United States Patent

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[54] **ROLL HEATER DEVICE**
4 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **219/469,**
219/244; 28/62; 38/100; 338/218

[51] **Int. Cl.** **H05b 3/02,**
B21b 27/06

[50] **Field of Search** 219/469,
470—471, 244, 388; 338/302—303, 217—218,
268; 38/44, 100—101; 28/62; 57/34

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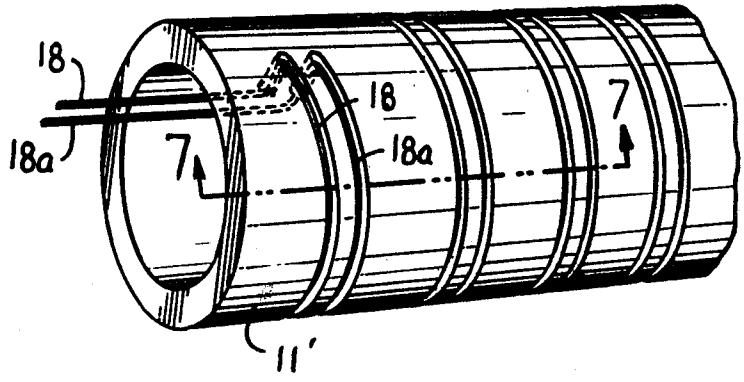
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ABSTRACT: A roll heater device comprising a stationary inner roll having a continuous variable pitch spiral groove along its outer surface of a depth sufficient to accommodate a resistance element, and a rotating sleeve provided over the inner roll in close proximity with the resistance element.



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FIG. 1

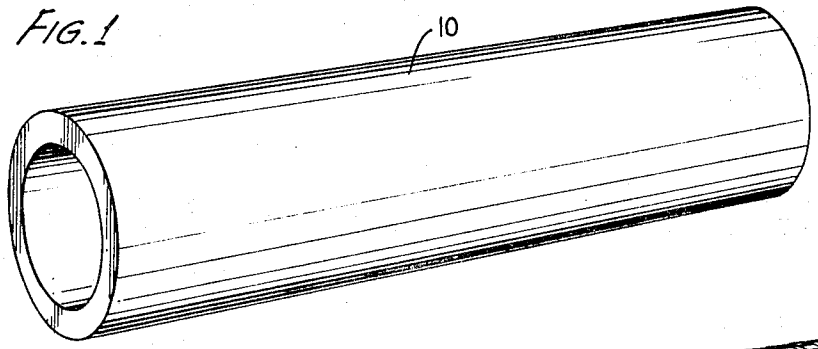


FIG. 2

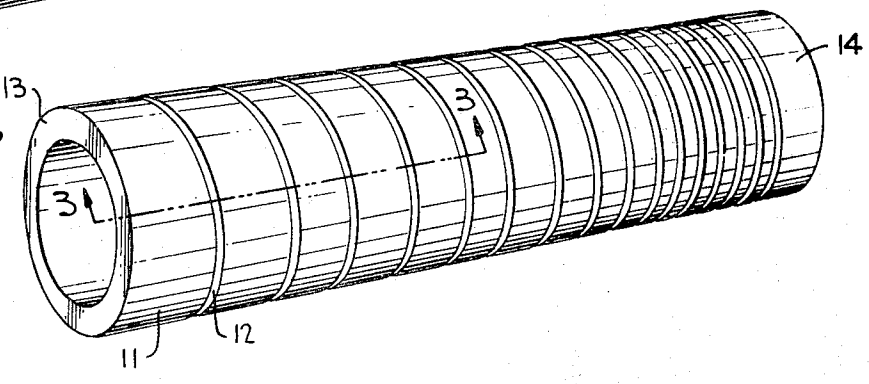


FIG. 3

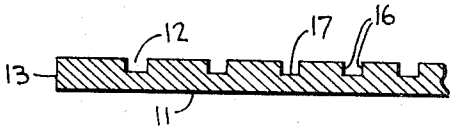


FIG. 4

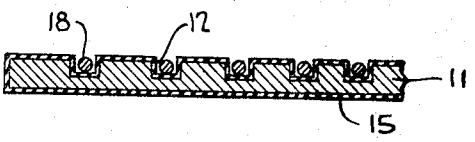


FIG. 5

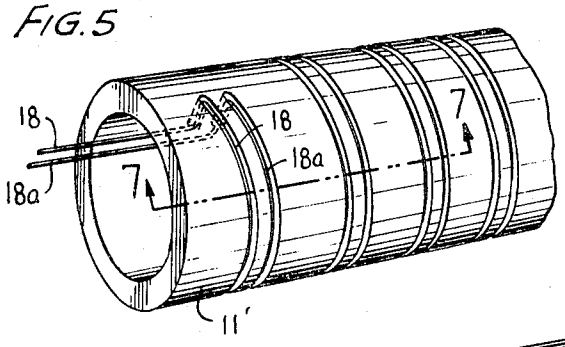


FIG. 7

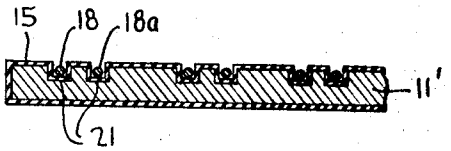
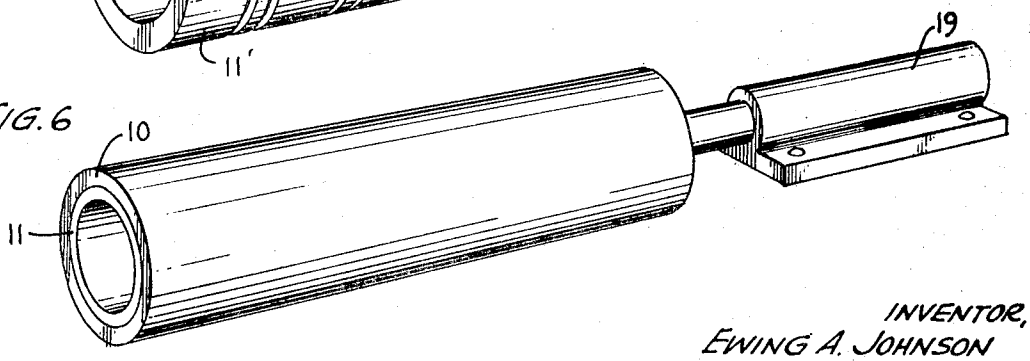


FIG. 6



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ROLL HEATER DEVICE

This invention relates generally to a means for heating rotatable surfaces and more particularly to a means for providing a variable amount of heat between the ends of a roller so that a continuous synthetic fiber may be adequately dried during passage over the roller.

During the manufacture of continuous synthetic fibers or yarns, it is customary to use at least one pair of roller devices spaced from one another so that the fiber may be conveyed in a helical path from one end of each roller to the other end thereof as each roller turns. The fiber or yarn is usually dried in this manner after passing through a reciprocating bath or some other type of wet treatment during the course of manufacture.

Most roll heaters currently available for the manufacture of synthetic fibers do not provide a means for changing the amount of heating along the length of the roller so as to characterize the heater for different temperature profiles presented to the synthetic fiber. On the other hand, those roll heaters which have been designed for such a purpose have been found to transfer heat to the surface over which the synthetic fibers are passed in a manner which is somewhat inefficient for adequately drying the fibers as uniformly and thoroughly as desired.

It is, therefore, an object of the present invention to provide a roll heater for processing a continuous length of fiber in a manner which is uniform and safe throughout the processing operation.

Another object of this invention is to provide a roll heater device for a continuous fiber passing thereover comprising a heating element designed to vary the concentration of heat between a maximum temperature at one end and a minimum temperature at its opposite end so that the greatest amount of heat contacts the filament first when the fibers contains the greatest amount of moisture.

A further object of this invention is to provide a roll heater device of the character described wherein the heating element is an elongated cylindrical tube of uniform cross section having a heater wire or resistor element seated within a continuous variable pitched spiral groove on the outer surface of the tube between both ends thereof so that the heat produced by the resistor will decrease from one end of the tube to the other thereby permitting the moisture content of the fiber to decrease as it passes from one end to the other over a rotatable sleeve provided on the tube.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

FIG. 1 and FIG. 2 are perspective views of the outer sleeve and the inner heating element, respectively, used in accordance with the present invention;

FIG. 3 is a sectional view taken substantially along the line 3–3 of FIG. 2;

FIG. 4 is a sectional view similar to FIG. 3 but showing the provision of electrical insulation means about the heating element and also showing a wire resistance element, in cross section, in place on the heating element;

FIG. 5 is a partial perspective view showing another embodiment of an insulation coated heating element with a pair of resistance elements in place;

FIG. 6 is a perspective view of the assembled sleeve and heating element shown in FIGS. 1 and 2; and

FIG. 7 is a sectional view taken substantially along the line 7–7 of FIG. 5.

Turning now to the drawings wherein like reference characters refer to like and corresponding parts throughout the several views, there is shown in FIG. 1 an elongated cylindrical sleeve member 10 of uniform cross section into which a heating element 11 of equal length, shown in FIG. 2, is disposed in coaxial relationship, as can clearly be seen in FIG. 6 of the drawings.

The heating element 11 comprises an elongated cylindrical tube also of uniform cross section throughout its length. Also, the tube 11 is provided along its outer surface with a continuous spiral groove 12, the groove decreasing in pitch from one end 13 toward its opposite end 14 thereby forming a plurality of nonparallel convolutions separated by the remaining portions of the tube outer surface.

Electrical insulation 15 is provided along the inner and outer surfaces of the tube 11 and, most importantly, along the side walls 16 and bottom wall 17 of the continuous groove 12, as can be clearly seen in FIG. 4. A continuous resistance wire 18 is seated within the coated groove between ends 13, 14 along the tube 11. It should be noted that the heating element or tube may be made from any suitable material which is a good conductor of heat. For example, it may be formed from aluminum or an aluminum alloy so that its surface may be coated with a thin film of an electrically nonconductive layer deposited by the anodizing process which is a good electrical insulator, shown in FIG. 4 as insulation 15. The depth of the groove 12 must be sufficient enough to allow the wire-type resistance element 18 to rest below the outer surface of the tube 11.

Formation of the groove as a spiral having a variable pitch serves to vary the heating characteristics of the heating element along the length of tube 11, since more electrical heating energy is concentrated near end 14 in the closer wound section and gradually decreases toward end 13, as the groove and wire element therein is wound along an increasing spiral pitch toward the end 13.

The tube 11, after being mounted wholly within the sleeve 10 as shown in FIG. 6, is fixed on the shaft of a suitable driving mechanism 19 so that only the sleeve 10 is rotatable about the tube 11 by means of conventional gearing provided in the driving mechanism. Because the resistance wire 18 is sufficiently embedded below the outer surface of the tube 11, the inner surface of the tube 10 is capable of being maintained in close proximity to the wire 18 without actually contacting it. Accordingly, any wear caused by friction between the inner wall of the sleeve 10 and the wire 18 is substantially avoided. Also, because of the proximity between the inner wall of sleeve 10 and the entire length of the resistance wire 18, any substantial loss of transfer of heat between the tube 11 and the sleeve 10 is minimized. Therefore, the continuous synthetic fiber (not shown) which is to be passed over the rotatable sleeve 10 and a like sleeve of a like roll heater device (not shown) spaced from the FIG. 6 assembly, is conveyed in a helical path from one end 14 of the roller to the other end 13 thereof. As the wet fiber begins to pass over the heated portion of the sleeve 10, it is less susceptible to heat so that, if the concentration of heat were not reduced as the moisture content decreased during its travel along the sleeve, the fiber could actually become damaged because the moisture content thereof would be decreasing while the heat intensity would remain constant along the entire length of the roller. Accordingly, it is obvious that the present invention avoids such a danger by varying the heat intensity between opposite ends of the roll heater by simply concentrating a greater amount of resistance wire at one end of a heating element and decreasing the number of wound coils along the length of the heater towards its opposite end. In this way, a high quality yarn is made possible, due to less internal strains in the fiber brought about by a constant decrease in temperature throughout the processing zone.

Referring now to FIG. 5 of the drawings, another embodiment of the heating element is shown characterized by a tube 11', similar in all respects to the tube 11 except that a pair of equally spaced grooves 21 is shown provided along a spiral path having a variable pitch between opposite ends of the tube 11'. Insulation 15 is provided along the inner, outer and grooves surfaces of the tube 11' in the same manner as described with reference to FIG. 4. Also, the resistance type wire 18 is wholly seated within one of the pair of grooves 21 (in the same way as described above) and a second resistance

wire 18*a* is seated wholly within the other of the pair of grooves 21, so that the two electric resistance elements 18, 18*a* may act as a unit for increasing the intensity of heat at each point along the lateral tube without increasing the size of the tube or the size of a single resistance element. Also, this type of arrangement permits the wires 18, 18*a* to be connected in series, parallel or individually, thereby providing a choice to be used with external switching.

From the foregoing, it can be seen that a roll heater device has been designed which is extremely simple in its operation yet highly effective in varying the amount of heat gradually between the ends of the device without any substantial loss of heat transfer between the rotatable sleeve and the fixed tube. The temperature profile along the roll is set as desired by varying the pitch of the spiral groove on the tube or heating element. Such a technique allows the synthetic fiber manufacturers to achieve as high a quality of yarn as necessary depending upon the desired characteristics of heating required.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

I claim:

1. A roll heater device for processing a continuous length of fiber, comprising a rotatable metallic cylindrical sleeve of uniform cross section, an elongated cylindrical heating element of uniform cross section disposed lengthwise within said sleeve in close proximity with the entire inner surface thereof, said heating element comprising a metallic hollow tube having at least one variable pitch spiral groove extending inwardly from the outer surface thereof and along said tube between both ends thereof, said at least one groove forming a plurality of nonparallel convolutions separated by the remaining portions of said outer surface, electrical insulator means on the bottom and side walls of said at least one groove, a continuous wire resistance element lying wholly within said at least one groove, and electrical terminal connecting said wire resistance element to an electrical source of energy, whereby a variable degree of heat is made available along said tube from one said end to the other said end so that heat may be transmitted to said sleeve in an amount which gradually varies between its ends.

2. The device according to claim 1, wherein a pair of equally spaced variable pitch spiral grooves is provided along said tube between both said ends and extending inwardly from said outer surface, said electrical insulation means being provided on the bottom and side walls of each of said pair of grooves, said resistance element lying wholly within one of said pair of grooves and another resistance element lying wholly within the other of said pair of grooves.

3. The device according to claim 1, wherein said electrical insulation means comprises an anodized layer of the oxide of said metallic tube.

4. The device according to claim 2, wherein said electrical insulation means comprises an anodized layer of the oxide of said metallic tube.