Sept. 12, 1967 J. B. R. CARROLL, JR 3,340,617

WEB DRYING

Filed Aug. 18, 1965

FIG. 1

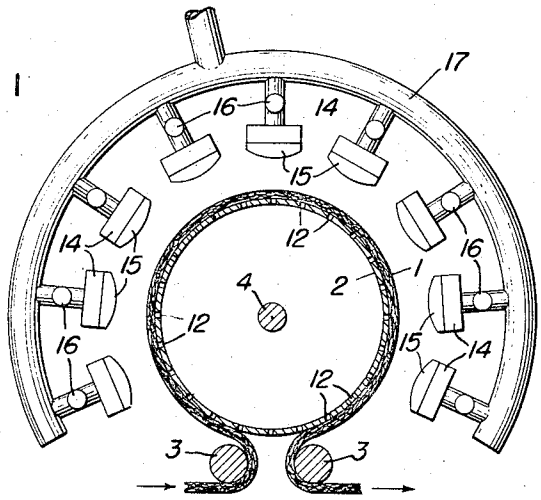


FIG. 2

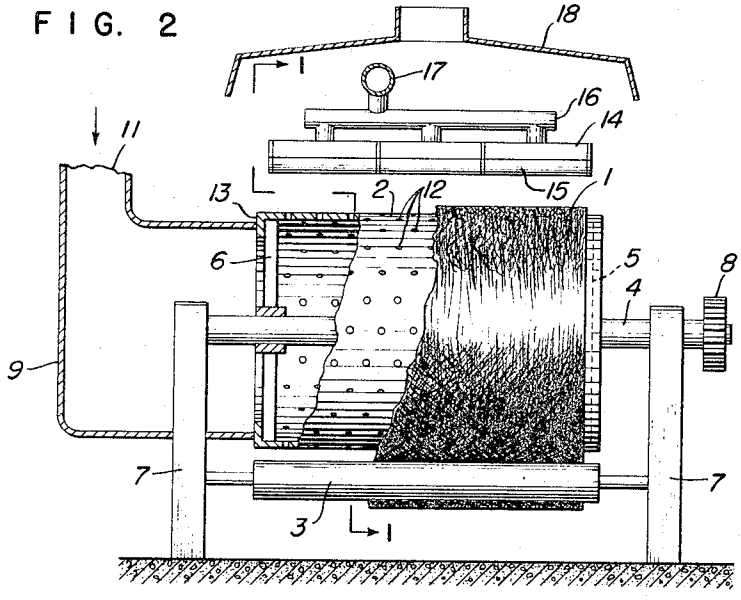
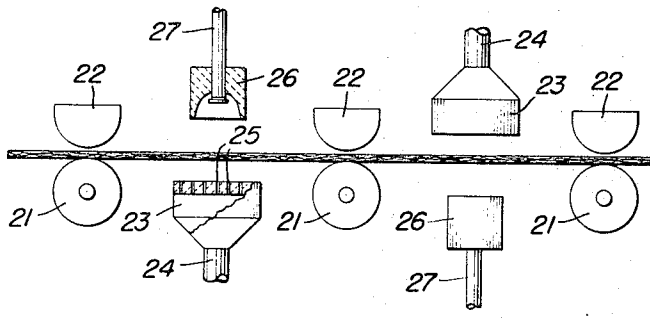


FIG. 3



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WEB DRYING

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ABSTRACT OF THE DISCLOSURE

Fibrous web material is dried by moving it under a high intensity radiant heat source and at the time time forcing heated air through the web toward the heat source.

The present invention relates to drying, and more particularly to the drying of continuous strands or webs of fibrous material such as rayon tow, for example.

It is necessary to reduce the moisture content of many materials during their manufacture, and this can usually be accomplished by heating them. The application of heat to various materials, however, can reduce their value appreciably if it is not done with care. This is particularly true in the drying of materials having a high moisture content and a relatively low scorching temperature. Extreme care is required in drying such materials because of the danger of scorching them or in case hardening the surface so that migration of moisture from below the surface is impaired or stopped.

It is an object of the invention to provide a method and aparatus for rapidly drying a continuous strand or web of fibrous material.

It is a further object of the invention to dry rapidly fibrous or similar material with radiant and convection heat in such a manner that the heat is prevented from scorching the material.

In many cases drying has been accomplished by guiding the moist fibrous material over a perforated drum. Heat has then been directed against the material moving on the drum to evaporate the moisture. At the same time air has been drawn through the material into the drums and discharged. This type of operation has the disadvantage that the air between the source of heat and the material is dry thus permitting the full intensity of the heat to strike the material. If the material has a relatively low scorching temperature, for example, the heat must be applied in such a manner that the drying process is relatively slow so that the material will not be damaged.

In practicing the present invention, the material to be dried is guided over a perforated surface, and under a source of radiant heat of high intensity directed toward it. Air, which may be heated, is blown through the material toward the radiant heat source to drive and carry moisture from the material to be evaporated, and also to protect the material from scorching.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a view partly in section taken on line 1—1 of FIG. 2;

FIG. 2 is a view partly in section taken from right of FIG. 1; and

FIG. 3 shows a modified form of the invention.

Referring to FIGS. 1 and 2 there is shown a web 1 of fibrous material, which can be rayon tow or a fabric, that

is to be dried. The material is directed around a drum 2 by guide rollers 3. The drum is mounted on a shaft 4 by means of a solid disc 5 and a spider 6, with the shaft being journaled for rotation in supports 7. The drum can be rotated by passage of material around it or by means of a suitable drive through a gear 8 on the end of shaft 4.

Air, under pressure, is supplied to the interior of drum 2 through a housing 9 having an intake 11. The end of this housing engages a flange 13 on the end of drum 2 and is provided with some suitable seal so that the leakage of air around the end of the housing is negligible. Air escapes through perforations 12 that are closely spaced over the surface of the drum and passes in a substantially uniform manner through the layer of material thereon.

Radiant heat is directed against the exterior of the drum and the material thereon from a plurality of burners 14 which produce high intensity radiant heat. These burners may be of any suitable type but are preferably of the type shown in Williams et al. Patent No. 3,199,570. These burners are provided with a screen 15 on the front thereof which is heated to incandescence by means of combustion back of this screen. This screen directs the heat against the drum. The burners are made in units with the units being placed end to end as shown best in FIG. 2 so that they are substantially equal to the length of drum 2. Individual rows of burners are mounted on pipes 16 with the various pipes being fastened to a substantially circular manifold 17. The arrangement is such that a plurality of burners are located in rows around the periphery of drum 2 with the burners being spaced from 1½ to 5 inches away from the surface of the drum. There may be provided, if desired, a hood 18 over the entire apparatus through which the moisture driven from the material being dried, can be withdrawn from the environment of the apparatus.

In the operation of the apparatus, air, which may be heated to about 200° F. is blown outwardly through openings 12 of drum 2 to pass evenly through the material thereon. Burners 14 are ignited and the screens 15 heated to incandescence, about 1575° F., with the heat being directed toward the material. The air, being below the wet bulb temperature, will carry evaporated moisture with it as it leaves the material. The evaporation of the moisture in the air plus evaporation of the additional water, or other liquid, which is carried or migrates to the surface of the material will keep the temperature of the material below the scorching point. Thus, during the entire drying period the surface of the material is moist. This not only protects the surface from the intense heat, it helps to speed up the drying process appreciably. The material may be passed successively over a series of drums if desired, the number depending upon the speed of the material, its original moisture content and the desired final moisture content.

Another form which the invention may take is shown in FIG. 3. In this form, the web of material is supported as it travels through a path, by means of a plurality of rollers 21 and the web is held against this plurality of rollers by a series of guides 22 which may be stationary or also may be in the form of rollers.

Between the first pair of rollers and below the web, there is a duct 23 that is supplied with air through a pipe 24. The upper surface of the duct, facing the material, is provided with a plurality of openings 25 through which air may be forced to flow substantially throughout the area of the material passing over the duct. In this case, radiant heat is directed against the upper surface of the material from a conventional radiant cup type burner 26 that is supplied with a fuel and air mixture through a pipe 27. Operation of this type of burner is well known. It is noted that the duct 23 will extend in a direction perpendicular to the plane of the drawing for a length at

least equal to the width of the web of material being dried, and that the burners will be placed side by side to form a row of burners at least equal to the width of the web of material.

Between the second and third rollers 21 there is provided a duplicate air duct and burner arrangement except that in this case, the air duct is above the web of material and the air is blown downwardly while the burners are below the web and direct their heat upwardly. In this fashion moisture is removed alternately from opposite sides of the web as it is moving through the apparatus. Obviously, as many of the duct and burner units as are necessary may be used. In each case, however, they will be reversed so that air will first flow upwardly then downwardly through the web of material in order to obtain even drying.

The operation of this form of invention is the same as that previously described as far as the drying and the final product is concerned. In the case of some types of fibers, however, more effective and rapid drying may be obtained by the reversal of the flow of air through the material. This feature may also be obtained with the apparatus of FIGS. 1 and 2 by suitably locating the drums and guiding the material.

Thus it will be seen that I have provided a method and apparatus by means of which a mat or web of fibrous material can be rapidly dried without scorching or otherwise harming the material.

While in accordance with the provisions of the statutes I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of the invention set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. The method of drying a fibrous material which comprises providing a source of radiant heat at a temperature above that required to evaporate moisture in the material, moving the material directly through the path of the radiant heat emanating from said source at a distance from the source so that the heat is of an intensity normally to damage the material, and blowing air through the material toward the source of heat.

2. The method of drying a fibrous material which comprises forming the material into a web, moving the web through a path, providing a source of radiant heat at a temperature high enough to evaporate the moisture in the web, directing the radiant heat toward and directly against one face of the web as it is moving through a portion of said path, and blowing air through the web from the other face thereof toward said source of radiant heat as the web moves through said portion of said path.

3. The method of drying a fibrous material which comprises continuously moving said material in a wet condition over a surface having a multiplicity of openings therein, forcing air through said surface into and through said material to evaporate moisture therein, directing radiant heat of at least a sufficient temperature to evaporate the moisture directly toward the material carried by said surface to evaporate the moisture in the material directly and withdrawing the moisture laden air.

4. The method of drying fibrous material which comprises moving the material to be dried in the form of a web having opposite surfaces through a path, at a first location along said path directing radiant heat against one surface of said material, blowing air through said material at said location from the opposite surface toward the source of radiant heat, at a second location along said path directing radiant heat against said opposite surface of the material, and at said second location blowing air through said material from said first mentioned surface toward said opposite surface and said second mentioned source of radiant heat.

5. Apparatus for drying a web of fibrous material comprising in combination a hollow cylinder having a surface provided with a multiplicity of openings, means to guide a web of fibrous material around a portion of said cylinder, means to supply air to the interior of said cylinder to flow outwardly through said openings and the web passing around said cylinder, a plurality of burners of a type operative to produce radiant heat, and means to mount said burners to direct heat produced by them directly against the exterior of that portion of said cylinder around which the web is guided.

6. Apparatus for drying a fibrous material comprising in combination, means forming a path through which the material is moved, a perforated member over which the material moves located along said path, means to force air through the perforations of said member and the material in front thereof, a device for producing radiant heat, and means to mount said device at said location on the opposite side of said material from and directly opposite said perforated member whereby radiant heat will be directed toward said material in opposition to the air flowing from said member and toward said device.

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