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METHOD OF DRYING FIBROUS MATERIAL

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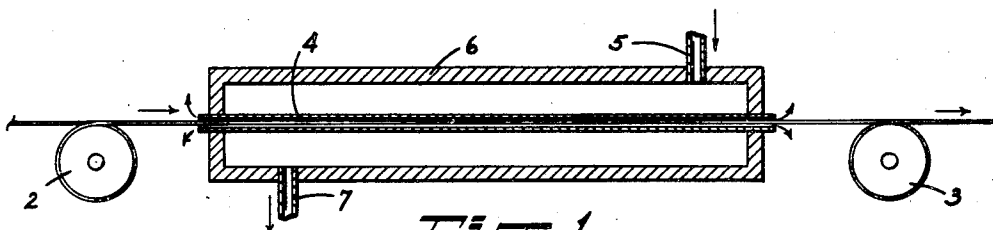


Fig. 1

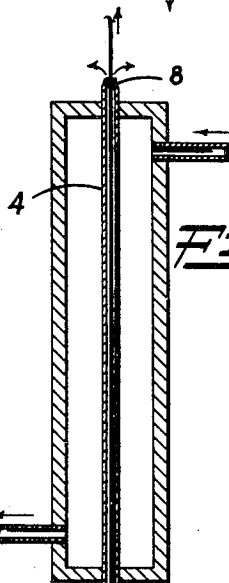


Fig. 2

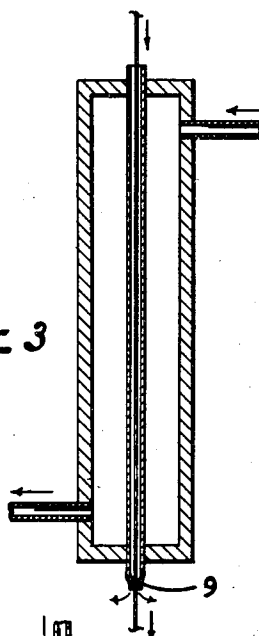


Fig. 3

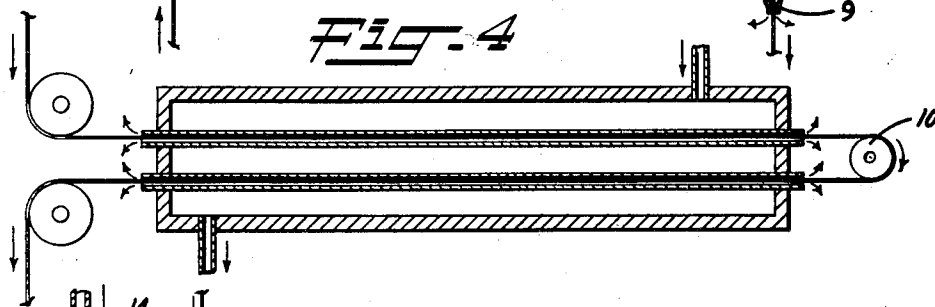


Fig. 4

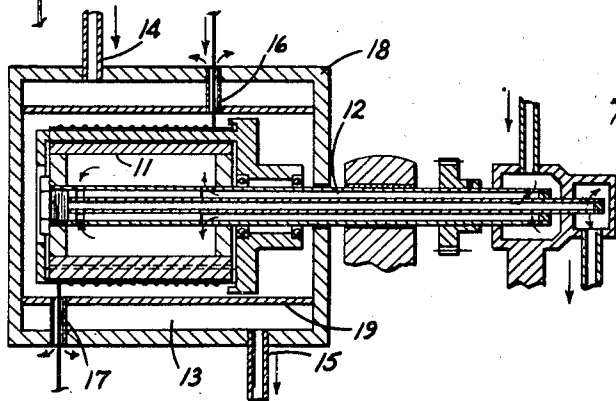


Fig. 5

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METHOD OF DRYING FIBROUS MATERIAL

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The present invention relates to drying of fibrous material having an indefinite length and at least one relatively thin dimension, such as yarns, ribbons, thin continuous felts, papers and the like. The invention is of special advantage for the drying of articles made of hydrophilic material, such as regenerated cellulose, polyvinyl alcohol, partially saponified cellulose esters and partially saponified polyvinyl acetates.

The conventional procedures for drying continuous articles of indefinite length while traveling, such as subjecting the traveling articles to radiant heat or to blasts of heated air or other heated gases, must be carefully controlled in order to prevent excessive dehydration and in some cases scorching of the material or of finishes carried upon the material. Sometimes it is desirable to leave a predetermined amount of moisture in the article rather than to leave it bone-dry, and when trying to accomplish this object by prior processes, it has been necessary to control the amount of moisture contained in the article at the time it enters the dryer, the speed of the article, as well as the temperature of the drying medium, or when using radiant heat, the power input. In addition, the moist articles are frequently in contact with conveying surfaces while they contain insufficient moisture to serve as a lubricant. When this is the case while drying hydrophilic materials such as regenerated cellulose, it is found that the articles intermittently stick to or become bound to the surfaces over a certain moisture content range e. g. about 30 to 180% water content and hinder relative smooth movement when that is desired.

It is the object of the present invention to provide an improved method of drying continuously traveling articles of indefinite length having at least one relatively thin dimension in which the article is passed through a channel in which it is heated, such as by heat radiated from the channel wall or walls, to evaporate the particular liquid carried into the drying zone by the article until the moisture content of the article approaches equilibrium with the vapor in the channel, maintaining the article at least during its period of travel in the channel beyond the stage where it approaches equilibrium and, preferably, throughout its travel in the heated channel, in a blanket of such vapor and then removing the article from the channel with some of the vapor directly into a relatively unheated atmosphere where the accompanying vapor is dissipated. By thus maintaining the vapor in contact with the article substantially at atmospheric pressure after

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reaching equilibrium with the vapor in the heated channel, a rapid drying can be effected without danger of scorching or burning of the article. Since the heating surfaces defining the channel constituting the drying zone can be brought to any temperature whatsoever in excess of the boiling point at the prevailing atmospheric pressure of the liquid carried by the yarn entering the drying zone, by maintaining the temperature of the channel defining surfaces in excess of the boiling temperature, sticking of the articles to the surfaces is prevented, since any small amount of moisture carried by the article is explosively evaporated at points of such contact, thereby driving the article out of contact with the surface, or if the thread is held against the metal surface by tension, the yarn surface is quickly dried to a moisture content below which sticking does not occur. As the articles emerge from the drying channel, they may rub over smooth heated surfaces, such as over the interior surface of the channel itself or of metallic guides extending across the channel. The invention is of special advantage for the drying of hydrophilic materials, since it inherently prevents the attainment of bone-dry condition. As the article emerges from the vapor blanket in the heated channel, it retains a small proportion of moisture in equilibrium with the vapor. This equilibrium proportion is appreciable but is generally much less than the proportion of moisture that the article normally contains in equilibrium with the ordinarily prevailing atmosphere of normal humidity, e. g. 60% relative humidity and is easily reproducible since the yarn is in contact with a vapor blanket of reasonably definite conditions. Consequently, the hydrophilic material is left with a small proportion of moisture which approaches that with which it is normally associated at normal atmospheric conditions. Thus, the internal strains which are undergone by articles dried by the conventional processes heretofore used, in which the articles are brought to a bone-dry or nearly bone-dry condition and then are allowed to regain moisture when exposed to the normal atmospheric air are avoided. This enables the immediate collection of a tighter wound package or cone than is possible from a bone-dry yarn since bone dry rayon undergoes considerable elongation upon regaining the first few percent moisture. Further advantages and objects of the invention will be apparent from the description hereinafter.

In the drawing illustrative of the invention—

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Figure 1 illustrates in cross section one embodiment for executing the invention.

Figure 2 shows in cross section a second embodiment.

Figure 3 illustrates in cross section a third embodiment.

Figure 4 illustrates in cross section a still further modification, and

Figure 5 illustrates in cross section still another modification.

Referring first to Figure 1, the invention is illustrated as applied to the drying of a continuously traveling yarn. The yarn may be drawn by means of positively driven rotors or godets 2 and 3 through a narrow drying zone within a tube 4. The tube is jacketed and any heating medium, such as steam, at temperatures in excess of the boiling point of the liquid carried by the yarn, is introduced into the jacket by means of a pipe 5. The jacket may be insulated by the lining 6 and a condensate discharge 7 is also provided. Where the yarn carries moisture in the form of water, the heating fluid introduced into the jacket surrounding the tube 4 is at a temperature above 100° C. Depending upon the speed of passage of the yarn through the tube and the length of the tube, any temperature from about 110° C. up may be used. Preferably, temperatures of 140° to 200° C. or higher are used, since a shorter length of tube and a faster speed of the yarn may be used, while assuring that substantially all of the moisture carried by the yarn is brought into the vapor state except the equilibrium amount carried thereby, that is, the amount held by the yarn in equilibrium with the surrounding vapor at substantially atmospheric pressure. Illustratively, a yarn of 300 denier regenerated cellulose containing 130-150% water traveling at 60 meters per minute can be handled in a tube 30 feet in length when the heating medium used is steam at 180° C. The steam used to heat the tube may either be superheated at atmospheric pressure, or it may be a high pressure saturated or superheated steam. Under these conditions vapor flows out from and is dissipated adjacent both ends of the tube 4 throughout the drying and the yarn leaving the tube contains about 4 to 5% moisture. Upon entering the outside atmosphere, however, some of this moisture is lost by evaporation (cooling of yarn in air) so that the final moisture content of the collected package is approximately 3%. This final value can be increased to 6% or reduced to 2% by the proper control of conditions.

In Figure 2, the arrangement of Figure 1 is disposed so that the yarn travels substantially vertically upwardly. As shown, the tube 4 may have its upper end restricted somewhat as shown at 8 to assure that the vapor from the yarn will escape from the top of the tube at a sufficiently slow rate as to assure that the yarn beyond the point in the tube where equilibrium is attained is surrounded in a blanket of vapor which completely and exclusively fills the tube. Preferably, the entire length of the tube is filled with saturated vapor so that some must escape from the bottom as well. This arrangement is useful when drying water moist articles, since steam has a lower density than air.

In Figure 3, the arrangement is adapted to dry articles containing liquids whose vapor density is greater than that of air. Instead of constricting the top opening of the tube 4, in this case, the lower opening of the tube is restricted as at 9. An arrow is shown to indicate downward travel

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of the article, though in all of the figures shown, if conditions are so controlled as to completely fill the entire length of the tube with vapor, the yarn or other article may travel in either direction.

While in Figures 1 to 3, there is shown only one passage of the article through a drying zone, the invention contemplates modifications which include a plurality of passages when, for want of space, it may be preferable to pass the material through several distinct passages. To save space, a U-shaped passage or tube may be provided and the yarn may enter one free end of the U and exit from the other free end thereof. In such case, the entire surface of the U-tube is heated, so that the yarn or other article is surrounded by vapor beyond the point of attainment of equilibrium, and preferably throughout its passage therethrough, and vapor is emitted from at least the yarn discharge end or from both free ends of the tube. Alternatively, as shown in Figure 4, the curved end of the U-tube may be removed and the yarn or other article may emerge from one passage or tube into the open atmosphere before attainment by the yarn of an equilibrium moisture condition. Then, the article may pass about an idling roller or godet 10 and enter a second tube in which completion of the vaporization occurs. As in previous embodiments, vapor emerges from the yarn discharge end or from both ends of all of the tubes constituting the drying passage. In the arrangement in Figure 4, the two tubes may be heated separately, for example, the top tube at a higher temperature to speed up drying, and the other at a lower temperature to enable a higher, final yarn moisture content.

While the description of Figures 1 to 4 has concerned itself mainly with yarns, it is within the contemplation of the invention to provide instead of a cylindrical tube 4 one of rectangular cross section, with restricted rectangular orifices when desired, to accommodate a thin ribbon or paper or thin felt. Again, a plurality of yarns may be sent through a single tube side by side in the form of a flat ribbon or as a three-dimensional bundle. In either of these cases suitable guides may be provided adjacent the entrance and exit of the passage or passages to separate the individual yarns to any extent desired. While the cross-sectional dimensions of the channel through which the yarn passes is not critical, for reasons of economy it is preferred to make the channel as narrow as possible.

Figure 5 illustrates an embodiment in which a yarn is advanced through a helical path, such as by a thread-advancing device, a reel being shown. The reel has an inner sleeve 11 within which a pipe 12 extends and may serve to introduce a heating medium, such as steam, at the desired temperatures. The reel is housed within a jacket 13 provided with connections 14 and 15 for entrance and discharge of a suitable heating medium. The jacket and housing may be provided with yarn entrance and exit 16 and 17 respectively and it may be suitably insulated. The upper wall 18 and the outer end wall 19 may be hinged to the remainder of the housing to facilitate lacing up by an operator. As in the previous embodiment, the heating fluid provided internally and externally of the reel serves to raise the surfaces defining the drying zone or channel for the yarn to a temperature in excess of the boiling point at the prevailing atmospheric pressure of the liquid carried by the yarn as it enters

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and vapor escapes through the yarn exit, and preferably from both yarn entrance and exit. As the yarn passes through the drying zone, it is surrounded by the vapor blanket and approaches an equilibrium therewith, after which it emerges into the unheated atmosphere outside the housing, where it is left with the equilibrium content of moisture.

While the embodiments hereinabove described have been described in connection with yarns carrying water, the invention is applicable as well to articles carrying other liquids which it is desired to remove from them. In such cases, the heating medium used is at a temperature sufficiently high to bring the heating surfaces surrounding the channel constituting the drying zone to a temperature in excess of the boiling point of the particular liquid to be removed at the prevailing atmospheric pressure. The term "moisture" is intended to refer to any liquid, whether aqueous or non-aqueous.

It will be seen that by assuring that vapor escapes from the drying zone at least at the article exit and preferably at both the entrance and exit of the articles, no condensation of vapor upon the yarn can occur after it has attained its equilibrium condition, and the yarn emerges from the vapor blanket with a definite moisture content. This moisture content is always appreciable, and does not vary widely with varying temperatures of the vapor, so that even if a certain amount of superheating of the vapor blanket surrounding the article occurs before the article emerges from the drying zone, there is no great variation in the final moisture content left on the yarn when it enters the unheated atmosphere. This fact that a certain small proportion of moisture is never removed from the yarn is especially advantageous in connection with the production of hydrophilic materials such as yarns of regenerated cellulose from viscose or cuprammonium cellulose, since it has been found that if such yarn is first dried to a bone-dry condition and then allowed to regain the 11% water which is the approximate equilibrium moisture content at normal atmospheric conditions, irregular shrinkages and internal strains develop which seriously affect the properties of the final yarns and are particularly detrimental to dyeing characteristics. Preferably, when passing yarns of regenerated cellulose through the drying zone, they are under a minimum of tension. If desired, however, any degree of tension may be placed on the yarns as they proceed through the zone and, in certain cases, it has been found, especially when dealing with artificially produced filaments of regenerated cellulose or of any other material which are undergoing their first drying that certain irregularities resulting from the spinning and/or processing operations can be leveled out and substantially eliminated if a constant tension such as between about 0.01 and 1 gram/denier is placed upon the material, the magnitude of the tension depending upon the particular nature of the filaments, the process of spinning, and the desired combination of strength and extensibility. There is no opportunity for sticking of the yarns to surfaces of the drying zone, and provided the temperature is below the decomposition temperature of the material there is no danger of scorching or burning the yarns even when high temperatures of the heating surface or surfaces defining the channel are used, since the yarns always retain a small percentage of moisture in equilibrium with the vapor.

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It may be desirable in some cases to introduce into the channel near the end from which the material being dried is discharged additional vapor to supplement that produced by vaporization of the moisture carried into the channel by the material. The vapor should be the same as that obtained from the particular liquid carried by the material. For example, when a water-wet yarn is dried in the system of Figure 1 and steam is employed for heating the channel, some of this steam may be introduced into the channel by providing small openings in the tube 4 to communicate with the space within the jacket adjacent the discharge end of the tube 4.

The invention is especially useful for the drying of yarns of artificial filaments, such as regenerated cellulose, produced by a continuous process in which event the drying is accomplished immediately after completion of the normal after-treatments of the yarns with liquids. In all such embodiments, it is to be noted that the prevailing atmosphere of the spinning room may be at a temperature somewhat higher than what is normally considered room temperature. In the claims, it is intended that the terms "unheated atmosphere" and "prevailing atmosphere" include within their scope such warm atmospheres as commonly prevail in spinning rooms as well as the normal room temperature conditions.

Whereas the channel walls are described herein as being heated by fluids, in jackets provided therearound, it is to be understood that other heating means may be provided, such as electrical heating devices.

In the present specification and the claims, it is to be understood that the term "drying" is not intended to be restricted or to necessarily mean entirely removing all liquid from the articles with reference to which the process is performed. Rather, the term is used to denote the removal of moisture, whether water or other liquid, to a sufficient extent that the resulting article feels dry and contains no more than the amount of moisture normally contained by the article in equilibrium with the prevailing atmosphere.

It is to be understood that changes and variations may be made in the invention without departing from the spirit and scope of the appended claims.

I claim:

1. The method of drying fibrous articles of indefinite length and having at least one small dimension comprising continuously passing the moisture-laden article through a substantially closed channel having an entrance and exit for the article, maintaining the walls of the channel at a temperature above the boiling point of the liquid carried by the article at the prevailing atmospheric pressure in the vicinity of the entrance and exit of the channel, evaporating the liquid on the article as it passes through the channel while maintaining the vapor in contact therewith until the moisture-content throughout the article closely approaches an equilibrium condition with respect to the vapor in the channel and discharging the article from the channel while enveloped with some of the vapor into an unheated atmosphere in which the vapor is freely dissipated while leaving the article in a dry condition but with an appreciable amount of moisture therein.

2. The method of drying fibrous articles of indefinite length and having at least one small dimension comprising continuously passing the moisture-laden article through a substantially closed channel having an entrance and exit for

the article, maintaining the walls of the channel at a temperature above the boiling point of the liquid carried by the article at the prevailing atmospheric pressure in the vicinity of the entrance and exit of the channel, evaporating the liquid on the article as it passes through the channel while maintaining the vapor in contact therewith until the moisture-content throughout the article closely approaches an equilibrium condition with respect to the vapor in the channel, maintaining the channel at least from the region where equilibrium is closely approached to the exit full of the vapor thus developed thereby substantially excluding the atmosphere outside the channel from entering it adjacent the article exit, and discharging the article from the channel while enveloped with some of the vapor into an unheated atmosphere in which the vapor is freely dissipated while leaving the article in a dry condition but with an appreciable amount of moisture therein.

3. The method of drying water-laden hydrophilic artificial filaments comprising continuously passing the wet filaments through a substantially closed channel having an entrance and exit for the filaments, maintaining the walls of the channel at a temperature above 100° C., evaporating the moisture on the filaments as they pass through the channel while maintaining the vapor in contact therewith until the moisture content of the filaments closely approaches an equilibrium condition with respect to the vapor, maintaining the channel at least from the region where equilibrium is closely approached to the exit full of the vapor thus developed thereby substantially excluding the atmosphere outside the channel from entering it adjacent the article exit, and discharging the filaments from the channel while enveloped with some of the vapor into a relatively unheated atmosphere in which the vapor is freely dissipated while leaving the filaments in a dry condition but with an appreciable amount of moisture therein.

4. The method of drying water-laden hydrophilic artificial filaments of regenerated cellulose comprising continuously passing the wet filaments through a substantially closed channel having an entrance and exit for the filaments, maintaining the walls of the channel at a temperature of about 140 to 200° C., evaporating the moisture on the filaments as they pass through the channel while maintaining the vapor in contact therewith until the moisture content of the filaments closely approaches an equilibrium condition with respect to the vapor, maintaining the channel at least from the region where equilibrium is closely approached to the exit full of the vapor thus developed thereby substantially excluding the atmosphere outside the channel from entering it adjacent the article exit, and discharging the filaments from the channel while enveloped with some of the vapor into a relatively unheated atmosphere in which the vapor is freely dissipated while leaving the filaments in a dry condition but with an appreciable amount of moisture therein.

5. The method of drying water-laden hydrophilic artificial filaments comprising continuously passing the wet filaments through a substantially closed channel having an entrance and exit for the filaments, maintaining the walls of the channel at a temperature above 100° C., evaporating the moisture on the filaments as they pass through the channel while maintaining the vapor in contact therewith until the moisture

content of the filaments closely approaches an equilibrium condition with respect to the vapor, maintaining the channel at least from the region where equilibrium is closely approached to the exit full of the vapor thus developed thereby substantially excluding the atmosphere outside the channel from entering it adjacent the article exit, and discharging the filaments from the channel while enveloped with some of the vapor into a relatively unheated atmosphere in which the vapor is freely dissipated while leaving the filaments in a dry condition but with an appreciable amount of moisture therein.

6. The method of drying water-laden hydrophilic artificial filaments of regenerated cellulose which have not previously been dried comprising continuously passing the wet filaments through a substantially closed channel having an entrance and exit for the filaments, maintaining the walls of the channel at a temperature of about 140 to 200° C., evaporating the moisture on the filaments as they pass through the channel while maintaining the vapor in contact therewith until the moisture content of the filaments closely approaches an equilibrium condition with respect to the vapor, maintaining the channel at least from the region where equilibrium is closely approached to the exit full of the vapor thus developed thereby substantially excluding the atmosphere outside the channel from entering it adjacent the article exit, and discharging the filaments from the channel while enveloped with some of the vapor into a relatively unheated atmosphere in which the vapor is freely dissipated while leaving the filaments in a dry condition but with an appreciable amount of moisture therein.

7. The method of drying fibrous articles of indefinite length and having at least one small dimension comprising continuously passing the moisture-laden article through a substantially closed channel having an entrance and exit for the article, maintaining the walls of the channel at a temperature above the boiling point of the liquid carried by the article at the prevailing atmospheric pressure in the vicinity of the entrance and exit of the channel, evaporating the liquid on the article as it passes through the channel while maintaining the vapor in contact therewith until the moisture-content of the article is reduced to 2 to 6% based on the weight of the article, and discharging the article from the channel while enveloped with some of the vapor into an unheated atmosphere in which the vapor is freely dissipated while leaving the article in a dry condition but with an appreciable amount of moisture therein.

8. The method of drying fibrous articles of indefinite length and having at least one small dimension comprising continuously passing the moisture-laden article through a substantially closed channel having an entrance and exit for the article, maintaining the walls of the channel at a temperature above the boiling point of the liquid carried by the article at the prevailing atmospheric pressure in the vicinity of the entrance and exit of the channel, evaporating the liquid on the article as it passes through the channel while maintaining the vapor in contact therewith until the moisture-content of the article is reduced to 2 to 6% based on the weight of the article, maintaining the channel at least from the region where the article reaches the 2 to 6% moisture range to the exit full of the vapor thus developed thereby substantially ex-

cluding the atmosphere outside the channel from entering it adjacent the article exit, and discharging the article from the channel while enveloped with some of the vapor into an unheated atmosphere in which the vapor is freely dissipated while leaving the article in a dry condition but with an appreciable amount of moisture therein.

9. The method of drying water-laden hydrophilic artificial filaments comprising continuously passing the wet filaments through a substantially closed channel having an entrance and exit for the filaments, maintaining the walls of the channel at a temperature above 100° C., evaporating the moisture on the filaments as they pass through the channel while maintaining the vapor in contact therewith until the moisture content of the filaments is reduced to 2 to 6% based on the weight thereof, maintaining the channel at least from the region where the filaments reach the 2 to 6% moisture range to the exit full of the vapor thus developed thereby substantially excluding the atmosphere outside the channel from entering it adjacent the article exit, and discharging the filaments from the channel while enveloped with some of the vapor into a relatively unheated atmosphere in which the vapor is freely dissipated while leaving the filaments in a dry condition but with an appreciable amount of moisture therein.

10. The method of drying water-laden hydrophilic artificial filaments of regenerated cellulose comprising continuously passing the wet filaments through a substantially closed channel having an entrance and exit for the filaments, maintaining the walls of the channel at a temperature of about 140 to 200° C., evaporating the moisture on the filaments as they pass through the channel while maintaining the vapor in contact therewith until the moisture content of the filaments is reduced to 2 to 6% based on the weight thereof, maintaining the channel at least from the region where the filaments reach the 2 to 6% moisture range to the exit full of the vapor thus developed thereby substantially excluding the atmosphere outside the channel from entering it adjacent the article exit, and discharging the filaments from the channel while enveloped with some of the vapor into a relatively unheated atmosphere in which the vapor is freely dissipated while leaving the filaments in a dry condition but with an appreciable amount of moisture therein.

11. The method of drying moisture-laden filaments of indefinite length comprising continuously passing the moisture-laden filaments under a predetermined constant condition of tension through a substantially closed channel having an entrance and exit for the filaments, maintaining the walls of the channel at a temperature above the boiling point of the liquid carried by the filaments at the prevailing atmospheric pressure in the vicinity of the entrance and exit of the channel, evaporating the liquid on the filaments as it passes through the channel while maintaining the vapor in contact therewith until the moisture-content of the filaments closely approaches an equilibrium condition with respect to the vapor in the channel and discharging the filaments from the channel while enveloped with some of the vapor into a relatively unheated atmosphere in which the vapor is freely dissipated while leaving the filaments in a dry condition but with an appreciable amount of moisture therein.

12. The method of drying moisture-laden filaments of indefinite length comprising continuously passing the moisture-laden filaments under substantially no tension through a substantially closed channel having an entrance and exit for the article, maintaining the walls of the channel at a temperature above the boiling point of the liquid carried by the filaments at the prevailing atmospheric pressure in the vicinity of the entrance and exit of the channel, evaporating the liquid on the filaments as it passes through the channel while maintaining the vapor in contact therewith until the moisture-content of the filaments closely approaches an equilibrium condition with respect to the vapor in the channel and discharging the filaments from the channel while enveloped with some of the vapor into a relatively unheated atmosphere in which the vapor is freely dissipated while leaving the filaments in a dry condition but with an appreciable amount of moisture therein.

13. The method of drying moisture-laden filaments of indefinite length comprising continuously passing the moisture-laden filaments under a constant tension between 0.01 and 1 gram/denier through a substantially closed channel having an entrance and exit for the filaments, maintaining the walls of the channel at a temperature above the boiling point of the liquid carried by the filaments at the prevailing atmospheric pressure in the vicinity of the entrance and exit of the channel, evaporating the liquid on the filaments as it passes through the channel while maintaining the vapor in contact therewith until the moisture-content of the filaments closely approaches an equilibrium condition with respect to the vapor in the channel and discharging the filaments from the channel while enveloped with some of the vapor into a relatively unheated atmosphere in which the vapor is freely dissipated while leaving the filaments in a dry condition but with an appreciable amount of moisture therein.

14. The method of drying water-laden hydrophilic artificial filaments of regenerated cellulose comprising continuously passing the wet filaments under a tension of 0.01 to 1 gram/denier through a substantially closed channel having an entrance and exit for the filaments, maintaining the walls of the channel at a temperature of about 140 to 200° C., evaporating the moisture on the filaments as they pass through the channel while maintaining some of the vapor in contact therewith until the moisture content of the filaments closely approaches an equilibrium condition close to the vapor, maintaining the channel at least from the region where equilibrium is closely approached to the exit full of water vapor thereby substantially excluding the atmosphere outside the channel from entering it adjacent the article exit, and discharging the filaments from the channel while enveloped with some of the vapor into a relatively unheated atmosphere in which the vapor is freely dissipated while leaving the filaments in a dry condition but with an appreciable amount of moisture therein.

15. The method of drying water-laden hydrophilic artificial filaments of regenerated cellulose comprising continuously passing the wet filaments under substantially no tension through a substantially closed channel having an entrance and exit for the filaments, maintaining the walls of the channel at a temperature of about 140 to 200° C., evaporating the moisture on the fila-

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ments as they pass through the channel while maintaining some of the vapor in contact therewith until the moisture content of the filaments closely approaches an equilibrium condition close to the vapor, maintaining the channel at least from the region where equilibrium is closely approached to the exit full of water vapor thereby substantially excluding the atmosphere outside the channel from entering it adjacent the article exit, and discharging the filaments from the channel while enveloped with some of the vapor into a relatively unheated atmosphere in which the vapor is freely dissipated while leaving the filaments in a dry condition but with an appreciable amount of moisture therein.

16. A method in accordance with claim 1 in which the equilibrium proportion of moisture content in the article as it is discharged from the channel is appreciable but less than the proportion of moisture that the article normally contains in equilibrium with an ordinarily prevailing atmosphere of normal humidity.

17. A method in accordance with claim 11 in which the equilibrium proportion of moisture content in the filaments as they are discharged from the channel is appreciable but less than the proportion of moisture that the filaments normally contain in equilibrium with an ordinarily prevailing atmosphere of normal humidity.

18. A method in accordance with claim 11 in which the filaments are of regenerated cellulose and the equilibrium proportion of moisture content in the article as it is discharged from the channel is appreciable but less than 11%.

19. A method in accordance with claim 12 in which the equilibrium proportion of moisture content in the filaments as they are discharged from the channel is appreciable but less than the proportion of moisture that the filaments normally contain in equilibrium with an ordinarily prevailing atmosphere of normal humidity.

20. A method in accordance with claim 13 in which the equilibrium proportion of moisture content in the filaments as they are discharged from the channel is appreciable but less than the proportion of moisture that the filaments normally contain in equilibrium with an ordinarily prevailing atmosphere of normal humidity.

21. A method in accordance with claim 13 in which the filaments are of regenerated cellulose and the equilibrium proportion of moisture con-

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tent in the article as it is discharged from the channel is appreciable but less than 11%.

22. A method in accordance with claim 17 in which the filaments rub over a smooth heated surface as they emerge from the channel.

23. A method in accordance with claim 17 in which the filaments are laden with water and proceed upwardly through the channel which is provided with a restricted exit opening for the filaments at its upper end.

24. A method in accordance with claim 17 in which the filaments are of regenerated cellulose and are laden with water and proceed upwardly through a channel which is provided with a restricted exit opening for the filaments at its upper end.

25. A method in accordance with claim 17 in which the filaments are laden with a liquid whose vapor density is greater than that of air and in which the filaments travel downwardly through the channel and the channel is provided with a restricted exit opening at its lower end.

26. A method in accordance with claim 17 in which the filaments proceed through a helical path comprising a large number of convolutions within the channel.

27. A method in accordance with claim 17 in which the filaments proceed through a substantially horizontal path through the channel.

28. A method in accordance with claim 27 in which the filaments proceed, in succession from the lowermost to the uppermost, of a plurality of generally superposed horizontal paths through a corresponding number of channels comprising as the last and uppermost thereof the channel mentioned in claim 27.

29. A method in accordance with claim 28 in which the channels become progressively hotter from the lowermost to the uppermost.

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