear to those skilled in the art that invention may also be used for applying many different types of coating materials to many different types of webs other than that specifically described. In addition, the paper which may be coated, may be of substantially any weight or quality, and it may have substantially any degree of porosity.

The coating apparatus 10 includes a tank or vat 12 which contains a supply of a suitable ink 14 to be coated on a paper web 16 which is fed to the apparatus from a supply reel 18. A first rotatable fountain roll 20 is fixed in place horizontally with its surface partly submerged in the coating material in the tank. A second

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rotatable roll 24, an ink transfer roll, is horizontally mounted fixed in place parallel to, and spaced from the first fountain roll 20 and, preferably, vertically above the fountain roll. The apparatus 10 also includes a third rotatable roll 28, a web-supporting roll, which is fixed horizontally in place parallel to the other two rolls and horizontally aligned with, and spaced from, the second coating transfer roll 24. The rolls 20, 24, and 28 all have hard surfaces of stainless steel or the like, and they all have substantially the same diameter.

A take-up reel 29 is also provided for receiving the paper after it is coated.

In operation of the apparatus 10, the hard-surfaced rolls 20, 24, 28 are positively driven, and, for this purpose, they are provided with shafts 30, 34, and 38, respectively, which are suitably coupled to a motor 40. The take-up reel 29 is also positively driven, for example, by coupling to motor 40. In addition, each of the rolls 20, 24, and 28 is adapted to be operated at a controlled temperature, and the desired temperature control is most conveniently achieved by means of a fluid which is circulated through each roll through its shaft which, of course, is hollow. Since the shafts are rotated in operation of the apparatus, suitable fluid-tight couplings 48, 50 and 54 are secured thereto to permit such rotation while allowing the flow of fluid therethrough. These couplings are connected through suitable conduits to sources of heating or cooling fluid as required. Couplings 48 and 50, and rolls 20 and 24, are connected to a source 53 of heating fluid, and coupling 54, and rolls 28, are connected to a source 55 of cooling fluid. Suitable pumping means are provided for circulating the heating and cooling fluid.

According to the invention, means are provided for transferring the coating ink 14 from the tank 12 to the paper sheet 16 by way of the first and second fixed rolls 20 and 24, and this means includes first and second free-floating rolls 60 and 64. These rolls have a soft, resilient surface of rubber or the like, and are henceforth known as first and second rubber rolls. The first rubber roll 60 is horizontally mounted parallel to, and between, the first and second fixed rolls 20 and 24, with its axis aligned with the horizontal center line 70 between the first and second fixed rolls. The second rubber roll 64 is similarly horizontally mounted between, and parallel to, the second and third fixed rolls 24 and 28, with its axis aligned with the vertical center line 72 between the second and third fixed rolls.

Both the first and second free-floating rubber rolls 60 and 64 are mounted on suitable frames represented schematically at 80 and 84, by which the rolls may be moved horizontally and vertically, respectively, into and out of contact with the fixed rolls with which each is associated.

If desired, a plurality of chill rolls 90 and 92 are mounted adjacent to, and following, the roll 28 in the cycle of operation of the apparatus 10.

Considering the various temperatures which may be employed in operation of the apparatus 10, the temperature of the coating material in tank 14 and of the rolls 20 and 24 is sufficiently high to maintain the coating material in a favorably fluid state. Thus, for an ink coating of the type used in making carbon paper, about 200° F. is suitable. The degree of penetration of the coating material into the paper 16 is determined by the temperature of roll 8, and the cooler the roll, the less the penetration of the coating material. The nature of the paper is also a factor. The necessary temperatures for desired operation in each case may be determined easily without extensive experimentation. In one operation of coating a carbon-paper-type ink on a typical paper, such as Kraft paper, a temperature of about 140° F. was used for the web-supporting roll 28, with the chill rolls 90 and 92 operated in the range of about 55° F. to about 65° F.

In operation of apparatus 10, the fountain roll 20, rotating counter-clockwise in the tank 12, as seen in FIG. 1, picks up a layer of coating material 14 on its surface. 75

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Roll 20, in turn, transfers coating material from its surface to the surface of the first free-floating rubber roll 60. The roll 60 then applies the coating material to the surface of the roll 24 which transfers the coating material through rubber roll 64 to the web 16.

During this coating process, the ink is metered between each rubber roll and the two fixed rolls with which each is in contact. In addition, since the rubber rolls are free-floating, particularly roll 64, a thin, smooth, uniform coating of ink is provided on the paper sheet 16.

As described above, the degree of penetration of the coating material into the paper 16 is determined by the temperature differential between the coating material and the paper. The temperature of the coating material is determined, essentially, by the temperature of roll 24, and the temperature of the paper is determined by the temperature of the roll 28. The differential can be adjusted so that the coating material will remain substantially on the surface of the paper 16, or it may penetrate to any desired depth within the paper. The lower temperature of the paper also serves to set the coating preliminarily, and the final set is achieved by chill rolls 90 and 92. The final coating is clean and dry to the touch and is substantially smear-proof.

The present invention has many advantages. One of the most important advantages arises from the fact that a free-floating roll applies the coating material directly to the web. Such a roll, not gear-driven, provides a smoother, more uniform coating than a gear-driven roll. In addition, with four metering surfaces provided between the first hard roll and the first rubber roll, between the first rubber roll and the second hard roll, between the second hard roll and the second rubber roll, and between the second rubber roll and the third hard roll, a thin coating of ink is finally provided on the web. Since there are no large-diameter rubber-surfaced rolls, which must be temperature-controlled, considerable expense is saved in the coating apparatus. Such rolls are expensive and generally unable to maintain their temperature within close limits. In addition, since the relatively large metal rolls are fixed and need not be moved in operation, additional savings are made. Finally, it is estimated that the coating apparatus of the invention should be able to achieve, with little difficulty, a coating speed of about 2,000 ft. per minute.

The apparatus of the invention also has the advantage that it can be used to coat at high speed a wide variety of types and qualities of paper from the best and heaviest papers to paper as thin as florists' wrapping paper or condenser paper. In addition, because of the temperature-control arrangement, the amount and depth of penetration of coating material can be controlled, and, if desired, minimum amounts of the coating material can be used to provide a satisfactory coating.

What is claimed is:

1. A web-coating apparatus comprising
 - a first fountain roll adapted to have its surface partly submerged in a tank of coating material,
 - a second transfer roll spaced from said first fountain roll,
 - a third web-supporting roll spaced from said second transfer roll and supporting a web to be coated, said first, second, and third rolls being rotatable and positively driven,
 - a first free-floating soft-surfaced roll positioned between said first and second fountain and transfer rolls and movable into and out of contact therewith,
 - a second free-floating soft-surfaced roll positioned between said second and third transfer and web-supporting rolls and movable into and out of contact therewith,
 - said first and second soft-surfaced rolls being adapted to be frictionally driven by contact with their associated driven rolls,

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said first fountain roll having its axis horizontally oriented,

said second transfer roll having its axis horizontally oriented and aligned vertically above the axis of said fountain roll, and

said web-feeding roll having its axis oriented horizontally and aligned horizontally with the axis of said transfer roll,

said first free-floating roll having its axis parallel to the axis of the other rolls and positioned on the center line between the axes of said first and second rolls,

said second free-floating roll having its axis parallel to the axes of the other rolls and positioned on the center line between the axes of said second and third rolls.

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2. The apparatus defined in claim 1 and including means for heating said fountain roll and said transfer roll and further including means for cooling said web-feeding roll and the web carried thereby.

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