

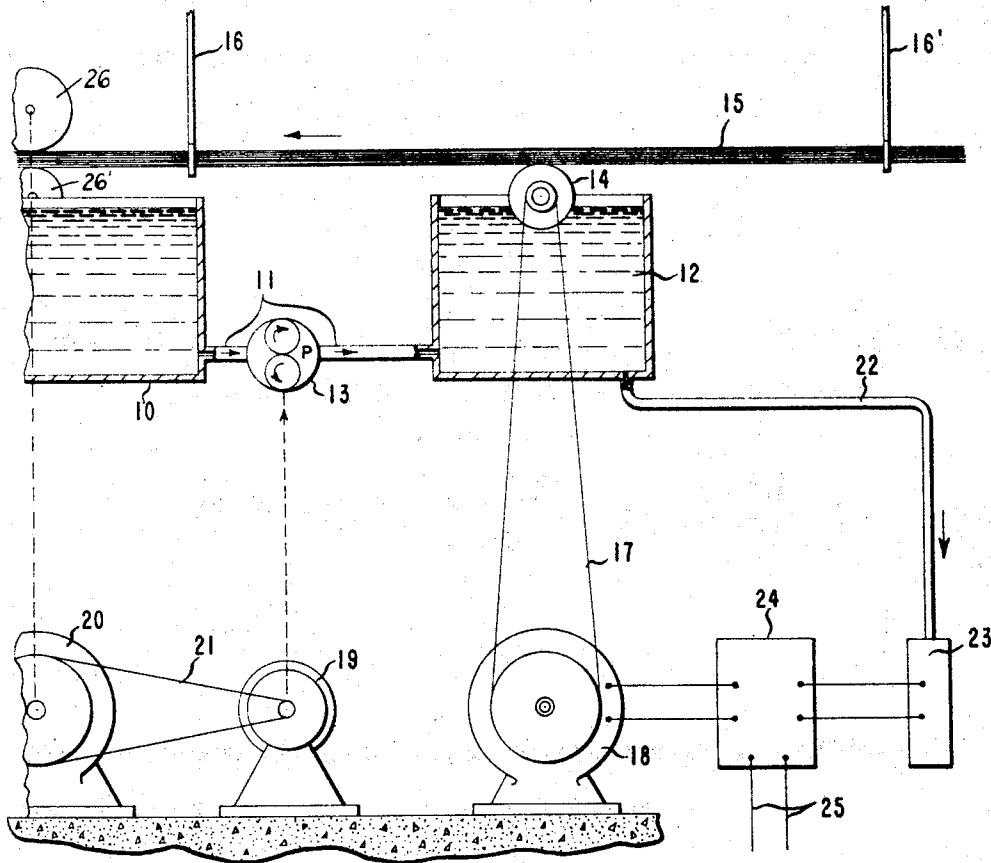
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APPARATUS AND METHOD FOR TREATING FILAMENTARY MATERIAL

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APPARATUS AND METHOD FOR TREATING
FILAMENTARY MATERIAL

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6 Claims. (Cl. 117-111)

This invention relates to apparatus for applying liquids to filamentary material and, more particularly, to means for applying a uniform amount of such liquid to a continuously moving strand.

In applying liquid conditioning agents to moving strands of filamentary materials by known wicking devices, applicator rolls, immersion baths and sprays, it has been difficult to apply accurately predetermined amounts of the conditioning agent uniformly along the material. Changes in the geometrical configuration of the strand, e.g., bunching, changes in the speed of travel of the strand, and changes in the viscosity and surface tension of the conditioning agent all lead to non-uniform application. In addition, in systems which utilize an excess of the agent, variations in both the quality and quantity of finish being applied often occur, due to the mixing and recirculation of the agent after it has contacted the filamentary material.

It is, therefore, an object of the present invention to provide means for applying an accurately predetermined amount of liquid conditioning agent to a moving strand in a uniform manner. Another object of this invention resides in applying a uniform amount of a liquid conditioning agent to a moving strand which may be moving at varying rates of speed or have varying geometrical configurations. Other objects of this invention will be apparent from a consideration of the following detailed description.

The objects of this invention are accomplished by the use of liquid applying apparatus which will be described in connection with the accompanying drawing wherein the figure is a schematic plan view of the apparatus of this invention.

Referring to the drawing, a quantity of liquid conditioning agent is stored in liquid storage tank 10. Tank 10 is, in turn, connected to metering pump 13 and then to liquid reservoir 12 by conduit means 11. A liquid applicator roll 14 is rotatably mounted in reservoir 12 so that it is partially immersed in the liquid.

In operation, a strand of filamentary material 15, supported by guides 16 and 16', is passed over applicator roll 14 which is rotated in reservoir 12 by means of chain 17 which is driven by variable speed motor 18. As roll 14 is rotated, liquid is picked up on its surface and transferred to the moving strand.

A predetermined amount of liquid is continuously metered by positive displacement pump 13 to reservoir 12. The exact amount of liquid is controlled by the speed of travel of strand 15. This is accomplished by the arrangement shown in which pump 13 is indirectly driven through a gear box 19 by a common driving means, motor 20, which drives pull rolls 26 and 26', which move the strand across roll 14. In the embodiment shown in the figure, power from motor 20 is transmitted to gear box 19 by means of chain 21. By selecting a suitable gearing ratio, the rate of flow of liquid from tank 10 to reservoir 12 is regulated to supply the exact quantity of liquid desired to be transferred to the strand, the quantity supplied changing in response to changes in the strand speed.

All of the liquid metered to reservoir 12 is applied to strand 15. As the liquid level rises or falls in the reservoir, the hydrostatic pressure at the bottom of the reser-

voir and in line 22 increases or decreases, thereby activating a pressure responsive control system consisting of a pressure transducer 23 and the variable speed control unit 24 for motor 18. Line voltage is delivered via leads 25 to the control system. In response to the signals from the speed control unit, motor 18 changes speed which in turn changes the speed of roll 14. If the level in the reservoir rises, this indicates that an insufficient amount of liquid is being applied to strand 15. Accordingly, the speed of roll 14 is automatically increased. Similarly, as the liquid level falls, the speed of roll 14 is decreased. The control system is sensitive enough to maintain an essentially constant level in the reservoir.

Comparative tests were conducted using the apparatus of this invention and apparatus which utilized a constant level liquid reservoir and a constant speed applicator roll. In the apparatus of this invention, a Model 174 pressure transmitter, manufactured by the Moore Products Company, Philadelphia, Pa., was positioned at the bottom of reservoir 12. The pneumatic signal from the device was transmitted to a Model 58P4WVC controller, manufactured by the Foxboro Company, Foxboro, Mass., which in turn actuated an air cylinder positioned to drive a 10,000 ohm potentiometer. The signal from the potentiometer was fed to a variable speed motor, manufactured by the Reliance Electric & Engineering Co., Cleveland, Ohio.

In the tests, a 3.0 denier (0.33 tex.), 126,800 filament acrylonitrile fiber tow was passed at a speed of 200 yards per minute across the surface of an applicator roll having a diameter of two inches. The reservoir contained a conditioning agent consisting of a mixture of fatty esters and adipatic hydrocarbons having an average kinematic viscosity of eight centistokes. In each test the conditioning agent was metered at a rate of 136 grams per minute by a positive displacement pump to the reservoir.

After treatment, the conditioning agent was removed by solvent extraction from sections along the tow to determine the uniformity of application in each test. It was found that a 30% improvement in uniformity was obtained using the apparatus of this invention.

Although the present invention has been described with reference to specific driving and control elements, it is to be understood that other known devices which perform the same function may be substituted therefor. Other modifications in the form and construction of the apparatus and the method of using it may likewise be made without departing from the spirit and scope of this invention.

The present invention provides improved results under many circumstances where the uniform application of a conditioning agent has heretofore been a problem, e.g., where the area of the strand contacting the surface of the applicator roll may vary, where the viscosity of the conditioning agent or its surface tension varies, where the angle of contact with the surface of the roll varies, and where the rate of travel of the strand varies, to mention a few. In addition, it will be apparent that since all of the liquid pumped to the reservoir is applied to the strand the build up of impurities in the liquid, due to recirculation and stagnation, does not occur.

I claim:

1. In apparatus for applying liquid to moving filamentary material, the combination comprising a liquid reservoir having an applicator roll rotatably mounted therein, a liquid supply tank, conduit means connecting said reservoir and said tank, a pump disposed in said conduit means for forwarding liquid from said tank to said reservoir, forwarding means for moving said filamentary material across said roll, and driving means for

3

rotating said roll, said forwarding means being operatively connected to said pump to provide a rate of flow of liquid from said tank to said reservoir proportional to the speed of travel of said filamentary material, control means responsive to the level of the liquid in said reservoir operatively connected to said driving means for increasing and decreasing the speed of said roll.

2. Apparatus for applying liquid to a moving strand of filamentary material comprising a liquid reservoir, an applicator roll rotatably mounted in said reservoir, a liquid supply tank, a pump in communication with said tank and said reservoir, means for forwarding said strand across the surface of said roll, said forwarding means being drivingly connected to said pump to provide a rate of flow of liquid from said tank to said reservoir proportional to the speed of travel of said strand, means for driving said roll, and means for automatically increasing and decreasing the speed of said roll to apply a uniform amount of liquid to said strand.

3. Apparatus for applying a predetermined amount of liquid to a moving strand of filamentary material comprising a rotating applicator mounted in a liquid reservoir, means for moving said strand across said applicator, means for supplying liquid to said reservoir at a rate proportional to the speed of travel of said strand, means for driving said applicator, and automatic control means responsive to the level of the liquid in said reservoir for increasing and decreasing the speed of rotation of said applicator.

4. In apparatus for applying a liquid to a moving strand, the combination comprising an applicator roll rotatably mounted in a liquid reservoir, a supply tank in communication with said reservoir, means for forwarding said strand across said roll, a pump for forwarding liquid from said supply tank to said reservoir at a rate proportional to the rate of travel of said strand across said roll, a variable speed motor for driving said roll, a pressure transducer connected to the bottom of said reservoir, and voltage control means operatively connected to said pressure transducer and to said motor for varying the speed of said roll in response to changes in pressure in said reservoir.

4

5. A method of applying to a continuously moving web of material a prescribed amount per unit length of a given substance comprising the steps of moving said web in arcuate contact with part of the surface of a driven roller another part of which dips into a reservoir normally containing a prescribed amount of said substance, feeding said substance in liquid form into said reservoir at a rate proportional to the speed of the web, said rate being constant at a constant speed of the web, sensing any variation in the amount of substance in the reservoir from the prescribed amount, and altering the speed of said driven roller upon sensing any variation in the amount of said substance in the reservoir from the prescribed amount in order to compensate for such variation, said alteration being an increase in the speed of said roller when the amount of substance in the reservoir increases above the prescribed amount and a decrease in the speed of said roller when the amount of substance in the reservoir decreases below the prescribed amount.

6. Apparatus for applying to a continuously moving web of material a prescribed amount per unit length of a given substance comprising a reservoir normally containing a prescribed amount of said substance, a driven furnishing roller mounted for rotation with the lower part of its periphery dipping into said reservoir, means for progressing said web of material with one side thereof in arcuate contact with the upper part of the periphery of said furnishing roller, means for feeding said substance in liquid form into said reservoir at a rate proportional to the speed of said web, said rate being constant at a constant speed of the web, means for sensing any variation in the amount of said substance in said reservoir from the prescribed amount, and means controlled by said sensing means for changing the speed of said driven furnishing roller in order to compensate for such variation.

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