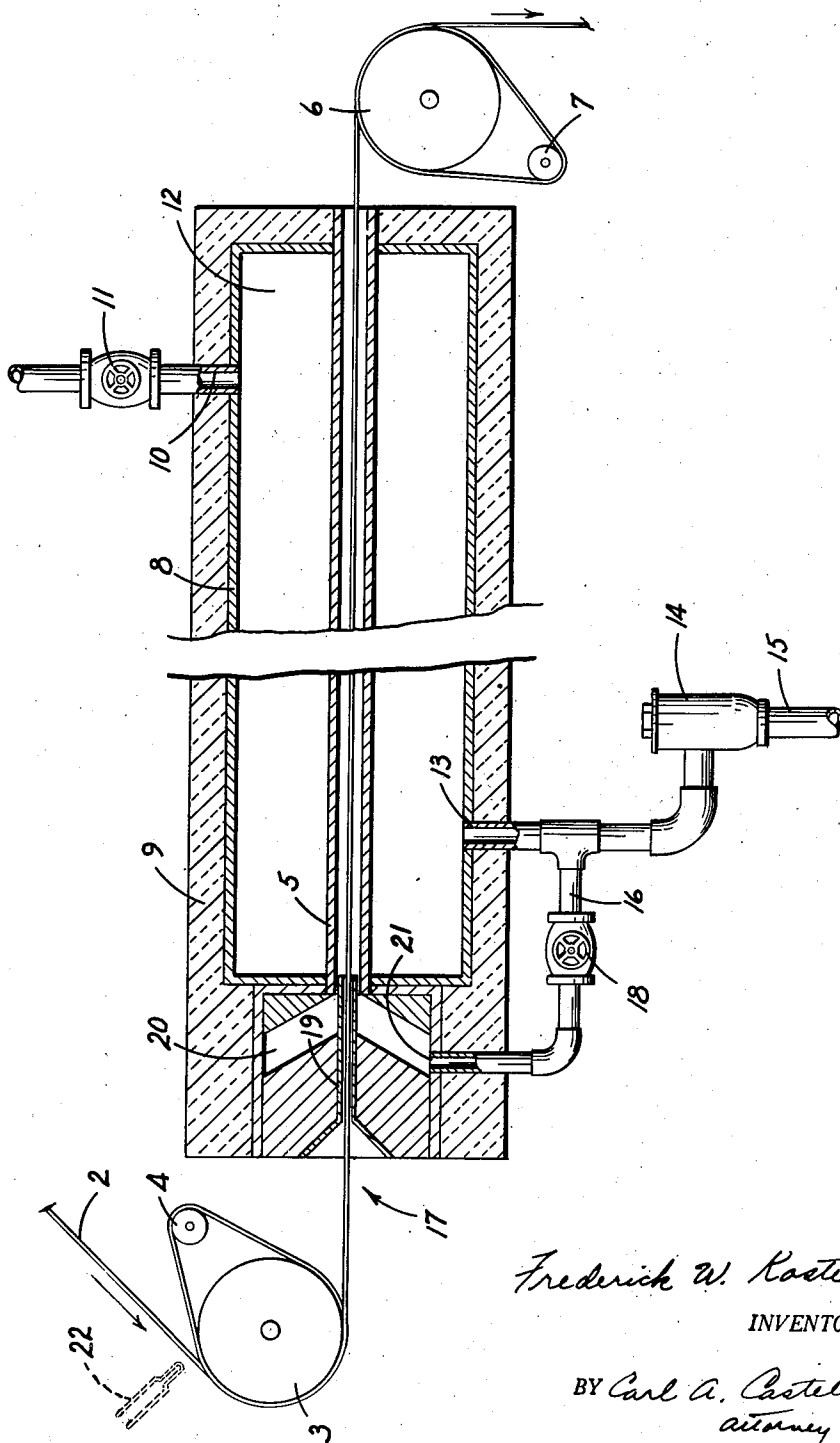


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METHOD AND APPARATUS FOR TREATING
FILAMENTARY MATERIAL
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METHOD AND APPARATUS FOR TREATING
FILAMENTARY MATERIAL

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1

This invention is concerned with improvements in or relating to the treatment of textiles and other materials, and particularly with improvements in processes and apparatus for the treatment of yarns and other materials in a closed chamber with fluid media in vapor condition during their travel from one point to another. The invention is particularly concerned with the utilization of such fluid media for applying heat to such filamentary material, or for applying heat while simultaneously softening the textile material by virtue of a swelling or solvent action of the vapors thereupon, and the invention is of special advantage when applied for the purpose of plasticizing or softening the textile materials, especially when in the form of yarn-like bundles when it is desired to stretch such materials in softened condition. For this purpose, the invention is of special application to such textile materials as yarn-like bundles of filaments made of cellulose derivatives and resins; examples of cellulose derivatives including cellulose acetate, cellulose propionate, cellulose butyrate, cellulose acetate propionate and cellulose acetate butyrate. Examples of the resins include the vinyl resins, such as polyvinyl chloride, copolymers of vinyl chloride with vinyl acetate or with acrylonitrile after-chlorinated vinyl polymers and copolymers, vinylidene polymers such as polyvinylidene chloride, nylons, polyethylene, and the like.

Running yarns of such materials have heretofore been subjected to fluids, such as steam in a closed chamber provided with inlet and outlet orifices at each end thereof. However, it is often desirable to make use of such vaporous fluids at temperatures in excess of their saturation temperature at normal atmospheric pressure, in order to obtain higher temperatures in proximity to the yarn. When applying such a vapor at high pressure to obtain higher saturation temperatures by introducing it into the chamber through which the yarn is running, the pressure is limited by the presence of the orifices through which the vapor escapes. In addition, the escape through the orifices occurs at extremely high speeds which imparts uncontrolled and secondary stretching effects to the yarn as it enters and as it leaves the chamber. It has heretofore been proposed to overcome these difficulties by providing additional chambers, one in advance of the entrance to the main stretching chamber and one following such chamber, so that air or other cold fluid can be maintained in these auxiliary chambers at a pressure substantially equal to the pressure of the vapor within the main stretching chamber. This

2

requires additional equipment and controls which makes it an expensive procedure.

In accordance with the present invention, an improved process and arrangement is provided in which a vaporous fluid at superatmospheric pressure is introduced in a jacket surrounding the chamber through which the textile material continually passes and some of the fluid discharged from the jacket and still in vaporous condition is directed into the main chamber adjacent the material entrance in such a manner as to flow in the same direction through the chamber as the material. The flow of the fluid into the main chamber is controlled so that the velocity of the fluid within the main chamber is relatively low, or if it is allowed to occur at high velocity, it is under substantial control and occurs concurrently with the material throughout its passage through the tube, so that there is substantially uniform treatment of the material by the fluid. The filamentary material may be preliminarily soaked in the liquid phase of the fluid to the vapors of which it is to be subjected, or it may be soaked with a liquid solvent or swelling agent just before entering the vapor treatment chamber.

The invention is illustrated in connection with the accompanying drawing, in which the single figure is illustrative of a preferred embodiment of equipment for performing the method of the invention.

As shown, the material 2, in the form of a yarn-like bundle which may be composed of continuous artificial filaments of a cellulose ester or of a vinyl resin, passes around a godet or wheel 3 and an associated lap-displacing guide 4 through a relatively narrow chamber or tube 5, preferably of good heat-conducting material, such as iron, steel, copper, and the like, and about another godet or wheel 6 and its associated lap-displacing guide 7. A jacket 8 well insulated as at 9 surrounds the chamber 5 and is provided with a supply conduit 10 controlled by a valve 11 for directing the vaporous fluid into the annular chamber 12 in the jacket 8 and surrounding the tube 5. A connection 13 is provided for conducting condensate into a trap 14; from which it may be discharged through the conduit 15. A connection 16 is provided between the high pressure side of the trap 14 and there is an injector arrangement at 17 for directing the fluid into the tube 5 concurrently with the material. A valve 18 is provided for controlling the flow of the fluid into the tube 5. The injector comprises a tube 19 having a restricted internal diameter

for guiding the material into the tube 5 and an annular chamber 20 communicating at 21 with the conduit 16 and having an annular opening surrounding the tube 19 communicating with the entrance end of the tube 5. A nozzle 22 may be provided to apply a liquid to the material as it passes over the godet 3.

In operation, the fluid, e. g. steam, is introduced by the conduit 10 at any desired super-atmospheric pressure, so that the temperature of the tube can be raised to any desired extent and the valve 18 can be controlled to permit any predetermined relatively small portion of the high pressure fluid to enter the injector 17 and thence the tube 5. Adjacent the point of entrance to tube 5, a reduced pressure is developed within the tube 19 when the fluid passes through the chamber 20 at a considerable velocity because of high pressure in the chamber 12 and a small amount of outside atmosphere may be drawn into the tube 5 along with the material. However, the effect of this air introduced is relatively negligible, and since the fluid flows concurrently with the material throughout its passage through the tube 5, it has a uniform and controlled action thereupon. The valve 18 can be so controlled that the fluid discharged from the exit end of the tube 5 flows at a relatively low velocity or high velocity as desired. At the same time, the thread can be maintained at the high temperature substantially throughout its passage through the tube, because of the fact that the steam bled through valve 18 into the tube 5 is thereafter heated by the steam in the jacket chamber 12. The godets may be driven at the same speed, or if stretching is desired as in the preferred case, the godet 6 may be driven at a higher speed than the godet 3. The exit opening of the tube 5 may be restricted, or if the tube 5 is of relatively small diameter such as from $\frac{1}{8}$ to $\frac{1}{2}$ inch, it may be left wide open without appreciably affecting the results obtained. Cold or hot water or a solvent or swelling liquid, such as acetone, ethyl acetate, and the like, may be applied to the material by the nozzle 22, if desired.

Where as in arrangements heretofore utilized without auxiliary end pressure chambers it has been found to be extremely difficult to obtain temperatures as high as 125 to 130° C. when using steam at 30 pounds per square inch gauge pressure, it has been found possible with the system of the present invention to obtain much higher temperatures without any difficulty whatsoever. Thus, steam under 60 pounds per square inch pressure may be supplied in the jacket to provide a tube temperature of about 153° C. It appears that the steam in the inner tube can actually be superheated. The tube and jacket, of course, can be designed to accommodate a fluid such as steam, under any pressure and temperature whatsoever within the strength characteristics of the materials, so that the system of the present invention can be utilized to obtain temperatures not heretofore obtained by the use of heated vapors. In addition, if high velocity steam is led into the tube from the jacket, it is controlled so that any stretching it exerts upon the material serves a useful purpose.

While the utilization of the apparatus has been described in connection with steam specifically, it is to be understood that the invention contemplates the use of other vapors, especially when it is necessary to use them at temperatures higher than their normal saturation temperature in or-

der to obtain the particular temperature needed for the particular material treated. To obtain the higher temperature with any particular vapor, it may be supplied in the superheated condition under slightly higher pressure than atmospheric, or it may be supplied at high superatmospheric pressures and either saturated or superheated with respect thereto. Examples of solvent vapors are acetone or acetone-air acetone-steam mixtures.

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

I claim:

1. A method of heating a strand comprising continuously passing the strand longitudinally through an elongated narrow channel having strand entrance and exit openings at its ends communicating with the atmosphere whereby the pressure in the channel is approximately atmospheric, heating the channel by conduction from a heated vapor medium supplied continuously at superatmospheric pressure to a region surrounding the channel, and continuously directing a portion of the vapor medium discharged from the surrounding region into the channel adjacent the strand entrance as a stream entering the channel substantially concentrically about the strand entrance and controlling the velocity of the vapor medium as it enters the channel by limiting the quantity entering so that the flow of the medium in the channel occurs at low velocity and is substantially concurrent with the strand throughout its passage therethrough and the spent medium is discharged from the channel with the strand whereby escape of the vapor medium from the channel through the strand entrance is inhibited and the necessity of special sealing means is obviated.

2. A method of heating a strand comprising continuously passing the strand longitudinally through an elongated narrow channel having strand entrance and exit openings at its ends communicating with the atmosphere whereby the pressure in the channel is approximately atmospheric, heating the channel by conduction from a substantially saturated vapor medium supplied continuously at superatmospheric pressure to a region surrounding the channel, and continuously directing a portion of the vapor medium discharged from the surrounding region into the channel adjacent the strand entrance as a stream entering the channel substantially concentrically about the strand entrance and controlling the velocity of the vapor medium as it enters the channel by limiting the quantity entering so that the flow of the medium in the channel occurs at low velocity and is substantially concurrent with the strand throughout its passage therethrough and the spent medium is discharged from the channel with the strand whereby escape of the vapor medium from the channel through the strand entrance is inhibited and the necessity of special sealing means is obviated.

3. A method of heating a strand comprising continuously passing the strand longitudinally through an elongated narrow channel having strand entrance and exit openings at its ends communicating with the atmosphere whereby the pressure in the channel is approximately atmospheric, heating the channel by conduction from steam supplied continuously at super-atmospheric pressure to a region surrounding the chan-

5

nel, and continuously directing a portion of the steam discharged from the surrounding region into the channel adjacent the strand entrance as a stream entering the channel substantially concentrically about the strand entrance and controlling the velocity of the steam as it enters the channel by limiting the quantity entering so that the flow of the steam in the channel occurs at low velocity and is substantially concurrent with the strand throughout its passage therethrough and the spent steam is discharged from the channel with the strand whereby escape of the steam from the channel through the strand entrance is inhibited and the necessity of special sealing means is obviated.

4. A method of heating a strand comprising continuously passing the strand longitudinally through an elongated narrow channel having strand entrance and exit openings at its ends communicating with the atmosphere whereby the pressure in the channel is approximately atmospheric, heating the channel by conduction from steam supplied continuously at superatmospheric pressure to a region surrounding the channel, and continuously directing a portion of the steam discharged from the surrounding region into the channel adjacent the strand entrance as a stream entering the channel substantially concentrically about the strand entrance and controlling the velocity of the steam as it enters the channel by limiting the quantity entering so that the flow of the steam in the channel occurs at low velocity and it substantially concurrent with the strand throughout its passage therethrough and the spent steam is discharged from the channel with the strand whereby escape of the steam from the channel through the strand entrance is inhibited and the necessity of special sealing means is obviated, and stretching the strand during its passage through the channel.

5. A method of heating a strand comprising continuously passing the strand longitudinally through an elongated narrow channel having strand entrance and exit openings at its ends communicating with the atmosphere whereby the pressure in the channel is approximately atmospheric, heating the channel by conduction from substantially saturated steam supplied continuously at superatmospheric pressure to a region surrounding the channel, and continuously directing a portion of the steam discharged from the surrounding region into the channel adjacent the strand entrance as a stream entering the channel substantially concentrically about the strand entrance and controlling the velocity of the steam as it enters the channel by limiting the quantity entering so that the flow of the steam in the channel occurs at low velocity and is substantially concurrent with the strand throughout its passage therethrough and the spent steam is discharged from the channel with the strand whereby escape of the steam from the channel through the strand entrance is inhibited and the necessity of special sealing means is obviated.

6. Apparatus for heating a strand comprising an elongated narrow tube having a wall of conductive material having strand entrance and exit openings in opposite ends thereof, means for continuously passing a strand longitudinally in a straight path through the openings and the tube, a tubular guide disposed concentrically within the entrance opening to provide an annular passage therebetween, an enclosed jacket surround-

6

ing the wall of the tube for receiving a vapor medium under pressure therein, means for supplying a heated vapor medium to the jacket, the exit opening of the tube being arranged to discharge the medium therefrom externally of the jacket, and means for continuously directing a portion of the vapor medium from the jacket through the annular passage into the tube adjacent the strand entrance so that the flow of the medium in the tube is substantially concurrent with the strand throughout its passage therethrough.

7. Apparatus for heating a strand comprising an elongated narrow tube having a wall of conductive material having strand entrance and exit openings in opposite ends thereof, means for continuously passing a strand longitudinally in a straight path through the openings and the tube, an enclosed jacket surrounding the wall of the tube for receiving a vapor medium under pressure therein, means for supplying a heated vapor medium at superatmospheric pressure to the jacket, the exit opening of the tube being arranged to discharge the medium therefrom externally of the jacket, and means comprising a pressure-reducing valve for continuously directing a portion of the vapor medium from the jacket into the tube adjacent the strand entrance, said latter means constituting with the strand entrance an injector having an annular fluid passage surrounding the strand entrance so that the flow of the medium in the tube is substantially concurrent with the strand throughout its passage therethrough.

8. Apparatus for heating a strand comprising an elongated narrow tube having a wall of conductive material having strand entrance and exit openings in opposite ends thereof, means for continuously passing a strand longitudinally in a straight path through the openings and the tube, an enclosed jacket surrounding the wall of the tube for receiving a vapor medium under pressure therein, means for supplying a heated vapor medium under pressure to the jacket, the exit opening of the tube being arranged to discharge the medium therefrom externally of the jacket, an injector jet at the entrance of the tube having a central opening to permit passage of the strand and an annular opening concentric with the central opening, a discharge conduit connected to the jacket, a branch conduit connected to the discharge conduit adjacent the connection of the latter to the jacket and connected to the annular opening of the jet for continuously directing a portion of the vapor medium from the jacket into the tube adjacent the strand entrance so that the flow of the vapor medium in the tube is substantially concurrent with the strand throughout its passage therethrough.

9. Apparatus in accordance with claim 8 in which a pressure-reducing valve is provided in the branch conduit for controlling the flow of the vapor medium into the tube.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,871,100	Walton	Aug. 9, 1932
2,371,579	Cole et al.	Mar. 13, 1945