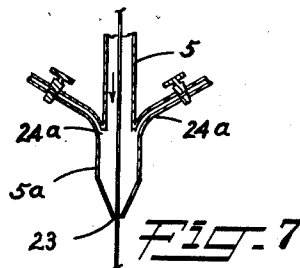
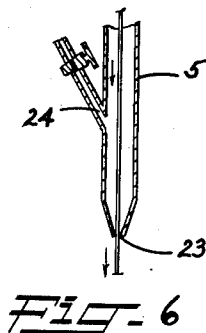
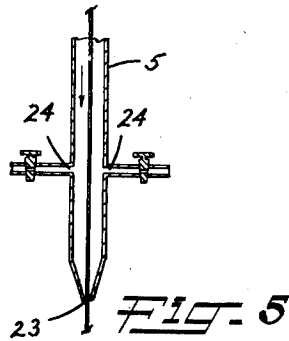
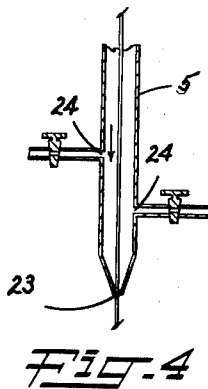
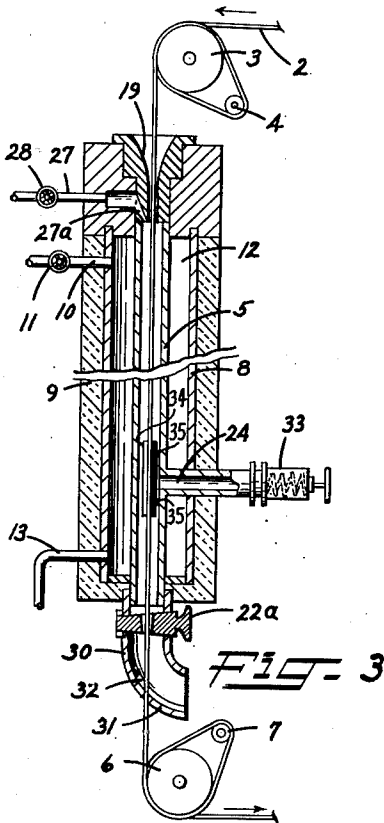
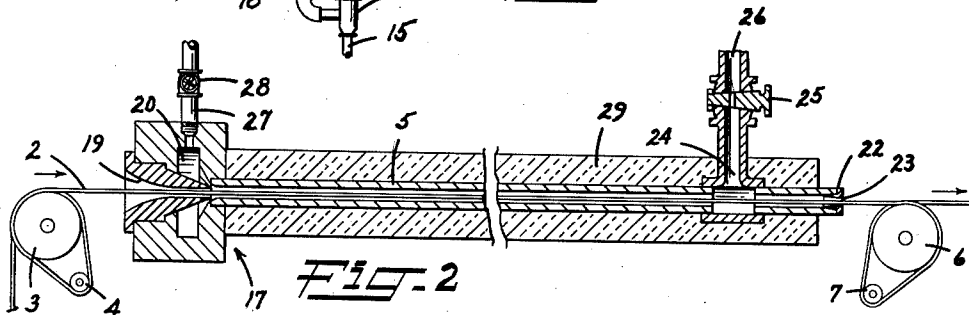
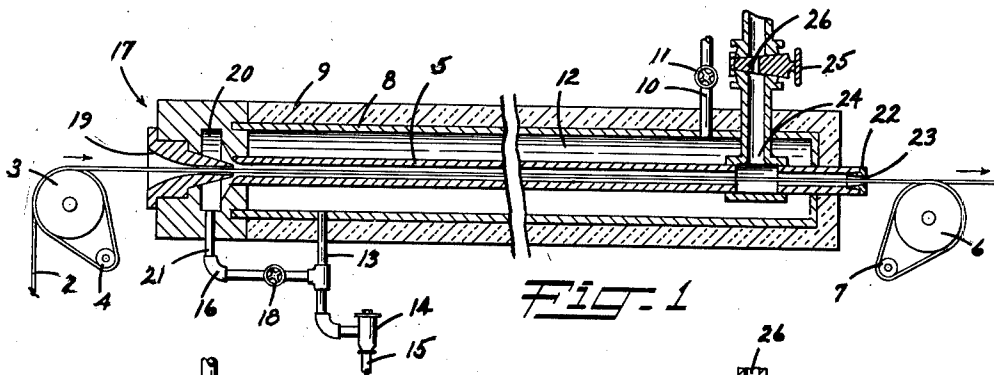


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METHOD AND APPARATUS FOR PROCESSING
FILAMENTARY MATERIALS
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METHOD AND APPARATUS FOR PROCESS-
ING FILAMENTARY MATERIALS

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3 Claims. (Cl. 134—15)

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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 monofilaments, yarns, and other materials in a closed chamber with fluid media in vapor or liquid 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 vapor or liquid 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 advantage when applied to such textile materials as yarn-like bundles of filaments made of cellulose derivatives and resins; examples of cellulose derivatives include 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 or hot water in a closed chamber provided with inlet and outlet orifices at each end thereof.

However, it is often desirable to make use of vaporous fluids in saturated or wet conditions at temperatures in excess of their saturation temperature at normal atmospheric pressure, in order to obtain higher temperatures in proximity to the yarn. Likewise it is desired to apply hot water in the liquid condition at temperatures above 100° C., the boiling point under normal atmospheric conditions. When applying such a vapor or liquid at high pressure to obtain higher saturation temperatures in the case of the vapor at temperatures above the normal boiling point in case of the liquid 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 or liquid escapes. In addition, the escape through the orifices occurs at extremely high speeds which impart uncontrolled and secondary stretching effects to the

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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 or liquid within the main stretching chamber. This requires additional equipment and controls which makes it an expensive procedure.

The present invention is concerned with that type of treating system in which the fluid is introduced into a treating chamber so that it flows mainly in substantially the same general direction as the filamentary material even when it first contacts the latter, such as by introducing the fluid and material into the chamber through adjacent openings in the end wall thereof or by any form of injector system, such as those shown in Cole and Lodge U. S. Patent 2,371,579 or by an injector provided with a central channel through which the filamentary material enters the chamber. When it is attempted to increase the pressure within the chamber by increasing the rate of introduction of the fluid and/or restricting the material and vapor exit of the chamber, a considerable stream of the fluid flows back out of the chamber through the material entrance channel, which then causes irregular and undesirable stretching effects upon the material because it opposes the passage of the material into and through the chamber. It has been found in general that under the best conditions a maximum pressure of about 25 pounds per square inch gage is all that is obtainable by this procedure when using steam.

It has been found, in accordance with the present invention, that considerably higher pressures can be obtained within the chamber without excessive flow of the fluid out of the chamber through the material entrance channel by providing at least one auxiliary lateral discharge opening for the fluid, preferably near the discharge end of the chamber. In this manner, it has been found possible to reach pressures of 60 pounds per square inch gage and sometimes somewhat higher in the case of steam without excessive back flow of the fluid through the material entrance chamber. Ancillary objects and advantages will be apparent from the drawing and the description thereof hereinafter in which—

Figure 1 is a cross-section of a preferred embodiment;

Figure 2 is a cross-section of a modification;

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Figure 3 is an elevation in section of still another modification; and

Figures 4 to 7 are diagrammatic views of other modifications.

As shown in Figure 1, 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, brass, 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 fluid into the annular chamber 12 in the jacket 8 and surrounding the tube 5. A connection 13 is provided for conducting condensate when a vaporous fluid is used 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. The tube 5 may be provided with a terminal closure 22 having a restricted material discharge orifice 23. Near the discharge end of the tube 5 (for example, one to three up to fifteen inches from the end of a tube three or more feet in length) it is provided with a side outlet 24 spaced from the bottom of the tube and to which a device 25, such as a cock, a pressure relief valve, a gate valve, a globe valve, or a needle valve, is connected to provide an adjustable fluid escape orifice 26.

In operation of the modification of Figure 1, the fluid, e. g. steam, is introduced by the conduit 10 at any desired 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 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 a 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 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 lateral escape orifice 26 may be adjusted to any

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size desired to provide a minimum escape of fluid from the material entrance channel 19.

Figure 2 is a modification in which no steam jacket is provided about the tube 5 and a high pressure fluid such as steam or hot water is admitted into the annular chamber 20 of the injector by the connection 27 controlled by valve 28. An insulating jacket 29 may be provided in this embodiment.

Figure 3 is a modification in which the tube 5 is arranged vertically, a high pressure fluid such as steam or hot water is introduced into the chamber 5 by the connection 27 controlled by valve 28 and opening into the end of the chamber 5 at 27a adjacent the material entrance at the end of channel 19. A separate stream of heating fluid is introduced through conduit 10 into the heating chamber 12 and is discharged through a pipe 13. A cock 22a serves as a material exit from tube 5 and is connected to a bent pipe 30 having a slot 31 and a ridge 32 around the slot to allow direct downward discharge of the material while largely deflecting an escaping fluid from the path of the material. A pressure relief valve 33 is connected to the tube 5 by the side opening 24 spaced from the bottom of the chamber 5. This relief valve may be set to open a small orifice when the pressure within the tube exceeds a predetermined pressure, say 20 to 25 pounds per square inch gage. Thus the device will function without benefit of a lateral outlet at low pressures but will automatically provide a small orifice at higher pressures when it is needed. A baffle plate 34 of semicircular cross-section may be supported by fastenings 35 so that it is spaced from the inside wall of tube 5 facing the side outlet 24 between it and the material 2. The baffle 34 serves to minimize side thrust and vibration of the filamentary material in the vicinity of the lateral outlets 24.

Figures 4 to 7 show modified arrangements of the lateral fluid discharge outlets, all being spaced from the bottom of the tube or chamber 5. In Figure 4, two such orifices 24 are shown offset longitudinally of the tube. In Figure 5, two are shown diametrically opposed. In Figure 6, a single outlet is shown extending at an angle from the normal to the tube wall. In Figure 6, two outlets 24a are shown which which open into an enlarged discharge end 5a of the tube 5. The openings 24a face the discharge end of the tube. Baffles similar to that of Figure 3 may be provided in any of the embodiments illustrated herein.

The invention thus makes it possible to treat filamentary materials or any form of strand, textile or otherwise, such as wire, with saturated or wet vapors or hot liquids under super-atmospheric pressure as well as superheated vapors at such pressures, without producing secondary irregular stretching effects that would occur because of back flow of the vapor or liquid out of the treating chamber if no lateral outlet were provided near the discharge end of the treating chamber.

While the utilization of the apparatus has been described in connection with steam or hot water 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, and under saturated or wet conditions, or other liquids when it is necessary to use them at temperatures above their normal boiling point, in order to obtain the par-

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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 negligibly higher pressure than atmospheric, or it may be supplied at high pressures and either saturated or superheated with respect thereto. The treatment fluids thus may be water superheated above its boiling point, other inert liquids superheated above their boiling points, steam itself, vapors of other inert liquids, or even for some purposes, vapors or superheated liquids having a swelling or solvent effect upon the filamentary material being treated. Examples of solvents which may be used are acetone, acetone-water, acetone-vapor-steam, acetone-vapor air mixtures. The apparatus may also be employed for carrying out chemical processes, such as saponification of cellulose acetate, or it may be used to wash filamentary material. Such other treatments may be performed upon the filamentary material with stretching rollers or without stretching. In the latter case, of course, the godets placed at either end of the chamber are driven at the same speed.

In the claims, the term "strand" is intended in a generic sense to include a single monofilament, yarns and yarn-like bundles, whether twisted or untwisted, tows, cords, and the like.

While preferred embodiments of the invention have been disclosed, the description is intended to be illustrative only, and it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. A process for treating a strand of filamentary material with a vapor under superatmospheric pressure comprising passing the strand through an elongated channel narrowly constricted at both ends but permitting free passage of the strand therethrough, introducing the treating vapor under superatmospheric pressure into the channel near the strand-entrance end in the same direction as the strand at sufficient velocity to neutralize the differential between the static pressures inside and outside of the channel at the strand-entrance end thereof, and continuously discharging a part of the vapor laterally from the channel through a

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small orifice while still in the same phase as when first introduced into the chamber.

2. In apparatus for treating a strand with a fluid, an elongated pressure chamber having small-size strand-inlet and strand-discharge openings at opposite ends thereof, means within the chamber in the vicinity of the strand-inlet for introducing the fluid into the chamber in the form of a jet centered about the strand path and directed toward the strand-discharge end of the chamber, a second chamber extending around the first-named chamber, means for circulating a heating fluid to and from the second chamber, a lateral duct connected with a zone of the first chamber and passing laterally through the second chamber, and means for controlling the passage of fluid through the duct.

3. In apparatus for treating a strand with a fluid, an elongated pressure chamber having small-size strand-inlet and strand-discharge openings at opposite ends thereof, a second chamber extending around the first chamber, means within the chamber having small-size strand-inlet and strand-discharge openings at opposite ends thereof and connected to the second chamber to transfer a fluid from the second chamber to the first chamber in the form of a jet centered around the strand path directed toward the strand-discharge end of the chamber, a lateral duct connected with a zone of the first chamber at a distance of the order of 3 to 40 per cent of the chamber length from the strand-discharge end thereof and passing laterally through the second chamber, and means for controlling the passage of fluid through the duct.

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