Jan. 5, 1960 H. D. MERION ET AL 2,919,464

TUBE SPINNING

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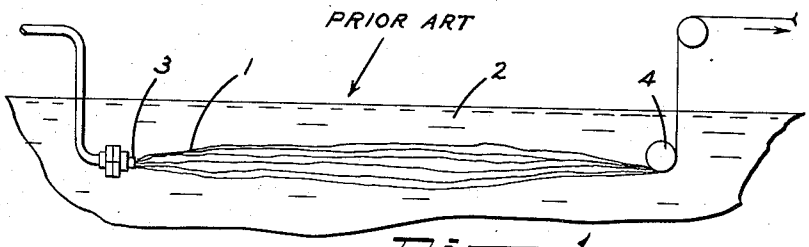


Fig. 1

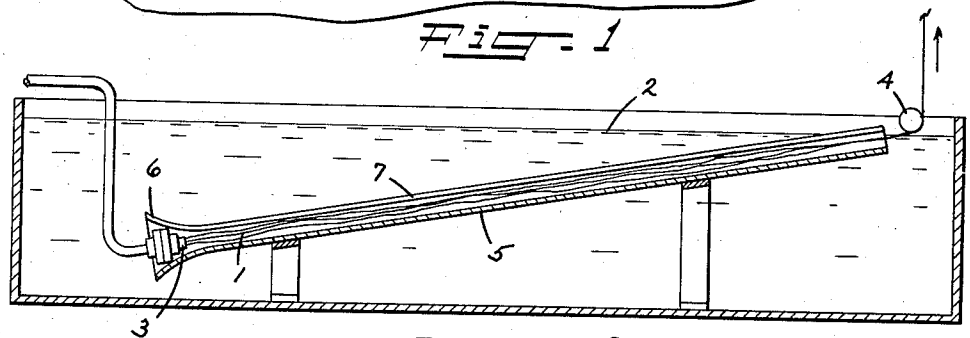


Fig. 2

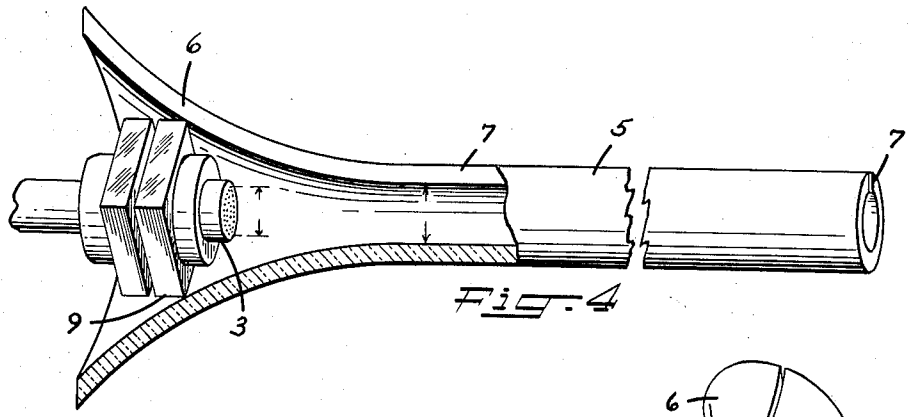


Fig. 4

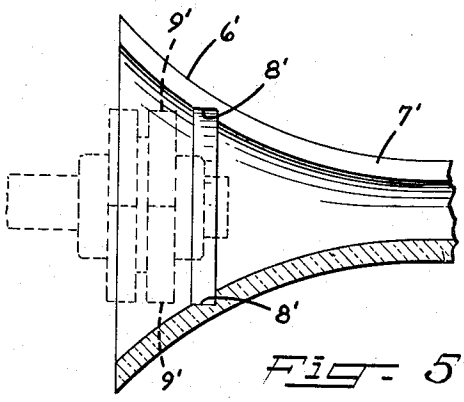


Fig. 5

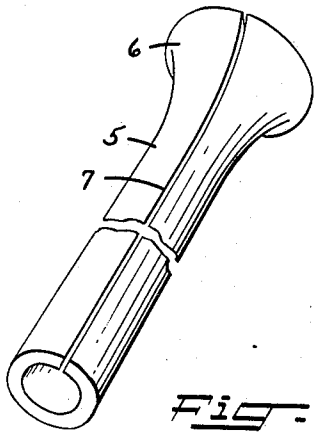


Fig. 3

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TUBE SPINNING

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This invention relates to the spinning of viscose and more particularly to improvements in the tube spinning of viscose in the manufacture of rayon and similar fibers.

It has heretofore been suggested in the spinning of viscose to pass the filaments, immediately after coagulation in the acid spinning bath, through a spinning tube immersed in the bath the filaments drawing acid through the tube during their passage therethrough.

When the viscose is spun into an acid spinning bath in the conventional manner, the filaments have a tendency to balloon outwardly, or sometimes sway or depart from a straight line, thereby giving an uneven stretch to the regenerated cellulose filaments at the time of regeneration. This has an appreciable detrimental effect on the qualities of the final yarn. By passing the filaments through a tube, this ballooning and swaying is avoided and filaments having improved physical properties are obtained.

It has been found that for the best results and to achieve the greatest improvements through tube spinning, the filaments as formed should substantially fill the interior of the tube but should not be crowded. Also, the tube should be axially aligned with the spinning face of the spinneret. Thus, the best results are obtained when the interior diameter of the tube is such that its cross-sectional area is about the same, or slightly larger than the cross-sectional area occupied by the spaced filaments as formed. This is approximately the same as the area covered by the orifice pattern of the spinneret.

Although substantial improvement is obtained through use of spinning tubes, it is difficult to get the filaments started through the tube. It has heretofore been the practice to pass a wire or similar object through the tube and to grasp the coagulated viscose as formed with the end of the wire and then draw the same through the spinning tube. However, this is a tedious process and is not particularly satisfactory, it being particularly objectionable in plant practice. It has now been discovered that the threading of the spinning tube can be substantially simplified if a thin slit is formed in the tube running the length thereof through which the formed filaments can be inserted. When it is considered that the filaments as formed tend to balloon outwardly, and that the tube in preferred tube-spinning operations is full of filaments in various stages of regeneration, it is surprising that an open slit can be provided throughout the length of the tube and the filaments still remain in the tube during the spinning operation. Indeed a slit cannot be used in a vertically disposed tube since the filaments will balloon out through the slit causing frequent breakage and the uneven stretching heretofore referred to. It is therefore necessary that the spinning tube be immersed in the acid spinning bath in such a manner that it is nearer horizontal than vertical, and preferably lies in a plane that does not depart more than about 30° from the horizontal. In the preferred practice, the angle is generally less than about 10° from horizontal. Also,

the slit should not exceed about one-eighth of an inch in width.

Referring to the drawings:

Figure 1 shows conventional spinning without a spinning tube;

Figure 2 shows a cross-sectional view of spinning with a spinning tube;

Figure 3 is a detailed drawing of the spinning tube showing the longitudinal slit therein;

Figure 4 is an enlarged view of the funnel portion of a spinning tube with a portion broken away to show the positioning of the spinneret; and

Figure 5 is the funnel end of a modified tube.

Referring to Figure 1, it will be noted how the filaments **1** balloon out through the spinning bath **2** as the filaments pass from the spinneret **3** to the guide **4**. On comparison with the tube spinning, as shown in Figure 2, it will be noted that the fibers **1** are substantially parallel as they pass through the tube **5**. It will also be noted that the interior diameter of the tube is essentially the same as, or only slightly larger than, the diameter of the cross-sectional area of the pack of spaced filaments as it leaves the spinneret **3**. The relation between the interior diameter of the spinning tube and the cross-sectional area defined by the outer ring of orifices in the spinneret is best illustrated by reference to Figure 4 where it will be noted that the diameter of the tube is only slightly larger than the diameter of the cross-sectional area occupied by the spinning orifices. Although the best results are obtained when the interior diameter of the tube is approximately the same as, or slightly larger than, the diameter of the cross-sectional area occupied by the spaced filaments as formed, the interior diameter of the tube may be somewhat larger or smaller than this optimum size relationship if desired. However, the diameter should be sufficiently small to insure movement of spinning solution through the tube at a rate only slightly less than the rate of travel of the formed filaments but sufficiently large that the filaments will not be crowded.

The spinning tube, as illustrated in Figures 2 through 5, consists of a straight tube **5** about 6 to 36 inches in length, containing a funnel **6** at the entrance end and a slit **7** extending the length of the tube. The slit should be sufficiently wide to permit easy threading of the cellulose filaments when formed but, as previously stated, should not exceed about one-eighth of an inch in width, the preferred width being about one-sixteenth of an inch. Widths much less than about 1/32 of an inch are generally too small to permit insertion of the filament bundle without difficulty. The spinning tube is generally made of glass or porcelain, though not limited to these materials.

When spinning with the slit tubes of the present invention, the tube is preferably immersed in the spinning bath at a slight angle, the exit end of the tube protruding slightly from the surface of the bath, as shown in Fig. 2, with the spinning bath filling approximately ½ of the exit end of the tube, i.e., the surface of the bath covering about ¼ to ¾ of the exit. The practice of the invention, however, is not limited to this preferred position since advantages of using the slit tube can also be realized with the tube completely submerged.

It is also necessary that the slit in the tube be in a vertical or substantially vertical position or the filaments of regenerated cellulose will tend to balloon out through the slit. Although a departure from a vertical will still permit satisfactory spinning, such departure should not exceed about 45°. Should the tube be so positioned that the slit is on the side of the tube as positioned in the bath or on the bottom of the tube as positioned in the bath, satisfactory spinning cannot be obtained because of the filaments passing through the slit into the main

body of the acid spinning bath. In general practice, the best results are obtained when the position of the slit is not more than about 10° from the vertical.

It is interesting to note that when a slit, not exceeding the dimensions previously indicated, is used and the tube is immersed in the acid so that the slit is in a substantially vertical position, i.e., on top of the tube, dye placed at the entrance of the tube during spinning is carried completely through the tube without any appreciable diffusion through the slit into the acid spinning bath. Also, when dye is placed in the bath, not near the entrance of the tube but near the body of the tube, the dye remains outside of the tube during spinning and does not enter to any appreciable amount through the slit. However, if the slit is increased in width to much above the ⅛ inch limit, heretofore mentioned, or if the tube is so positioned in the bath that the slit is not substantially on top of the tube, dye was noted to pass through the slit either into or out of the tube depending on whether it had been inserted near the mouth of the tube or in the acid bath in the immediate vicinity of the tube body. The invention, however, is not limited to tube spinning wherein no appreciable acid is drawn into the tube along the length thereof since in some spinning processes this may be desirable. Where such is the case a partial blocking of the tube entrance to further restrict the flow of acid will result in acid being drawn into the tube through the slit, the amount being regulated by the amount of blocking at the entrance.

When starting to spin, the viscose is extruded through the spinneret **3** into the acid spinning bath in a conventional manner. As the viscose coagulates, the coagulated viscose is drawn out through the bath and the formed filaments are passed around a guide **4** and then to godets for stretching and other treatment as in conventional spinning practice. The filament bundle is then inserted into the spinning tube **5** through the slit **7**. The spinning tube is thereafter aligned with the spinneret in the funnel end **6** with the spinning face of the spinneret perpendicular to the longitudinal axis of the tube and the slit on top of the tube.

As previously stated, the spinning tube with the slit cannot be placed in a vertical position, and should generally not depart more than about 30° from the horizontal or the filaments will tend to balloon outwardly through the slit.

In Figure 5, the funnel portion of a modified tube is shown in which indentations **8'** are provided within the conical end of the tube. These indentations **8'** are adapted to engage the corners **9'** of the spinning head so as to readily align the spinning face of the spinneret in a perpendicular position with respect to the axis of the spinning tube.

Use of the spinning tubes of the present invention is not limited to any particular viscose or acid spinning bath. The spinning tubes, however, have been found to be particularly suitable where improvements in quality, including strength, are desired and have been found to be especially useful in the spinning of viscose to which additives have been added to give improved strength and high percentage skin.

As a specific example, the spinning face of spinneret **3** may have about 980 holes therein spaced in a cross-sectional area having a diameter of about ⅜ inch. The spinneret is immersed in an acid spinning bath having a temperature of about 25° to 80° C., containing about 10% to 25% sodium sulfate, 3% to about 15% zinc sulfate, and 6% to about 12% sulfuric acid. A spinning tube of about 18 inches in length, an inside diameter of about ½ inch, and a 1/16 inch slit running the length thereof is positioned in the spinning bath at an angle of about 5° to the horizontal. The tube has a conical entrance **6**, such as shown in Figure 3, at its lower end near the spinneret as illustrated by Figure 2. A viscose of about 4% to 9% cellulose, 4% to 11% caustic, and about 32% to 60% carbon disulfide based on the weight of the cellulose and containing a small amount of an additive, such as a higher polyethylene oxide ether of phenol, is forced through the spinneret at a rate corresponding to about 1900 denier. As the viscose enters the spinning solution it coagulates and is removed to form an extended filament bundle of regenerated cellulose fibers. These are passed around guide **4** and from there, on to godets for stretching and further processing. The extended bundle is then passed through the slit **7** into the spinning tube **5** and the tube moved along the bundle until the funnel end is over the spinneret as shown in Figure 2, care being taken to have the spinning face of the spinneret perpendicular to the axis of the spinning tube and the slit **7** on top.

Though a specific embodiment of the invention has been given, various changes and modifications can be made without departing from the spirit and scope thereof. The invention should therefore not be limited except in accordance with the appended claims.

Having thus described our invention, we claim:

1. In yarn-spinning apparatus in combination with a tank for receiving a spinning bath and a spinneret having a spinning face containing a plurality of spinning orifices, a spinning tube having an internal diameter of substantially the same order as the cross-section of the area covered by the spinning orifices and a slit for threading extending the full length of the tube, said slit having a width of between about 1/32 inch and about ⅛ inch, the tube being positioned in the tank at an angle not more than 30° to the horizontal and with the slit opening upwardly and at an angle of not more than 45° to a vertical plane passing through the axis of the tube, the tube during spinning having its longitudinal axis disposed perpendicularly to the face of the spinneret.

2. Yarn-spinning apparatus as defined in claim 1 wherein the width of the slit in the spinning tube is about 1/16 inch.

3. Yarn-spinning apparatus as defined in claim 1 wherein the spinning tube is positioned within the tank at an angle of less than 10° to the horizontal.

4. Yarn-spinning apparatus as defined in claim 1 wherein the spinning tube is positioned within the tank with its slit opening upwardly in a substantially vertical position.

5. In yarn-spinning apparatus in combination with a tank, a spinning bath in the tank and a spinneret having a spinning face containing a plurality of spinning orifices, a spinning tube terminating at one end in a funnel having indentations in the funnel, having an internal diameter of substantially the same order as the cross-section of the area covered by the spinning orifices and having a slit for threading extending the full length of the tube, the slit having a width of about 1/16 inch, the tube being positioned within the tank and bath with the spinneret disposed within the funnel and abutting the indentations whereby the spinneret is aligned coaxially with the spinning tube, the opposite end of the tube being raised so that the tube is at an angle of not more than 10° to the horizontal and with the slit opening upwardly in a substantially vertical position.

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