May 31, 1938. B. R. ANDREWS 2,119,261

METHOD OF DRYING SYNTHETIC FIBER

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Fig.1.

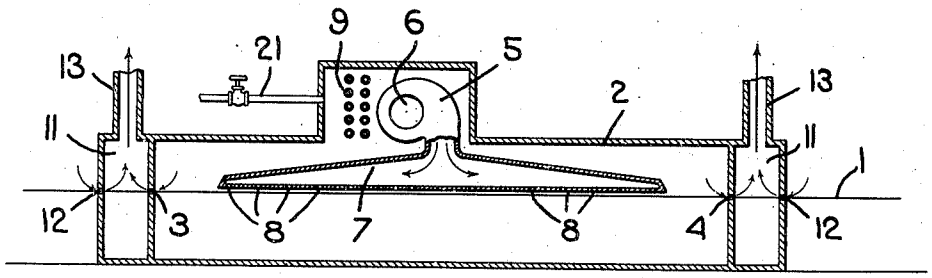
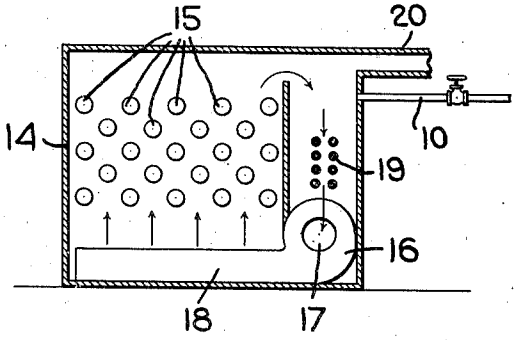


Fig.2.



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METHOD OF DRYING SYNTHETIC FIBER

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1 Claim. (Cl. 34—24)

This invention relates to the drying of synthetic or other material (of which rayon is a familiar example) whether such synthetic or other material is in the form of thread or strands, or in the form of cloth woven from such threads or strands, or in the form of sheets or in any other form.

The method now commonly employed in drying synthetic material is to subject the material to the action of a drying current of heated air. It has been found, however, that if the temperature of the drying current of air exceeds a predetermined upper limit (which in some cases is in the neighborhood of 200° F.) the drying of the synthetic material is accompanied by certain physical changes therein, such, for instance, as a change in color and/or a change in elasticity and/or a change in breaking strength, the elasticity and breaking strength of the fibers being decreased by the employment of a drying current of too high a temperature. Furthermore, this commonly accepted method of drying synthetic material causes undesirable and variable shrinkage in the material.

All of these detrimental effects are increased if the material remains in the drying atmosphere after the drying has been completed.

The rapidity with which material is dried by subjecting it to the action of a current of drying medium, depends to a considerable extent upon the temperature of the drying medium and because the use of a hot air drying medium above the temperature mentioned is apt to deleteriously affect synthetic and some other materials, the drying of such material commercially, whether in yarn form, cloth form or sheet form, has been accomplished by the slower process resulting from the use of a drying current of air having a temperature approximately 200° F.

I have discovered that if the drying of synthetic material is accomplished by subjecting it to the action of superheated water vapor which is substantially free from air, and which of necessity must be of a higher temperature than 200° F., the drying operation is not only greatly expedited due to the relatively high temperature of the drying medium, but the drying is accomplished without any resultant change in color of the material and without any diminution in either the elasticity or breaking strength of the material and also without any undesirable shrinkage therein. My experiments have shown that it is feasible to subject many synthetic or other materials to the action of a drying current of superheated water vapor having a temperature of approximately 300° F. without producing any of the above-mentioned deleterious effects, and at this high temperature the speed of drying is greatly increased. Moreover, I have found that continued action of this superheated water vapor on the materials after the drying has been completed will produce none of the above-mentioned deleterious effects. This feature is of considerable importance because in commercial drying operations many materials are often dried in package form, this being especially true where the material is in the form of a thread or strand. The thread or strand is frequently dried after being wound on a spool or it is dried in a mass referred to in the rayon industry as a "cake" or "package". When synthetic material in this form is being dried the outer layers or portions of the spool, cake, or package become over-dried before the inner portion of the mass is sufficiently dried.

In the practice of my invention this over-drying of the outer portions of such a mass of synthetic material has no deleterious effect on the material and when the complete package or mass is completely dried the synthetic material composing the mass will be uniform in character throughout the extent of the mass.

Synthetic fiber or other materials when dried in accordance with my invention retain their original soft pliable characteristics and also their original strength, dimension and the ability to take dye uniformly.

In order to give an understanding of the invention I have illustrated in the drawing two ways in which the invention may be practiced.

In Fig. 1 there is shown a sectional view of the drying apparatus adapted to dry a web of cloth made from synthetic fiber.

Fig. 2 is a sectional view illustrating an apparatus designed for drying synthetic fiber in the form of yarn wound upon spools.

Referring first to Fig. 1, 1 indicates a web of cloth to be dried which is made from synthetic fiber and 2 represents a drying chamber through which the cloth passes in web formation, the drying of the cloth occurring while it is traveling through said chamber. This drying chamber is provided in one end wall with an opening 3 in the form of a slit or slot through which the web enters the chamber 2 and at the other end it is provided with a similar opening 4 through which the dried web is discharged from the chamber. 5 indicates a fan or blower for circulating over or through the cloth 1 the drying medium which is in the form of superheated water vapor that is substantially free from air. In the carrying out of the process a portion at least of the superheated water vapor used for drying purposes is the water vapor evaporated from the cloth itself, such superheated water vapor being augmented by such an amount of superheated water vapor introduced into the chamber from outside sources through the pipe 21 as may be necessary to keep the chamber filled with substantially air-free superheated water vapor.

The fan or blower 5 has an inlet 6 communicating with the interior of the chamber 2 and it delivers the drying medium into a duct 7 situated above the cloth 1, and provided in its lower face with slots 8 through which the drying medium is directed against the cloth. 9 is a heater of some suitable type situated to heat the drying medium before it enters the inlet 6 of the fan. The water vapor discharged through the openings 8 impinges against the cloth and after circulating through the chamber 2 returns to the inlet 6 of the blower, and during its return it is superheated by the heater 9 so that superheated water vapor is continuously being delivered against the cloth. This causes a continual evaporation or vaporization of water vapor from the cloth which is recirculated in the chamber 2 and is superheated by the heater 9 before it enters the blower. In carrying out the improved process it is important that the chamber 2 should be filled with superheated water vapor which is substantially free from air, and hence if during the drying operations insufficient water vapor is being given off from the material being dried to keep the chamber filled with superheated water vapor then it will be necessary to introduce a sufficient added amount of superheated water vapor into the chamber 2 through the pipe 21 to prevent any possible leakage of air into said chamber.

In referring to the superheated water vapor as being substantially free from air, I mean as free from air as is commercially practical in carrying out the operation. It is found that the presence of even a small percentage of air in the superheated water vapor will have a deleterious effect on the synthetic fiber during the drying operation. When the drying operation is started the chamber 2 is first filled with superheated water vapor through the pipe 21 so that the drying operation is initiated in a drying medium of superheated water vapor which is substantially free from air.

To prevent leakage of air into the chamber through the openings 3 and 4 I have shown the drying chamber as provided at each end with a compartment 11 which also has an opening 12 through which the cloth extends. Each compartment 11 communicates with a duct or pipe 13 that may lead to a suction apparatus by which a pressure somewhat less than atmospheric pressure may be contained in said compartments. Any air leaking through the openings 12 will be taken off through the ducts 13 by the suction apparatus and this apparatus will also function to withdraw from the chamber 2 surplus steam or water vapor.

During the drying of the cloth water vapor will be continually given off from the cloth and the continual discharge of steam or water vapor through the openings 3, 4 into the compartments 11 prevents building up any substantial pressure in the chamber 2. The relatively high temperature of the superheated water vapor serves to evaporate quickly the water from the cloth and thereby speed up the drying operation, and as stated before, this is accomplished without producing any change of color in the material and without any diminution of the elasticity of the material or its breaking strength and also without causing any undesirable shrinkage.

In Fig. 2 there is shown an apparatus operating on the above principle and suitable for drying synthetic material in mass form, such, for instance, as synthetic yarn wound on spools. In said Fig. 2, 14 indicates a closed drying chamber within which the spools 15 containing the synthetic yarn may be placed. Situated in this drying chamber is the fan 16 for re-circulating the superheated water vapor, said fan having the inlet 17 and having its discharge connected to a duct 18 provided with a plurality of discharge slots or ports. 19 is a heater designed for superheating the water vapor before it enters the inlet of the fan. 20 indicates a discharge opening through which the surplus water vapor is discharged and 10 is a pipe by which the chamber may be filled with superheated water vapor at the start of the drying operation. In the operation of this device the superheated water vapor which is delivered through the discharge duct 18, circulates over the spools 15 containing the synthetic fiber and then passes over the heater 19 and to the fan by which it is re-circulated by the chamber 14. The continual giving-off of water vapor from the synthetic fiber will help to keep the chamber 14 filled with superheated water vapor. If added water vapor is necessary to keep the chamber filled sufficiently to prevent the leakage of air into the chamber such added superheated water vapor may be introduced through the medium of the pipe 10. The superheating of the water vapor supply may be accomplished by expanding high pressure steam to the pressure in the drier or to a pressure below the supply pressure, yet sufficiently above the pressure in the drier to cause it to pass through the material being dried direct or assisted by the use of ejectors.

While the drawing shows two installations by which my invention may be practiced, yet it will be understood that the carrying out of the improved process is not limited to the operation of the devices shown, but may be carried out through the medium of other forms of drying apparatus.

An important feature of the invention is the drying of the synthetic material by subjecting it to the action of superheated water vapor which is substantially free from air, that is, as free from air as it is possible to have the superheated water vapor in commercial operations.

I claim.

The method of rapidly drying synthetic material such as artificial silk, rayon or regenerated cellulose in web or yarn form which consists in placing the synthetic material in a drying chamber, filling said chamber from an outside source with superheated water vapor which is substantially free from air and thereby expelling all air from the chamber, circulating said superheated water vapor through a closed circuit in said chamber whereby said superheated water vapor passes repeatedly over or through the material to be dried and thereby causes evaporation of moisture from said material, maintaining the circulating water vapor in a superheated condition while it is being circulated and during the drying operation supplying from an outside source such additional amounts of superheated water vapor substantially free from air to the repeatedly circulating stream of superheated water vapor as it moves through its closed circuit as may be necessary to maintain the drying chamber continuously filled with air-free superheated water vapor.

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